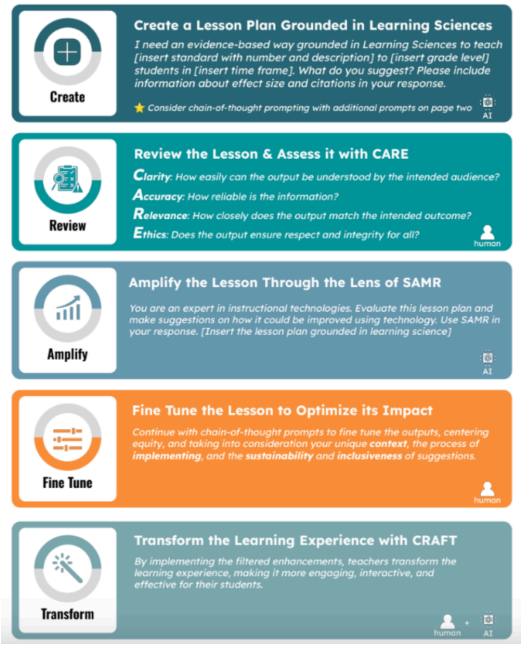
CRAFTing Better Learning Experiences: Infusing GenAI in Education Effectively and Ethically



CRAFT Framework by Andrew Fenstermaker, Drew Olsson and Sarah Hampton

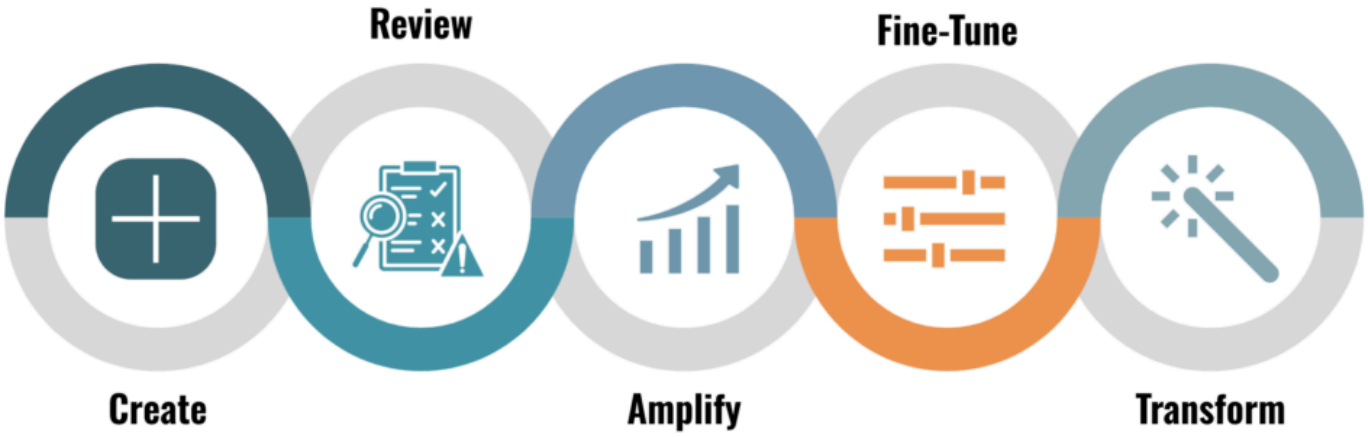
by Andrew Fenstermaker, Drew Olsson, and Sarah Hampton

Introduction

Generative artificial intelligence (GenAI) stands to be a disruptive technology in education and all facets of our daily life. While this technology offers significant advantages for teaching and learning, it hinders the process when used without a full understanding of how the technology works and how to evaluate the content generated. The educator must remain the expert, advocate, arbiter, human in the loop identifying why and when the technology gets used, and the critical evaluator to uphold the best of our human ideals.

CRAFT Framework Overview

Using GenAI to augment the lesson design process can seem overwhelming. From composing and revising prompts to evaluating the outputs, integrating GenAI requires a new set of literacy skills. CRAFT was collaboratively designed by Andrew Fenstermaker, Drew Olsson, and Sarah Hampton and augmented using GenAI. The framework serves as a step-by-step roadmap that scaffolds the process of infusing GenAI with the learning sciences to improve learning experiences ethically.



1. Create

The first step in the framework is to *create* a lesson plan using GenAI prompting that is grounded in learning sciences based on a specific standard, age group or grade level, and time frame. Often, we start with a basic prompt providing no persona or context for GenAI to use in its algorithm as it generates the output. As you can see in this example of generating a lesson plan on the main idea, the chatbot makes inferences about the grade level being taught, length of time, and materials available. The chatbot is simply following its algorithm to predict the next word in its sequence of constructing a complete lesson plan.

Giving a chatbot a persona, such as an expert teacher, and providing more details up front can enhance its recommendations. Reviewing the output from the Detailed Prompt example, you will see that the targeted grade level, specific standard, and length of time are now tailored to our prompt. We can improve the outputs further by including a request for evidence-based best education practices from learning sciences research up front. Therefore, the goal of the create step in the CRAFT framework is to underpin a detailed prompt with learning sciences.

Basic Prompt	Detailed Prompt	Detailed + learning sciences + Chain-of-Thought Prompts
No persona assigned to chatbot.	Persona assigned to chatbot. *(ex. You are an expert third grade teacher.)*	Persona assigned to chatbot as well underpinning the lesson design in learning sciences. *(ex. You are an expert third grade teacher. Provide an evidence-based way grounded in learning sciences to teach…)*
Little context provided	Context provided including, but not limited to: - Standard - Age group - Time frame	Context provided including, but not limited to: - Standard - Age group - Time frame
	No chain-of-thought prompting used to refine output	Chain-of-thought prompting leveraged to further refine and enhance the learning experience.

In addition, the results from the prompt with learning sciences can be optimized using chain-of-thought prompting. Chain-of-thought prompting is a technique that allows us to take a complex task and decompose it into a series of logical steps to increase the performance of the large language model (chatbot). As you explore the Detailed Prompt + learning sciences + Chain-of-Thought prompts, you will see that a series of 11 chain-of-thought prompts were used to continually refine the output. Decomposition methods were used as we broke our complex task into smaller chunks, from identifying effect size and selecting an evidence-based learning strategy to incorporating elements aligned with student interests and crafting sentence starters to scaffold the process for students.

2. Review

Advancements in GenAI capabilities and detailed prompting strategies may lull the user in "falling asleep at the wheel." That is, over-relying on outputs without going through the process of refining its outputs for a given context with intentional consideration. The CARE framework is designed to critically evaluate each output for ***Clarity***, ***Accuracy***, ***Relevance***, and ***Ethics***.

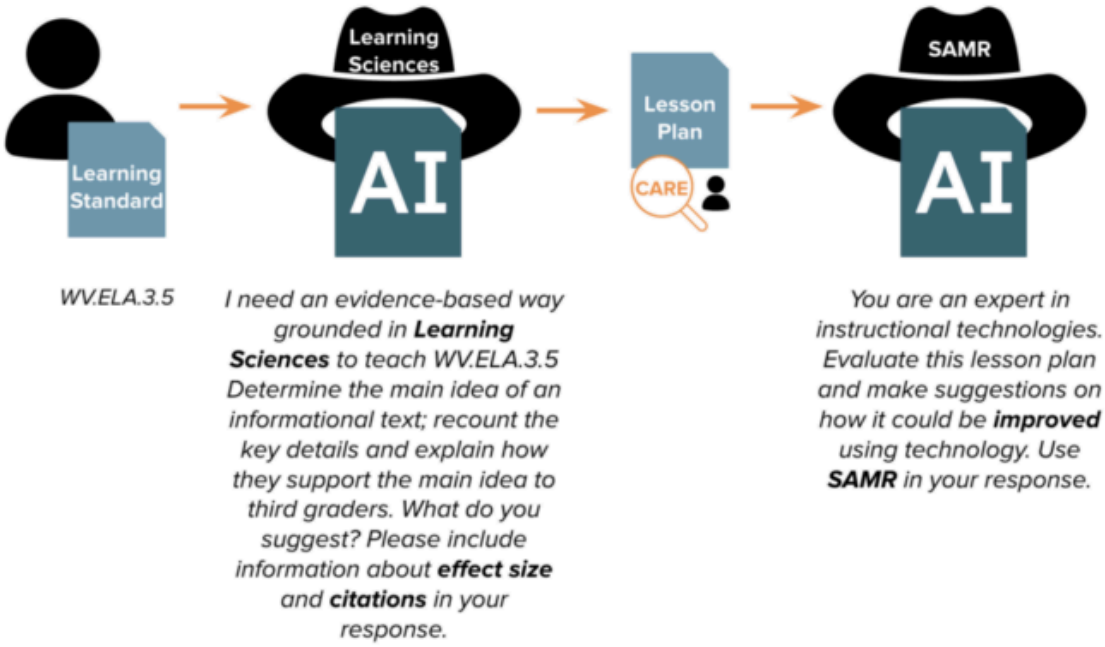
- ***Clarity***– A lack of clarity in GenAI output might mean the output is not appropriate for a given audience such as overly wordy sentences for a 5th grade class.
- ***Accuracy***– It is well known that AI makes things up, from citing studies that never existed to stating facts there are blatantly false. It is up to the user to fact check GenAI outputs so that misinformation is not shared in a classroom setting.

- ***Relevance***– Often, an AI's first output will not generate a response that matches the intent of the input given. Continue refining your prompts until the output fits your needs.
- ***Ethics***– GenAI is trained on biased data and can be racist. Inspecting outputs for possible stereotypical depictions or biased results is imperative to uphold integrity and respect for all.

3. Amplify

Once we have reviewed our lesson plan grounded in learning sciences using the CARE framework, we are ready for the Amplify stage of CRAFT. The recent National Ed Tech Plan highlights three different divides with instructional technology: Access, Design and Use. The COVID-19 pandemic sparked a rapid influx of instructional technology, decreasing the access divide but exposing prominent divides in how teachers were designing digital learning as well as how students were using the digital tools and resources.

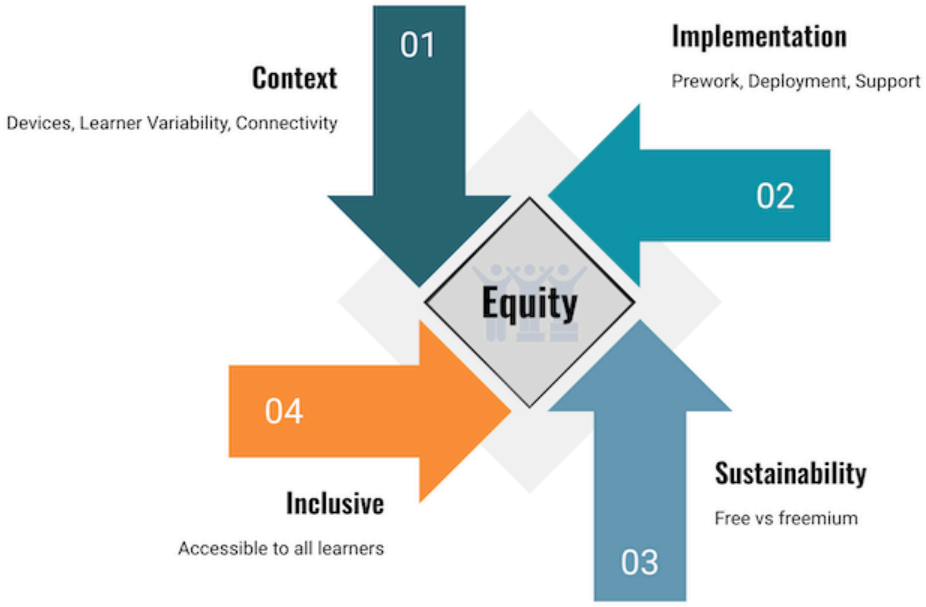
The *amplify* stage fosters opportunities for teachers to work towards minimizing the Design and Use divides by using GenAI prompts centered around the SAMR (substitution, augmentation, modification, redefinition) model. The graphic below illustrates the progression from beginning with a standard, using chain-of-thought prompting grounded in learning sciences, reviewing with the CARE framework, and concluding with instructional technology enhancements through the SAMR model.



As outlined before, we continue to use chain-of-thought prompting to further refine our outputs. Within our amplified SAMR lesson plan, you can see that the additional prompts help refocus the large language model (chatbot) when the algorithm deviates from our original vision and allow us to select the specific level(s) of SAMR we wish to incorporate within our final lesson. Just as we did before, we must leverage the review stage to critically evaluate the outputs using the CARE framework.

4. Fine-tune

Leveraging the *fine-tune* stage allows us to ensure that our lesson is both effective and equitable by carefully evaluating the integration of instructional technology. This includes considering the context of use, implementation strategies, sustainability factors, and inclusivity for all learners. By focusing on these key areas, we can enhance the technology's impact and ensure it aligns with our pedagogical goals.



5. Transform

The final stage of the CRAFT framework does not require additional prompting or reviewing of outputs. Instead, by implementing the filtered enhancements, teachers transform the learning experience, making it more engaging, interactive, and effective for their students.

Conclusion and Call to Action

As GenAI continues to evolve, it is essential for educators to remain the experts in their classrooms and use technology as a tool to enhance, not dictate, their practices. We encourage you to employ the CRAFT Framework to center students in the learning design process. It is through the intentional underpinning of learning sciences that we can remove barriers to create rich learning experiences for all students.

Resources

Link to PDF of CRAFT (two pager)

About the Authors

Andrew Fenstermaker is the Instructional Technology Coordinator for the Iowa City School District. A perpetual learner who infused emerging technologies into his own classroom for ten years now works to empower educators through dynamic professional development, one-on-one coaching, and innovative lesson design that centers students and removes barriers to success. He is a Google Certified Coach and Innovator, leading efforts locally and nationally on adopting and scaling computational thinking and AI in education while sharing key deliverables through presentations and publications.

Drew Olsson is the Technology Integration Coordinator for the Agua Fria High School District. An advocate for staff and student AI Integration, mindful EdTech implementation, and building tech literacy for all. He taught math and computer science for 9 years before moving into his current role where he services 5 comprehensive high schools and over 10,000 students. He is invested in providing powerful learning opportunities for all students so that they may thrive in an increasingly techno-centric world. Drew holds Master's Degrees in Secondary Education and Educational Leadership from Arizona State University.

Sarah Hampton is a Technology and Curriculum Specialist for the Greenbrier County School District specializing in secondary math education. Prior to her current role, she brought passion for evidence-based instructional strategies and thoughtful technology integration to her middle and high school math and science classrooms. A veteran educator of 15+ years, Sarah works to bring the benefits of education research to more students through embedded professional development in her district and through collaboration with researchers and educators at the Center for Integrative Research in Computing and Learning Sciences.

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Navigating Ethical AI: Empowering Educators with Tools, Frameworks, and Critical Perspectives

by Marlon Matilla

Photo of CRAFT Ethical Engine card game designed by Marlon Matilla

The Navigating Ethical AI: Interactive Lessons and Equitable Practices for Educators webinar serves as a microcosm of the broader challenges and opportunities that artificial intelligence (AI) presents in the educational landscape. The session brought together educators to explore the ethical implications of integrating AI into classrooms, highlighting the intersection between technological innovation and pedagogical responsibility.

The Ethical Imperative in AI Education

Central to the discussion was the need for educators to critically engage with AI, not just as a tool but as a complex system with far-reaching implications. Dr. Kip Glazer, principal at Mountain View High School, emphasized that understanding the technical distinctions between different types of AI—such as generative and supervised AI—is crucial for educators (see *Ethical Use of AI – Privileging measured and deliberate thinking*, for further thoughts from Dr. Glazer). This technical literacy forms the foundation for ethical decision-making, as educators must navigate the biases inherent in AI systems and their potential impact on students and teaching practices. The dialogue in the session reflects a growing recognition that AI's role in education is not neutral; it is laden with ethical considerations that educators must address proactively.

Practical Engagement with AI Ethics

Assistant professor Dr. Victoria Delaney introduced the Stanford Classroom-Ready Resources About AI for Teaching (CRAFT) project, which exemplifies how these ethical considerations can be translated into classroom practice. By developing adaptable AI literacy resources, the CRAFT initiative seeks to empower teachers to integrate AI education in a way that is both practical and responsive to the needs of diverse student populations. The project underscores the importance of flexibility and customization in educational resources, recognizing that teachers must be able to tailor AI lessons to their specific classroom contexts.

This approach is further exemplified by my CRAFT *Ethical Engine* card game, a tool I designed to foster critical thinking and ethical reasoning among students. This game moves beyond theoretical discussions, offering a hands-on way for students to grapple with the real-world implications of AI. Through scenarios like AI in law enforcement or AI-controlled military drones, the game prompts students to consider both the benefits and risks of AI technologies, thereby cultivating a more nuanced understanding of AI ethics.

Collective Responsibility and Advocacy

The session also highlighted the collective responsibility of educators to advocate for ethical AI practices. The Educator Bill of Rights, discussed by Dr. Kip Glazer, is a testament to this advocacy. It asserts the rights of educators to have a say in the AI tools introduced into their work environments and emphasizes the need for transparency and equity in AI implementation. This document not only empowers educators to protect their professional autonomy but also ensures that AI adoption in schools does not exacerbate existing inequalities or undermine educational goals.

The session's exploration of these themes reflects a broader narrative within education: the need for a critical, reflective approach to technology. As AI becomes increasingly integrated into classrooms, educators are not just passive recipients of these tools; they are active participants in shaping how AI is used and understood in educational settings. This requires a deep engagement with the ethical dimensions of AI, as well as a commitment to advocating for practices that are fair, transparent, and aligned with educational values.

Engaging Educators in Discussion

The CRAFT Ethical Engine card game resource presented in the session and the Educator Bill of Rights can serve as starting points for bringing educators and students into conversations about ethical issues. As the presenters emphasized in this webinar, it is important to empower educators to think critically about how to safeguard against the ethical pitfalls that these technologies can produce and bring awareness to students about potential issues.

A Unified Perspective on AI in Education

Synthesizing the insights from the session reveals a unified perspective on the role of AI in education: It is a powerful tool that holds both promise and peril. The session participants collectively underscore that the successful integration of AI into education hinges on the ability of educators to critically assess and ethically navigate these technologies. Furthermore, our conversations with educators illustrate the necessity of an ethical framework for AI in education, one that is informed by a deep understanding of the technology and a commitment to equity and fairness. It is my hope that this synthesis of ideas and the resources shared can provide guidance for educators who are navigating the complex landscape of AI. Educators need more

resources to ensure they are equipped to make informed, ethical decisions that benefit both their students and the broader educational community.

About the Author

Marlon Matilla is an educator dedicated to advancing data-driven and technology-focused learning in K-12 STEM education. Since 2015, he has taught mathematics, computer science, and cybersecurity with a strong emphasis on hands-on learning. As a CIRCLS Educator Fellow, he has contributed to AI education initiatives, including the co-design of ethical AI resources through Stanford's CRAFT Fellowship. His recent publication, *Optimizing Breakfast Choices: Leveraging Data Analytics in Packaged Foods for Informed Student Nutrition Decisions*, supported by the University of Arkansas' NSF-funded Data Analytics Teacher Alliance RET program, is published in the ASEE Professional Engineering Education Repository. Committed to merging research with practice, Marlon (aka Matt) aims to continue as a researcher-educator, fostering data literacy and ethical AI technology use in education.

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Ethical Use of AI – Privileging measured and deliberate thinking

by Kip Glazer

Photo by Ahmed Almakhzanji on Unsplash

As a school leader and educator, I am deeply committed to promoting the ethical use of artificial intelligence (AI), a responsibility that we all share as AI-embedded tools become increasingly prevalent in our school systems. I strongly advocate using interactive methods, such as leveraging games to engage learners and educators in these crucial discussions (featured in this blog post by Marlon Matilla). I believe that the active participation of both researchers and practitioners is essential, and I am proud to have contributed to this vital discussion by being a part of the Educator CIRCLS community over the years.

As I think about the ethical use of AI, I can't help but think about the design of the AI system and how it nudges the users to behave. In his book *Thinking Fast and Slow*, Daniel Kahneman argues that humans have System 1 thinking that reacts quickly and instinctively, while System 2 thinking reacts more slowly and deliberately. Unfortunately, our System 1 thinking (aka impulses) often overrides our System 2 thinking when making decisions, and many companies have used this to maximize profit at the expense of the consumers. As much as technology companies tout the usefulness of AI systems, I am concerned that the rapid spread of AI is amplifying the functions of System 1 thinking at the expense of System 2 thinking. Because AI prioritizes speed and volume (similar to System 1 thinking) over quality based on careful deliberation (which is the hallmark of System 2 thinking), I am concerned that we humans will not be able to avoid the temptation of choosing the quickest answers. If you believe that is not likely, I would encourage you to consider reading *Nudge: The Final Edition* by Thaler and Sunstein. Thaler and Sunstein argue how choice architecture influences human behaviors. They cite Kahnmen's work extensively to clarify that even the slightest nudge easily influences all humans and can have a significant impact.

Undoubtedly, we have made significant strides in acknowledging and discussing the potential harm of AI. Our *Navigating Ethical AI: Interactive Lessons and Equitable Practices for Educators* webinar is a testament to

how the learning sciences field is actively responding to the growing concerns about the ethical use of AI. It's important to note that the dangers and harm of AI often do not stem from any malicious intent by its creators. Instead, they result from our automatic thinking, reinforced by Generative AI's (GenAI) speed. However, our increased understanding and awareness can help us navigate these challenges and somewhat mitigate potential harm.

Still, I can't help but be concerned about the proliferation of GenAI as it seems to automate and propagate products that replicate the basest human instincts. Think about the deep fakes and their ability to go viral! Think about the students attempting to shortcut their learning. Think about the educators using GenAI tools to grade all their student work to save time. Such routine behaviors are not what we typically consider to be unethical AI use. It is our automatic thinking allowing the results generated by a biased-ridden system. Even if we are aware of the potential harm of blindly trusting GenAI's outcome, it will be difficult to eschew such influences based on simple nudges by our general environment. Most importantly, I am concerned that classroom teachers without basic AI literacy won't be able to guide their students in this new environment to recognize the potential harm done by GenAI because they can't compete against System 1 thinking.

To activate System 2 thinking safely and productively, teachers need support from knowledgeable leaders who can lead them. Because we recognized the importance of school leaders in implementing Systems 2 thinking, Sofía De Jesús and I wrote Framework for AI Implementation for Administrators and Leaders in K-12 Schools when we participated in the Computer Science Teachers Association's Equity Fellowship Program. We wanted to make it easier and more manageable for the many school leaders who feel overwhelmed by the number of currently available AI-enabled tools and the feverish sales pitches encouraging them not to leave their teachers and students behind! With the framework, we hope that they can access their System 2 thinking as they consider purchasing and implementing AI-enabled tools.

Educators need to stay vigilant against the urge to choose *automation* and *efficiency* over *ethical* and *deliberate* as further AI-embedded tools are being introduced to our school ecosystems. Now more than ever before, we must activate our Systems 2 thinking to ensure we are modeling and instilling equitable values with AI in education.

References:

Kahneman, D. (2011). Thinking, fast and slow. *Farrar, Straus and Giroux.*

Thaler, R. H., & Sunstein, C. R. (2021). *Nudge: The final edition*. Yale University Press.

About the Author

Kip Glazer, Ed.D. is the proud principal of Mountain View High School. A long-time practitioner participant for CIRCLS and Educator CIRCLS, she has been sharing her school leader's perspective on various learning technologies topics, including Artificial Intelligence implementation in schools. She has been an **Equity Fellow** for the Computer Science Teachers Association and a member of the EngageAI Practitioner Board.

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The Convenience of Inconvenience: Exploring Connections with Researchers and Practitioners

Image by Steve Johnson on Unsplash

by Nneka McGee and Krystal Chatman

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The goals of change are aspirational. In the artificial intelligence (AI) era, we see change as a catalyst that will bring about the true transformation in education many of us have sought for decades. We all agree that change is necessary, right? Therefore, it's only a matter of time before aspirations become concrete. Though we should continue to strive for the best ideas, there is one reality we must face: The difficulty of change is an inconvenient truth.

While change can be a challenge, particularly in education, hope is still a constant. Artificial intelligence and other emerging technologies have potential, but what are optimal ways to incorporate them into learning environments? Researchers have long explored the questions and possible answers of improving educational outcomes. Practitioners apply real-world experiences that significantly impact learners. The premise of bringing these disparate groups together offers a promising solution to understanding change.

In summer and fall of 2024, the Center for Integrative Research in Computing and Learning Sciences (CIRCLS) facilitated a convening of researchers and practitioners to explore AI problems of practice in PreK-12 education (for further details, see Educator CIRCLS '24 Summer Series). An innovative act in itself, as it is not often the explorers of educational theory (researchers) are provided with the opportunity to collaborate with the facilitators (teachers) of the suggested strategies. This convening offered an opportunity for both sides to engage at a deeper level, gaining insight into how the "other side" operates to improve their practice. Through discussions, researchers had the opportunity to convey how valuable the experiences of practitioners are to the work of advancing innovation in education. Practitioners shared their interest in research areas such as generative AI and expressed their concerns about helping students navigate the future of learning.

Problems of Practice

Dialogue was a primary focus of the convening. To bridge the distance between practice and research, CIRCLS facilitators divided attendees into groups with the goal of centering conversations on what practitioners experience within their educational ecosystems. Through in-depth discussions, researchers and practitioners identified areas of focus by posing questions such as:

- Do we need multiple literacies?
- How do we address accessibility issues?
- How do we use AI tools and what are the benefits?
- How do we include others across the spectrum to include more voices in developing AI tools?
- How can we use AI to support educator coaching?

AI literacy was a common thread among the groups. There was a collective acknowledgement of the limitations surrounding this emerging technology given the current state of training at educational institutions. Without the appropriate requisite foundations on how to use AI effectively, its potential to transform education is unclear. Additional conversations explored the limitations practitioners face with utilizing or implementing AI tools due to policies and how use of AI in learning spaces cannot swiftly progress until practitioner decision-makers gain more knowledge and confidence in AI use. Although researchers may be working on other areas, the conversations provided essential insights into the needs and wonderings of practitioners.

Research to Action

During a second round of grouping, researchers also sought input on their research topics and potential impact in today's classrooms. Recruiting research subjects has always been a challenge; therefore, informing practitioners of research topics opened avenues for feedback and questions related to applicability and feasibility. Several topics emerged from the group, including:

- Collaborative learning
- Student voice
- Systemic challenges
- AI scoring
- Policy development
- Navigating tensions
- Centering pedagogy

Just as in the prior group discussions, AI literacy was a popular talking point, often interwoven within the topics listed above.

When groups reconvened, all agreed that more conversation was necessary. More action was also on the minds of researchers and practitioners, but the realities of change were ever present. Several participants expressed concern about the trajectory of AI in education, particularly when considering access, bias, safety, security, and environmental impact. Despite misgivings, there was an overall sense of optimism about the future of research and the contributions of practitioners in propelling use of emerging technologies forward.

About the Authors

Nneka J. McGee, J..D., Ed.D. is an educational consultant and former Chief Academic Officer dedicated to ensuring students have access and opportunities to explore AI and emerging technologies. She completed her doctoral studies on AI and its implementation in K-12 classrooms. She is a frequent speaker on AI topics and serves as a member of several AI-focused advisory boards and committees.

Krystal Chatman is a seasoned educator and advocate with over 15 years of experience in integrating technology into teaching and promoting equitable computer science education. Currently serving as the Professional Learning & Community Manager for the Computer Science Teachers Association, she is also a co-founder of the Mississippi AI Collaborative, focused on AI upskilling across the Southern U.S. A dedicated leader in broadening participation in computer science and STEM, Krystal has facilitated panels on AI at the White House, spoken at the Brookings Institution, and developed Mississippi's first AI conference.

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Translating Research on Emerging Technologies for Educators

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by Cassandra Kelley

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This blog post discusses the development of an Educator CIRCLS workshop aimed to "translate" or disseminate computer science education research findings to practitioners while promoting AI literacy.

Have you ever played the telephone game, where a sentence is whispered into someone's ear and passed from person to person, until the final person reveals the message aloud to see how closely it aligns with what was originally said? I am frequently reminded of this childhood game in my role as the Broader Impacts Project Coordinator at the University of Pittsburgh and CIRCLS, where I think about how we can "translate" research into practice for practitioners; however, the game has become much more challenging due to the technical terminology, academic jargon (e.g., research methodologies), and other contextual phrases that are often included within the message being communicated. Moreover, all of the players have individual "language barriers" (e.g., prior knowledge, experience, expertise, etc.) that add another layer of difficulty to ensure the mediated message is comprehensive for all.

My broader impacts position, inspired by the National Science Foundation (NSF) merit review criteria, was created as an avenue for broadly disseminating research on emerging technologies for teaching and learning—similar to programs such as Research Practice Partnerships (RPP) or Research Experiences for Teachers (RET). I was drawn to this opportunity because I feel it is critical not only for educators to learn about and understand education research, but also for researchers to consider the direct impact of their work on practice. I firmly believe in the importance of bridging the gap that currently exists between research and practice by promoting partnerships among all stakeholders, which can include further engagement in participatory research and involvement in co-design models.

As a former PreK-12 educator and higher education faculty member supporting pre-service teachers, my initial concern about this translation process was thinking about how students and teachers will benefit. From my own experience working in school systems, I have observed an institutional culture where research and policy are "thrown" at teachers through mandates and other recommendations. Educators' voices are often missing from the conversation and there is not an immediate focus on how to best support their practices, which truly should center on the needs of students. I have also witnessed researchers temporarily engaging with educators for the purpose of conducting a study and then disappearing, which I personally know can feel like a one-sided transaction.

These factors led me to consider novel strategies for research dissemination that could potentially build stronger connections between researchers and practitioners. Specifically, I wanted to explore the development of supplemental curricular resources to be shared with teachers during a workshop so they could have opportunities to: (1) interact with computer science (CS) education concepts and understand their relationship within research findings, (2) experience the role of a learner and researcher, (3) engage in discussion with other educators and researchers about the impact of specific research projects on practice—especially with regard to the integration of emerging technologies, and ultimately to (4) bring elements of their professional learning back into the classroom via guided activities that could be adapted for implementation with students.

It is important to note that these goals were shaped through many discussions with practitioners, especially after having the opportunity to speak directly with 20 educators about their experiences as participants in professional development programs for CS education. I sought their recommendations for how we might design and structure a workshop to disseminate research findings via our supplemental curricular resources (see Engaging Educators in Emerging Technology Research for further details about the facilitation of this workshop). Throughout these reflective conversations, it was frequently mentioned how most programs tend to be "technocentric" and focus more on "new shiny technology tools" rather than pedagogy for classroom integration or research-based practices and learning theories. Educators advocated for further rigor and inquiry-based activities that immerse them into the research literature, paired with opportunities for collaboration and the exchange of ideas or curricular resources; each of these elements would be intentionally incorporated into our workshop design.

Additionally, I connected with members of interdisciplinary research teams to better understand their different areas of expertise and the methodologies used across projects. I had to consider the application of CS terminology and concepts within each project (many of which were new to me) and pinpoint the key areas to focus on in the translation. Fortunately, I was introduced to a new undergraduate student in the lab who was double majoring in both CS and communication. She was eager to help and became a translator for me when I wore my "learner hat," similar to how a teacher's assistant or tutor might provide direct instruction to dive deeper into the content. Likewise, I would then put on my "teacher hat" and explain pedagogical concepts (e.g., scaffolding, asking different levels of questions, Universal Design for Learning- UDL strategies, etc.) or

learning theories (e.g., constructivism, sociocultural learning, project-based learning, etc.) while we discussed how we could take research findings and use them to develop supplemental curricula or guided activities for dissemination to educators.

A final consideration in the development of these guided activities was how to simulate the research procedures in an immersive way without the technology equipment. This was necessary because we wanted to acknowledge potential constraints of implementation in schools, such as access issues and the need for further technical support or training—not to mention how expensive these emerging technologies are. Therefore, we engaged in further conversations with the research teams about how we might develop user-friendly prototypes of simulations that educators could interact with on their own devices. Our discussions reminded us that there may be further barriers to research dissemination in the traditional schooling environment including challenges with existing curricula requirements and/or scheduling constraints. For this reason, we decided it might make more sense to frame our activities as supplemental or enrichment materials that can be adapted/remixed across a variety of settings (e.g., after school programs or summer camps).

In summary, these convenings with researchers and practitioners across what Wenger-Trayner and colleagues (2014) refer to as the "boundaries in landscapes of practice" helped us consider the institutional culture bounding each landscape. We found it extremely valuable learning from multiple perspectives and using these insights to help us identify existing boundaries and ways to collectively navigate them.

Key takeaways from the experience are:

- Acknowledge the systemic barriers with regard to education policy and practices in different community settings.

- Engage in learning partnerships by collaboratively negotiating and exploring the existing boundaries. This includes actively listening to all voices (e.g., researchers and practitioners) from different landscapes (e.g., PreK-12 education, higher education, and industry) to create a two-way dialogue of mutual reflection.

- Focus less on the technology and more on the diffusion of innovative ideas as well as the AI literacy needed by ALL stakeholders for advancement of these ideas.

- Develop immersive guided activities that promote further conversations about AI literacy while being grounded in research and learning theories. Be sure to clearly communicate these connections when translating back-and-forth and offer opportunities for reflective discussion.

- Seek feedback at every stage of the iterative process and prioritize the community partnerships across the landscapes of practice above all.

- Remember that the ultimate shared goal or vision is to positively impact the future of learning for students.

Since I personally identify as both a researcher and practitioner, I have learned firsthand the importance of negotiating my own experiences to build a bridge between my understanding of the teaching practice and students' needs, while also thinking critically about advancing the field of education research. In order to bring these landscapes together, researchers must consider ways to make their work more accessible so they can get the necessary buy-in from teachers that will propel institutional change and innovation in the future of schooling and education. Likewise, educators need to keep seeking opportunities to stay abreast of current research findings, especially to help lead this exploration of new pedagogical practices or emerging technologies that can support teaching and learning. One avenue to achieve this is establishing sustained partnerships between researchers and practitioners through co-design or participatory research. Moreover, the incorporation of "intermediaries" or "knowledge brokers," which Levin (2013) defines as "people or organizations that translate or transmit research," similar to my position as a Broader Impacts Project Coordinator, can "play a critical role in the process of diffusing ideas and practices in education" (p. 21). It is my hope that researchers will take into account how emerging scholars, such as school administrators, academic coaches, a subgroup of PreK-12 teachers, post-doctoral students, or graduate students, might be leveraged to help spearhead this essential translation of research into practice.

Thank you to **Sarina Saran**, **Deniz Sonmez Unal**, **Sarah Hampton**, **Dr. Erin Walker**, and **Dr. Judi Fusco** for their thinking and feedback on this post.

References:

Levin, B. (2013, February). To know is not enough: Research knowledge and its use. *Review of education*, 1(1), 2-31. DOI: 10.1002/rev3.3001

Wenger-Trayner, E., Fenton-O'Creevy, M., Hutchinson, S., Kubiak, C., & Wenger-Trayner, B. (Eds.). (2014). *Learning in landscapes of practice: Boundaries, identity, and knowledgeability in practice-based learning*. Routledge.

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Engaging Educators in Emerging Technology Research

Image by Tung Lam from Pixabay

by Cassandra Kelley, Sarina Saran, Deniz Sonmez Unal, and Erin Walker

This blog post discusses the outcomes of an Educator CIRCLS workshop that disseminated computer science education research findings to practitioners while prompting broader discussions of AI in classrooms

This past summer and fall of 2024, Educator CIRCLS hosted a series of webinars, workshops, and convenings between researchers and practitioners focused on artificial intelligence (AI) literacy. Specifically, they were designed to engage participants in reflective conversations about ethics, equity, and other problems or possibilities of practice concerning the integration of AI (especially genAI) in PreK-12 education.

As part of this series, our team from the University of Pittsburgh piloted a novel strategy for research dissemination, in which we developed supplemental curricular resources or guided activities and shared them with educators in a workshop format. The goals behind these activities were twofold:

- To facilitate discussion among educators about current research on the integration of emerging technologies that incorporate AI (e.g., robots and intelligent tutoring systems) and how they might impact the future of learning in education settings, and

- To provide a mechanism for educators to think critically about ways to introduce elements of AI literacy to students via real world exercises that can simulate the work that researchers are doing (see Translating Research on Emerging Technologies for Educators for further background context about the design of this workshop).

During the planning stage of the workshop, we felt it was pertinent to get a better understanding of PreK-12 teachers' experiences with professional learning for computer science (CS) education. We wanted to speak

directly with them about the impact of these experiences on their practice and seek their recommendations for how these professional development programs are designed.

We interviewed 20 educators from 16 states, who taught across different grade levels and/or content areas. Most interviewees felt a disconnect with research dissemination as a form of professional learning and expressed their desire to better understand how emerging technologies connect with research-based practices and learning theories. They discussed how previous workshops they have attended either focus directly on the technology tools or on a mandated "turnkey curriculum" based on rote memorization and knowledge transfer (e.g., Advanced Placement CS course materials). Teachers expressed how they appreciated receiving curricular resources because such resources help them to stay current in this ever-evolving field. They would like to see less "direct instruction" lessons and more real-world approaches with project-based or problem-based learning (PBL) that promote inquiry—similar to what is expected in the industry. They also emphasized the need for further collaborative opportunities to ideate on promoting digital/AI literacy through their instruction.

Following our conversations with teachers, we intentionally designed a workshop with guided activities, based on research projects on emerging technologies, that could expose practitioners to existing literature and findings while potentially seeding new ideas for curricula. Our workshop design incorporated the following structure: (1) outline the theoretical framework and CS concepts, (2) have participants experience different roles (e.g., student, educator, and researcher) within inquiry-based activities, (3) share project research findings, (4) discuss implications for practice and ways to address AI literacy, and (5) reflect on the overall format of the workshop and considering how to improve the design of future workshops.

We featured two research projects:

- **Project 1:** The design of intelligent robots with social behaviors and their potential roles in learning settings

- **Project 2:** Utilizing neuroadaptive learning technologies to assess a learners' cognitive state with brain imaging

Our first session on teachable robots presented a research project that examined middle school students' interactions with Nao robots in mathematics instruction. Participants were asked to think about the design and implementation challenges in building a robotic dialogue system for learning from the perspective of a student, educator, and a researcher. They explored CS concepts related to Natural Language Processing (NLP) by: (1) determining keywords used in solving a math problem, (2) reviewing sample dialogue scripts and Artificial Intelligence Mark-up Language (AIML) that researchers used to program the Nao robot, and (3) interacting with prototype simulations created in Pandorabots that represented social and nonsocial versions of a chatbot. We

also shared further extensions that could potentially be remixed or adapted for use with students, such as revising the dialogue by adding more social elements, writing a new script for solving a different math problem in AIML, developing a chatbot to test the code, or experimenting with a program such as Scratch to create a dialogue between two sprites.

Our second session on neuroimaging and educational data-mining presented a research project that examined how students process information while interacting with intelligent tutoring systems. A major component of this study focused on the analysis of data collected by these systems to uncover patterns or trends that can inform and potentially improve teaching and learning practices. Additionally, neuroimaging brain data was collected as a proof of concept to explore how it might be analyzed to better understand how cognition, attention, and emotion affect learning (for further background on how this equipment works, see Neuroscience in Education). Similar to the first workshop, we presented guided activities to help participants think about the design of intelligent tutoring systems and the types of data collected ; participants created their own data visualizations from sample datasets for analysis using the free educational software, Common Online Data Analysis Platform (CODAP) and categorized example brain activation images based on the corresponding levels of task difficulty. Further extension activities were shared, such as outlining specific actions that an intelligent tutoring system might take to provide feedback (e.g., hints, prompting questions, or praise) in response to student behavior and debunking "neuro-myths" in education.

At the conclusion of each workshop, we asked educators their thoughts about the potential benefits and challenges of integrating these emerging technologies in PreK-12 classrooms and what they would like future research to explore. Our goal was to hear practitioner voices and gather input for researchers and developers to consider. This led to a focused discussion on the need to promote AI literacy in education, especially to address ethics and transparency.

Key takeaways from the experience are:

- Teachers appreciate the opportunity to learn more about innovative research projects, but they especially like the idea of being in dialogue with researchers and potentially playing a role in the work that's being done. Many volunteered to pilot future projects exploring the implementation of curricula and/or emerging technologies with their students if invited.

- Teachers expressed that the content in our guided activities, while rigorous, enabled them to be more reflective. They were engaged with the hands-on simulations of the research and discussed how "active learning helped to promote deeper thinking." As one participant mentioned, the activities allowed her to "think outside of the normal pedagogy box."

- Teachers had mixed feelings on the relevance of the workshop content and how to bring it into their schools or classrooms. Some thought it would be challenging to implement the activities with students due to external factors and other curricular mandates. As one participant stated, “one tension with cutting-edge research is that it’s difficult to be practical in the moment. I think you’re on the right track with scaling down the technology or bringing the insights to the classroom level…this [workshop] is way more effective than most formats, but I think you would have a difficult time getting educators to opt in.” Meanwhile another participant said, “in both workshops, the concepts and practice of the teachable bot and neuroimaging was beyond the ‘here and now’ of teaching and learning, but the examination of how our current concepts of pedagogy may change as we catch up to the technology.” Additionally, several teachers discussed how the workshop offered new ways for them to think about bringing in real-world data and student-led projects to promote further inquiry and AI literacy.

- Teachers valued the opportunity to collaborate with other educators and researchers. They liked exploring different lenses (e.g., student, teacher, and researcher) while engaging in reflective discussions about the impact of research on their practice. One teacher highlighted how it felt like a “safe space to troubleshoot uses of AI and educational data mining” and another expressed appreciation for “garnering others’ experiences to get further ideas for their own classroom.”

Based on overall positive feedback from our teacher participants, we believe this research dissemination workshop model is worth exploring with other projects, especially since educators felt they were able to take something meaningful away from the experience. As one participant stated, “I feel very fortunate to be involved in this work. I’m very happy that your team is working to push the boundaries of how we learn and teach.” This gives us hope that researchers will consider the importance of collaborating and co-designing with educators. Additionally, this work validates the need for further mediation between research and practice, which potentially can include creating new roles for “knowledge brokers” (Levin, 2013) to promote further dialogue across these boundaries in order to truly make a broader impact.

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References:

Levin, B. (2013, February). To know is not enough: Research knowledge and its use. *Review of education*, 1(1), 2-31. DOI: 10.1002/rev3.3001

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