Executive Summary of *TPACK in the age of ChatGPT and GenAI*

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Generative AI (GenAI) technologies like ChatGPT have sparked much discussion about their potential impact on education. In this paper the authors argue that the rise of generative AI (GenAI) technologies like ChatGPT requires reimagining aspects of the Technological Pedagogical Content Knowledge (TPACK) framework. TPACK describes the types of knowledge teachers need to effectively integrate technology into teaching.

The paper first provides background on GenAI, defining it as AI that can generate new content like text, images, or music. GenAI is not explicitly programmed to give certain responses. Rather, it learns and reproduces patterns from large datasets. The paper summarizes current educational discourse, concerning GenAI touching on topics such as cheating and biases. The authors also express optimism about the benefits of GenAI. For example, it can support personalized learning and new forms of creativity.

Next, the paper dives deeper into the unique properties of GenAI. Understanding these properties is central to developing the Technological Knowledge (TK) teachers need to use GenAI effectively. Like other digital technologies, GenAI is protean, opaque, and unstable. However, its protean nature is magnified by its ability to fluidly interact with diverse digital media through natural language and its wide applicability for creative and analytical tasks. Its opacity results from the complexity of its neural networks. In fact, aspects of GenAI can be incomprehensible even to its creators. Its instability stems not just from errors but from its tendency to "hallucinate" or generate untethered outputs.

In addition to understanding the protean, opaque, and unstable properties of GenAI, teachers should also consider its unique properties: it is generative and social. GenAI is generative in that it creates original, unanticipated content on the fly rather than retrieving pre-existing information. In fact, its developers have been surprised by innovative capabilities it developed independently. GenAI is also social, encouraging anthropomorphism and social interaction due to its conversational nature. The paper argues that we must recognize GenAI as a generative, social "psychological other" rather than simply a

productivity tool. Teachers should approach it as an expert yet unreliable collaborator who can assist with complex conceptual tasks but whose proclivity for falsehood requires vigilance.

Most significantly, GenAI requires a philosophical shift in TPACK from viewing technology as a tool to recognizing the emergent, reciprocal dance between users and technologies like GenAI. Rather than passive objects, these social, generative technologies actively shape interactions. The learning space now includes a non-human, alien intelligence.

Because of the unique properties of GenAI, TPACK must adapt. For examples, Technological Pedagogical Knowledge (TPK) could involve utilizing GenAI for formative assessment while focusing summative assessment on higher-order skills. Technological Content Knowledge (TCK) should prepare students for AI-transformed careers. Further, given GenAI's potential to transform society, Contextual Knowledge (XK) must expand in scope. While XK traditionally focuses on constraints within school systems, it must now also consider broader personal, cultural, political, and ethical implications of AI over decades-long timescales. These include impacts on notions of truth, trust in institutions, mental health, and workforce disruption that schools will need to address.

The authors make an important analogy about the impact of social media in describing the potential impact of generative AI on education. They suggest that while initially focusing on incorporating social media in the classroom, educators did not consider how these technologies could negatively impact society by exacerbating polarization, eroding trust in institutions, and harming mental health - consequences now evident and are challenges that schools must now address. The authors warn that a similar dynamic could unfold with GenAI, where educators would be left to contend with adverse societal impacts they did not anticipate as technology companies rapidly develop and deploy these tools.

The authors argue that the rise of generative AI necessitates reimagining aspects of the TPACK framework to empower teachers to ethically integrate this technology. Updating TPACK will require recognizing these tools as collaborators rather than mere productivity aids. Expanding Contextual Knowledge (XK) involves developing foresight about long-term societal impacts. Overall, TPACK must shift from a toolset view to one recognizing the emergent relationships between users, contexts, and AI technologies. With creativity and a proactive perspective, alongside increasingly capable AI, educators can design transformative approaches to educating all learners. Rather than offering a reactive response, this paper calls for teachers to proactively build capacity to mitigate adverse consequences and harness benefits of this transformative technology as it continues evolving within and shaping culture.