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Editorial: Preparing Teachers for Tomorrow's Technologies

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Technology is rapidly changing how we teach and how we learn. Emergent technologies offer opportunities to understand concepts in deeper, often different, and more meaningful ways. However, this growth in understanding will occur only if teachers learn to use these technologies in effective ways. The federal initiative, *Preparing Tomorrow's Teachers to Use Technology* (PT3), was launched in 1999 to address this challenge. Startup funding to establish the National Technology Leadership Coalition (NTLC) was included among the 400 grants awarded through this effort.

The NTLC includes representation by the teacher educator associations for the core content areas and corresponding educational technology associations. The teacher educator content associations currently include mathematics education (AMTE), science education (ASTE), social studies (NCSS/CUFA), and English language arts (NCTE/CEE). In addition, the International Technology and Engineering Association (ITEEA) contributes expertise in that area.

Establishment of *Contemporary Issues in Technology and Teacher Education* (the *CITE Journal*) was one of the first actions undertaken by the NTLC associations. An article by the director of the PT3 program, Tom Carroll, published in the first issue of the *CITE Journal*, outlined the goals of the program (Carroll, 2000). Reviewers selected by the aforementioned associations edit their corresponding sections in the *CITE Journal*. Two sections of the *CITE Journal* (the General and Current Practice sections) are sponsored by the Society for Information Technology and Teacher Education (SITE), also a member of the NTLC.

Additional educational technology associations participating in the NTLC include the Association for Educational Communications and Technology (AECT) and the International Society for Technology in Education (ISTE). The American Association of Colleges for Teacher Education (AACTE) serves as host for an annual National Technology Leadership Summit (NTLS) in which member associations participate. Its Innovation and Technology Committee members connect the work of NTLC and AACTE.

The Emergence of a Framework: TPACK

Three essential types of knowledge—technological knowledge, pedagogical knowledge, and content knowledge—emerged as a framework for collaborative work across associations. The framework of technology, pedagogy, and content knowledge (TPACK; Mishra & Koehler, 2006) builds upon Shulman's (1986) notion of pedagogical content knowledge. Pedagogical knowledge goes beyond knowledge of subject matter, involving understanding of effective strategies for teaching a subject in ways that make it comprehensible.

TPACK involves an interaction among all three forms of knowledge—technological knowledge, pedagogical knowledge, and content knowledge. In other words, the most effective uses of technology also require a deep understanding of content and related pedagogical strategies. Teacher educators comprising these content associations are, therefore, best positioned to understand how technology may be best employed within their specific disciplines. Hence the organization of the *CITE Journal* is configured around this framework.

The TPACK framework has been influential, as evidenced by more than 200 related articles in peer-reviewed journals, two theme issues of peer-reviewed journals (including a TPACK-themed issue of the *CITE Journal*), and more than a dozen doctoral dissertations to date. The upcoming fourth edition of AECT's *Handbook of Research on Educational Communications and Technology* will contain a chapter on TPACK, evidence that this framework is maturing and influencing both research and practice. The AACTE *Handbook of Technological Pedagogical Content Knowledge* (2008) is a seminal work for this area that has been translated into Chinese and other languages, affecting practice in many other countries as well as the United States. A chapter in the AACTE Handbook, "Advancing TPACK through Collaboration across Educational Associations," describes the contributions of the NTLC associations.

The single largest category of submissions for the most recent SITE conference was the TPACK strand. Apparently, presenters are increasingly aware of the need to prepare teachers to integrate disciplinary knowledge, technological knowledge, and pedagogical knowledge. However, many experienced educators have not yet fully assimilated implications for teaching. Even though a large number of proposals related to TPACK are submitted at many teacher education conferences, panels of reviewers with expertise in this area report that a significant percentage of these proposals do not fully reflect best practices related to TPACK. Often these papers do not incorporate the three areas of requisite knowledge in an appropriate way. If the teacher education faculty members who prepare future teachers do not fully understand the practical implications of this framework, there is little chance that tomorrow's teachers will be able to employ technology effectively.

Teacher Education Initiative (TEI)

In light of this continuing need, the NTLC associations are collaborating with Microsoft to develop a Teacher Education Initiative (TEI). TEI builds upon Microsoft's Partners in Learning Program (PIL), a ten-year, $500 million global initiative that supports educators' use of technology in K-12 schools. The goal of the initiative is to ensure that future teachers are prepared to use technology effectively by building upon prior work

such as the PT3 and PIL initiatives and continuing to advance this effort by incorporating new and emergent technologies.

Working in concert with the NTLC teacher educator content associations, a series of TEI modules have been commissioned for each content area. The modules will include a variety of activities that will provide teacher education faculty members with content-based technology exemplars that teacher education faculty can do with their preservice teachers to help them develop TPACK.

Experienced teacher educators from each association are developing modules for their respective disciplinary areas. Many of these activities have been previously presented in workshops with both teacher education faculty and K-12 teachers at professional conferences of each discipline, and have been revised based on feedback from those presentations. These resources will now be made available through an online open-education site to make them accessible to all teacher education faculty members working with preservice teachers.

Each module will reflect guidelines for best practice in the respective area or discipline. Because the activities and examples will be grounded in each disciplinary area, integrating both pedagogy and content, they will be grounded in the perspective of TPACK. Punya Mishra, a scholar who has written extensively about the TPACK framework (see tpack.org), is developing the first module of the series that will introduce this concept.

The modules will serve as an additional resource for teacher preparation programs, but by themselves cannot be expected to achieve significant change. To facilitate dialog regarding the most effective ways to incorporate these materials into teacher preparation, a series of seminars will be offered to faculty members worldwide. These highly interactive seminars will provide experiences for faculty members to learn and practice using technology in their respective disciplinary areas as well as additional support to then develop their own ideas.

The goal of this far-reaching endeavor is to facilitate effective integration of technology by teacher educators from the majority of teacher preparation programs in the United States. The seminars introducing content in the TEI modules will be made available without charge to participating teacher education faculty members. Pilot seminars are scheduled for the SITE and ISTE conferences in the spring and summer of this year to allow NTLC leaders to provide input and feedback prior to broader dissemination. In addition to seminars at meetings of participating professional associations, a series of regional workshops at universities at different areas of the country will also be scheduled.

Mark Hofer, former editor of the Current Practice section of the *CITE Journal*, is collaborating with the TEI module developers to create a series of supportive teaching cases for each content area. These teaching cases will illustrate effective practice in each content area through collaboration with classroom teachers. Each teaching case will provide illustrative video of a teacher working with K-12 students, samples of student work, reflections by the teacher, and commentary by teacher educators.

The Practitioner's Guide to TPACK

The teaching cases developed in this manner will form the nucleus of a book, the *Practitioner's Guide to TPACK*, and it will include additional teaching cases from other sources, as well. The book will serve as a companion to the AACTE *Handbook of*

Technological Pedagogical Content Knowledge. The AACTE Handbook provides a theoretical framework for TPACK as an approach to incorporating technology in teaching. The Practitioner's Guide will provide concrete examples that illustrate TPACK in action in each content area. Lynn Bell, co-editor of the *CITE Journal,* will serve as editor of the *Practitioner's Guide to TPACK* in collaboration with Mark Hofer.

The TEI teaching cases are intended to be illustrative rather than prescriptive. There are dozens of ways in which technology might be effectively used in each content area, and the teaching cases showcased in the *Practitioner's Guide to TPACK* will provide an introduction only to a handful of these approaches. To provide a mechanism for highlighting the diverse ways in which technology can be used, a peer-review process for publishing additional teaching cases will be established.

If sufficient need exists, the possibility of developing an additional section of the *CITE Journal* will be explored. This would provide a process for submission of teaching cases that will be published after peer review.

Evaluation and Research

These plans to better prepare tomorrow's teachers to use technology, facilitating integration of technology in teacher preparation programs, requires a method for determining the extent to which these efforts are enhancing the field. The NTLC Editors include the editors of peer-reviewed journals published by the associations affiliated with NTLC. By virtue of their editorial positions, the NTLC editors are familiar with current trends in the field and are also in a position to facilitate and encourage dissemination of best practices. On several occasions the NTLC editors have coordinated publication of a series of editorials across all of their respective journals as a way of connecting with the membership of participating associations.

The NTLC Editors have agreed collectively to constitute a research and evaluation panel for these efforts. This will include two objectives: (a) identification of desired objectives and goals that may occur as a result of these efforts, and (b) identification of benchmarks that may be used to measure whether these objectives are being achieved.

Conclusion

The associations that collectively publish this journal established it with the intent of providing a peer-reviewed resource for teacher preparation programs. The CITE Journal employs TPACK as a framework, focusing on best practices for integration of technology in each discipline. Despite the progress that has been made, there is still a continuing need to explore how emergent technologies can best be integrated into teaching and teacher preparation. The steps described in this editorial provide an overview of the most recent plans across the NTLC teacher education associations to address their stated goal of increasing the use of emergent technologies to teach content across disciplines.

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