From the Editor

The Great Integrator: Any Content, Any Practice

The capacity of our discipline (Technology, Engineering, and Design Education [TED]) to intentionally integrate the content and/or practices of any other subject area, is a unique epistemological and pedagogical characteristic. Nationally in the U.S., this characteristic was first made explicit in the 1996 publication of the *Technology for All Americans: A Rationale and Structure for the Study of Technology* (T*f*AA) by the International Technology Education Association (ITEA). This seminal document devoted an entire section (pp. 28-29) to discussing the interdisciplinary connections between technology and all other fields of knowledge. This section emphasized that a technologically literate person is one who is knowledgeable "of the underlying basic science, mathematics, engineering, and architectural concepts and their relationship to technology" (p. 29). And furthermore, that such literacy is inclusive of "an appreciation and understanding of the interdisciplinary connections between technology, language arts, the humanities, and social sciences" (p. 29). The second edition of the T*f*AA published in 2006 expanded this interdisciplinary characterization by specifying that all technological systems were comprised of knowledge, processes, and contexts around which the universals of technology are organized. The interdisciplinarity nature of the field is implicit within the three contexts of all technological systems: biological, informational, and physical. Ensuring students experience each of these contexts is an essential aspect of preparing them to be technologically literate with an expressed intent to develop within them the "mental capabilities and strategies such as problem solving, visual imagery, and reasoning" (p. 18); i.e., critical thinkers and informed decision-makers. Students acquire such abilities "through experiences in designing, modeling, testing, troubleshooting, observing, analyzing, and investigating" (p. 18). As gerunds, these nouns reflect essential experiences in which TED students regularly engage, and all of which naturally impose on them the need to acquire the disciplinary knowledge (content and/or practices) inherent to such activities.

In 2000 when the first edition of the *Standards for Technological Literacy* (STL) was published, followed by revised second and third editions in 2002 and 2007 respectively, those standards conveyed an even more overt vision of technology education as an integrator of other subjects: "…a way to apply and integrate knowledge from many other subject areas – not just mathematics, science, and computer classes, but also the liberal and fine arts" (pp. 6-7). Using several pages to present grade-level examples of how technology classes can intentionally integrate the content and/or practices of other disciplines, the section closes by recognizing that "…students are expected to synthesize and apply information from other subjects as well as from within the study of technology" (p. 9). The publication in 2020 of the newly updated *Standards for Technological and Engineering Education* (ITEEA) continued promoting the vision of being a disciplinary integrator (pp. ix and 5-6), albeit not as strongly emphasizing the opportunities for teaching and learning the content and practices of other disciplines inherently imposed on learners of all ages when engaged in the design of satisficing solutions.

Given the long-standing premise of technology education in the U.S. as the great integrator, it should not be surprising that in this issue of the Journal of Technology Education alone, the research presented by each article is in some way capitalizing on the transdisciplinary nature of our field to intentionally integrate the content and/or practices of another discipline. You see this in the first article where McLain is contextualizing the integration of Q Methodology, an analytical approach originating in the field of Psychology using factor analysis and interpretive techniques to explore qualitative data within TED educational research. This is followed by the Rinder, et al. article reporting on their thematic analysis of publications by members of two long-standing U.S. Technology and Engineering Education (TEE) networks over the past decade, which identified STEM & Integrated Education as one of several top themes addressed by these TEE scholars. And in the third article, Wang & Denson directly address the integration of instructional technologies into the K-12 technology education classrooms to enhance student engagement during the teaching and learning process.

Although the topic of integration is associated within the Spring 2026 articles, it is not unique to this issue of the JTE. The fact is that in 32 of the 38 years since the first publication in 1989, more than half the issues (53%) contained at least one article connecting the integrative nature of TEE with the teaching and/or learning of content and practices from other disciplines (Table 1). As well, a review of the abstracts for publications in the IJTDE during the last two and a half years (2024-2026) found there was at least one article addressing the integration of other disciplines through TED in each of the 12 issues (Table 2).

Table 1
JTE articles addressing integration of content and/or practices from other disciplines through the teaching/learning of TEE

Year/Vol:#	1st Author	Truncated Article Title
1989/1:1	Zuga	Relating Technology Education Goals to Curriculum Planning
1990/1:2	Roy	The Relationship of Technology To Science and the Teaching of Technology
1991/2:2	Gloeckner	The Integration of Science, Technology, and Mathematics Myth or Dream?
1991/3:1	Frey	Another Look at Technology and Science
1992/3:2	Johnson	A Framework for Technology Education Curricula Which Emphasizes Intellectual Processes
1992/4:1	Dugger	A Comparison of Principles of Technology and HS Physics Student Achievement Using a…
1993/4:2	Daugherty	Mathematics, Science, and Technology Teachers' Perceptions of Technology Education
1994/5:2	Scarborough	PHYS-MA-TECH: An Integrated Partnership
1994/6:1	Wells	Establishing a Taxonometric Structure for the Study of Biotechnology in Secondary School…
1995/6:2	Wicklein	Case Studies of Multidisciplinary Approaches to Integrating Mathematics, Science and…
1996/8:1	de Vries	Technology Education: Beyond the "Technology is Applied Science" Paradigm
	Childress	Does Integrating Technology, Science, and Mathematics Improve Technological Problem…
1997/8:2	Johnson	Expanding the Content Base of Technology Education: Technology Transfer as a Topic of…
1998/9:2	Hill	Practice Meets Theory in Technology Education: A Case of Authentic Learning in the High…
1999/10:2	Lewis	Research in Technology Education— Some Areas of Need
2000/11:2	Williams	Design: The Only Methodology of Technology?
2000/12:1	Walton	Heidegger in the Hands-on Science and Technology Center: Philosophical Reflections on…
2001/13:1	Wicklein	Are We Thinking About Technology?
2002/13:2	Zubrowski	Integrating Science into Design Technology Projects: Using a Standard Model in the Design…
2002/14:1	Pannabecker	Integrating Technology, Science, and Math at Napoleon's School for Industry, 1806-1815
2005/17:1	Zinser	The Ford Partnership for Advanced Studies: A New Case for Curriculum Integration in…
2006/17:2	Dyer	Investigating the Relationship between High School Technology Education and Test Scores…
2007/18:2	Rafi	Relationship of Spatial Experience, Previous Math Achievement, and Gender with Perceived…

2008/19:2	Doppelt	Engagement and Achievements: A Case Study of Design-Based Learning in a Science Context
2010/21:2	Merrill	STEM Education and Leadership: A Mathematics and Science Partnership Approach
	Obrien	Characteristics of a Unique Undergraduate Multidisciplinary STEM K-5 Teacher Preparation…
2010/22:1	Burghardt	A Study of Mathematics Infusion in Middle School Technology Education Classes
2011/23:1	Custer	Teaching Engineering Concepts in High School Projects
2012/23:2	Asunda	Standards for Technological Literacy and STEM Education Delivery Through Career and….
2012/24:1	Dixon	Transfer of Learning: Connecting Concepts During Problem Solving
	Williams	Using CoRes to Develop the Pedagogical Content Knowledge (PCK) of Early Career Science…
2013/24:2	Brown	Engineering Efforts and Opportunities in the National Science Foundation’s Math and…
2014/25:2	Flowers	Mathematics in Technology & Engineering Education: Judgements of Grade-Level…
2015/26:2	Ortiz	Examining Students’ Proportional Reasoning Strategy Levels as Evidence of the Impact of…
2016/27:2	Wells	Efficacy of the Technological/Engineering Design Approach: Imposed Cognitive Demands…
2017/29:1	Love	Examining the Teaching of Science, and Technology and Engineering Content and Practices…
2018/29:2	Havice	Evaluating the Effectiveness of Integrative STEM Education: Teacher and Administrator…
2018/30:1	Chelsey	The Impacts of Integrating Introductory Composition, Communication, and Design Thinking…
2019/31:1	Figliano	Evicencing STEM Content Knowledge Transfer: Abstraction in Technological/Engineering…
2020/32?1	Sherman	Oral Communication in an Integrated STEM and Humanities First-Year Experience
2023/34:2	Asunda	Embracing Computational Thinking as an Impetus for Artificial Intelligence in Integrated….
2025/36:2	Gullberg	How Does Emotion and Matter Matter in Engineering Education

Table 2
Recent IJTDE articles addressing integration of content and/or practices from other disciplines through TEE teaching/learning

Year/Vol:#	1st Author	Truncated Article Title
2026/36:1	Lu	Integrating virtual reality and physiological feedback into architectural education: enhancing…
	Morgan	Promoting elementary student graphical device comprehension: efficacy of technological…
2026/36:2	Videla	Sustainable computing in STEAM generative education: integrating biology, art, science…
	Li	Effects of engineering design-based science on students’ STEM competence and engineering….
2025/35:1	Thomason	The effect of a STEM integrated curriculum on design thinking dispositions in middle school…
	Colecchia	Interdisciplinary integrative capabilities as a catalyst of responsible technology-enabled…
2025/35:2	Zhou	Integrating story-based STEM design challenges in early childhood curricula: an activity…
	Ahuja	Cultivating ethics sensitivity in design: Impact of integrating ethics within K-12 digital…
2025/35:3	Pokuah	Exploring contexts: the connection between mathematics and electricals/electronics for…
	Cerovac	Fostering technologies literacy: integrating technical vocabulary into the primary school…
2025/35:4	Santos	Fostering students’ motivation and self-efficacy in science, technology, engineering, and…
2025/35:5	Deng	Designing integrated STEM curriculum to enhance STEM literacy among middle school…
	Giffney	Towards an integrated model of STEM education in secondary schools: perspectives of…
	Acharya	Integrating Vedic principles into architectural education: a systematic literature review.
2024/34:1	Xu	Impacts of maker education-design thinking integration on knowledge, creative tendencies…
2024/34:2	Ozkizilcik	The influence of an engineering design-based STEM course on pre-service science teachers’…
2024/34:3	Bayar	The impact of design-based science instruction on students’ science achievement and science…
2024/34:4	Yeung	Using empathy maps to support design-thinking enhanced transdisciplinary STEM innovation…

The commitment to integration of multiple disciplines through TED teaching and learning is not relegated to the U.S. alone. Quite the contrary - the intentional integration of other disciplines as part of the TED curricula, or within curricula such as STEAM where TED plays a critical role, is today an internationally embraced pedagogical vision. To illustrate this, findings from a cursory analysis (Table 3) of national curricula and/or standards in a select few countries, reveals the intent to teach content and/or practices of disciplines other than TED is both overt and explicit.

Table 3

Select international curricular examples of TED used for intentional integration

Country	Curricula Model	Integrative Role	Implementation
Australia	Australian Curriculum	Tech Ed: Connective Tissue Subject	Mandatory integration through Digital Literacy, Integrated Cross-Curricular
Canada	BC Model	Cross-Curricular Doing	Applied Design, Skills and Technologies
	Ontario Model	Integrative Hub	STEM & Engineering Design Integration
	Quebec Model	Integrated Sci/Tech	Science and Technology Program
Germany	Common Standards	Cross-Curricular, STEM, Digital Literacy, Interdisciplinary Reflection	Via *Education in the Digital World*
Ireland	Primary Curriculum	STEM Ed Specification	Mandatory STEM Education
	Junior Cycle	Digital Learner	Embedded across all curriculum areas
	Senior Cycle	Design-Based Problem Solving	Design Approach
United Kingdom	Design & Technology	Core Subject Synthesis in D&T	Interdisciplinary Learning Functional Literacies embedded in English/Math/Science
New Zealand	Curriculum Refresh (Te Mātaiaho)	Cross-Curricular Thematic Approach	Disciplinary Dependencies, STEM Framework, Unplugged Integration, Cultural and Social Context
Republic of Korea (South Korea)	Revised National Curriculum	Convergence Education Engineering-Centered Integration	Practical Arts Technology and Home Economics
Sweden	Lgr22 Curriculum	Math/Science Integration Multidisciplinary/Vocational	Application Theory in STEM Framework
Taiwan	108 Curriculum	Domain Integration/Cross-Curricular Global/Life Connection/Emerging AI	Natural Science & Living Technology Special Topics/Life-Centered Contexts

Since its inception, from Industrial Arts to Technology and Engineering Education, our field of study has perceived itself as part of general education. A field of study whose goal is not to prepare a student for a specific vocation, but one intent on preparing that student to be technologically literate in the same sense that mathematics or science prepares students to be mathematically and scientifically literate. And for more than 30 years, integral to promoting technological literacy has been the charge, at least in the U.S., that Technology Education (now TEE) intentionally integrate the content/practices of not just science, technology, engineering, and mathematics (STEM), but language arts, the humanities, and social sciences as well (ITEA, 1996, p. 29). Such integration was envisioned as a transdisciplinary approach to teaching any subject inherent to the design of satisficing technological and/or engineering artifacts or systems, abstract or concrete.

The publication evidence overwhelming demonstrates that research on the designerly approach to integration is occurring nationally and internationally. Furthermore, a review of recent proceedings and/or conference programs from TED conferences such as PATT, ITEEA, TENZ, ICTE, and TERC to name a few clearly demonstrates that our research on integrative techniques is being shared globally. This being the case, we obviously do well in communicating our research on integration within our own profession. However, we are surprisingly unmotivated to connect our research and expertise on the designerly approach to integration through presentations delivered at conferences outside our discipline.

Over the past several decades I have attended and presented at conferences outside our profession such as the National Science Teachers Association (NSTA) and the National Association of Research in Science Teaching (NARST). Most recently I attended the April 2026 NARST conference held in Seattle, Washington and presented on design based biotechnical learning. The conference was extremely well attended by science education researchers from around the world, and a common research focus was on the incorporation of engineering in science education. This focus is perhaps to be expected given NARST has a research interest group (RIG) in Engineering Education whose purpose is to bridge research across science and engineering, promote research in engineering education, and to support intellectual and professional exchange and networking. A review of the 786 presentations contained in the conference program (https://narst.org/sites/default/files/2026-04/NARST_2026_Conference_Program_updated_4-21-26.pdf) together with their abstracts (https://narst.org/sites/default/files/2026-04/Conference_Abstract_Book_with_author_index_4-21-2026.pdf) shows there were 256 addressing STEM-related research, 46 addressing integration, and 38 specifically addressing research on engineering ranging from developing effective engineering instruction for the elementary classroom, to the preparation of pre-service science teachers for evaluating the quality of their engineering design lessons.

In attending several of the NARST research presentations addressing engineering design-based learning, the focus was consistent on using an engineering activity or project for the teaching and learning of science content and/or practice. Granted this might be expected at a conference on science teaching research, but what is troublesome is that little to no attention was given to teaching the design process itself. The focus was not on promoting TEE design thinking, or on the unique way in which knowledge is acquired through engagement in the TEE design process. More precisely, the research was devoid of any discussion regarding how our designerly way of knowing and thinking utilizes a disciplinarily unique heuristic for acquiring knowledge. The knowledge acquisition heuristic (KAH) for TEE design thinking is a minds-on/hands-on way of coming to know that is distinctly different from that of the scientific inquiry method, the mathematical logic method, and the hermeneutic method of the humanities (Wells, 2021). An equally distinctive pedagogical characteristic of TEE is that the integration of content/practices from all disciplines is not a forced process; not one where a contrived TEE design context is used for the instructional purpose of teaching the content/practice of a discipline outside of our field. To the contrary, the potential for integrating any and all disciplinary content or practice is an inherent characteristic of our technological, engineering, and design (TED) based pedagogy.

Presented in this editorial is the long-held position of TEE as the great integrator, projected alongside a steady rise in research being conducted in fields outside of ours using engineering design to teach their content and practices. Reflecting on the extent to which engineering-related research was presented at the 2026 NARST, what stands out is the absence of researchers from our field communicating the unparalleled role of TEE as the great integrator. What became clear from this observation is that we are missing important opportunities for the profession to convey the collective international body of expertise regarding the utilization of TEE design to foster in students the "mental capabilities and strategies such as problem solving, visual imagery, and reasoning" and for them to acquire such abilities "through experiences in designing, modeling, testing, troubleshooting, observing, analyzing, and investigating" (ITEA, 2006, p. 18). And from this clarity comes the realization that by not participating in research dissemination opportunities of closely aligned disciplinary fields incorporating TEE design into their pedagogical practices, we are abdicating our responsibility for communicating the unique designerly way of knowing that is arguably the sole purview of our field. That said, and not to the exclusion of our own annual meetings, I would urge all TED researchers to consider the 2027 NARST and NSTA conferences as key opportunities to showcase the research and pedagogical expertise of our profession.

The 2027 annual NSTA conferences are scheduled for April in Boston and November in Portland, Oregon (https://www.nsta.org/future-conferences). NARST has scheduled its 100th annual conference for March of 2027 in Boston, Massachusetts (https://narst.org/conferences/2027-annual-conference).

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