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Philip A. Reed
Old Dominion University, preed@odu.edu

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WHAT DO WE VALUE? RESEARCH ON TECHNOLOGY EDUCATION PROBLEMS, ISSUES, AND STANDARDS IN THE UNITED STATES

Philip A. Reed
Old Dominion University
Norfolk, Virginia

Technology education has seen significant changes since the early 1990's. The paradigm shift from industrial arts has been widely received. Communication tools have merged the global community and standards have helped unify content. While many of these changes have been positive, there are compelling calls for research to support technology education practice. How are we addressing this need? More importantly, is the research we are conducting adding value to technology education practice? This study presents a review and synthesis of published research, as well as graduate research, to address these questions. Specifically, research that has addressed recognized problems and issues within technology education will be highlighted. Additional connections linking research and practice will be analyzed by looking at research relating to Standards for Technological Literacy.

Introduction

Technology education in the United States has been receiving unprecedented attention from politicians, engineers, the science community, and other external groups. Much of this interest was spawned by release of *Standards for Technological Literacy* (STL) (ITEA, 2000, 2002) and from the increasingly competitive global economy. This attention, however, has come at a price. For example, the National Academy of Engineering and the National Research Council publication *Technically Speaking* concluded that widespread adoption of dedicated courses in technology was "an unlikely scenario" (Pearson & Young, 2002, p. 104). Additionally, the American Association for the Advancement of Science (AAAS) held a conference to address needed research that would help achieve the goal of technological literacy (Cajas, 2000). Calls for research within the profession are equally compelling but do not focus solely on technological literacy (Lewis, 1999; Petrina, 1998). This paper addresses internal and external calls for research. Specifically, research that investigates recognized problems and issues in technology education will be highlighted. Also, research addressing *Standards for Technological Literacy* (ITEA, 2000, 2002) will be reviewed since STL is driving the content and activities of the profession within the United States.

Research was located by reviewing the Journal of Technology Education (JTE), Journal of Industrial Teacher Education (JITE), Journal of Technology Studies (JTS), The Technology Teacher (TTT), International Technology Education Association (ITEA) publications, and Council on Technology Teacher Education (CTTE) publications. Graduate studies were also located in the *Technology Education Graduate Research Database* (Reed, 2006). A twelve year timeframe was maintained to follow the period utilized by the research on critical problems and issues. This timeframe also encompasses the publication period for the Technology for All Americans Project (TfAAP).

Research on Problems and Issues

Wicklein (1993, 2005) utilized a modified Delphi technique to identify critical problems and issues within technology education. Table 1 demonstrates that the top five critical problems have remained relatively consistent over time. A critical problem was defined by Wicklein as "A crucial impediment to the progress or survivability of technology education". The term "future" was defined as "A projected period of time of 3-5 years in the future" (1993, p.56). Each of the critical issues identified in Table 1 is discussed in this section.

Table 1

Problems in Technology Education

	Future Problems (Wicklein, 1993)		Problems (Wicklein, 2005)
1.	Insufficient quantities of technology education teachers and elimination of teacher education programs in technology education	1.	Insufficient quantities of qualified technology education teachers
2.	Loss of technology education identity, absorbed within other disciplines	2.	Inadequate understanding by administrators and counselors concerning technology education
3.	Poor and/or inadequate public relations for technology education	3.	Inadequate understanding by general populace concerning technology education
4.	Insufficient funding of technology education programs	4.	Lack of consensus of curriculum content for technology education
5.	Non-unified curriculum for technology education	5.	Inadequate financial support for technology education programs

The top problem identified in both of Wicklein's studies, insufficient quantities of qualified technology education teachers, has received a considerable amount of attention. Research does show that this is a critical problem (Ndahi & Ritz, 2003; Weston, 1997), however, recruiting and alternative licensure have been addressed through strategies and models outlined in articles and monographs (Daugherty, 1998; Grey & Daugherty, 2004; Hoepfl, 2001; Litowitz, 1998; Litowitz & Sanders 1999; Weston, 1997; Wright & Custer, 1998). Additionally, distance learning is being used to reach more teacher education students (Flowers, 2001; Mugan, Boe, & Edland, 2004; Ndahi, 2006).

Loss of identity/absorption into other disciplines has not come to fruition although there is currently significant attention regarding the relationship of technology education and engineering (Lewis, 2004, 2005; Rogers, 2005; Zinser & Poledink, 2005). It is important to note, however, similar attention was given in the 1990's to technology, science, and mathematics (TSM) integration (LaPorte & Sanders, 1995). Now, TSM integration is recognized as important for helping students to achieve technological literacy (Foster, 2005).

Inadequate understanding by administrators and counselors has received almost no research attention. One study did investigate administrators' views of STL but did not address counselors (Phillips, 2005). Poor and/or inadequate public relations, on the other hand, have been addressed. Several national samples representative of the United States population showed that most people did not understand what technology education is but they felt that the study of technology was important (ITEA, 2002, 2004).

Research on program funding is non-existent in the literature. A search of the TEGRD (Reed, 2006) only found ten funding studies out of over 5,200 theses and dissertations and all were well before the twelve years of interest in this study. ITEA did establish the Foundation for Technology Education (FTE) to provide scholarship funding and Hughes (1998) published sources for grants, scholarships and other funding sources. Nevertheless, research on program funding is not to be found.

Research does support the notion of a lack of consensus on curriculum. As mentioned above, the role of engineering is being questioned although integration with mathematics and science has been accepted. Petrina (1994) identified six trends in technology education curriculum. Sanders (2001) reported that the organizers of communication, manufacturing, construction, and transportation were widely accepted nationally in the curriculum but biotechnology was scarce even though it had been pushed by the profession for ten years.

Wicklein's (1993, 2005) top five issues are listed in Table 2. A critical issue was defined by Wicklein as "Of crucial importance relating to at least two points of view that are debatable or in dispute within technology education" (1993, p.56). Like the critical problems, many of the identified issues have remained constant over time. Additionally, many of the issues parallel the critical problems discussed above (e.g. curriculum paradigms, design and development; recruitment of students and teachers).

Table 2
Issues in Technology Education

	Future Issues (Wicklein, 1993)		Issues (Wicklein, 2005)
1.	Curriculum development paradigms for technology education	1.	Recruitment of students/teachers into teacher education programs
2.	Positioning of technology education in the school program	2.	Curriculum design and development for technology education
3.	Knowledge base identification for technology education	3.	Identification of a knowledge base for technology education
4.	Interdisciplinary approaches for technology education	4.	Positioning technology education within the whole school curriculum
5.	Business, industry and political support for technology education	5.	Identifying and procuring adequate funding sources for technology education

Positioning of technology education in the school program appears to be gaining support according to two status surveys inclusive of all fifty states and the District of Columbia (Meade & Dugger, 2004; Newberry, 2001). Additionally, ITEA has worked on materials to help position technology education into the schools by identifying cross curricular connections (Sanders & Binderup, 2000).

It is somewhat ironic that the identification of a knowledge base was listed as an issue in Wicklein's 2005 study. Status studies demonstrate that the content standards (STL) (ITEA, 2000, 2002) have been widely accepted nationally (Meade & Dugger, 2004; Newberry, 2001). Program, professional development, and student assessment standards have also been created to clarify the knowledge base of technology education (ITEA, 2003). Publications relating to the Technology for All Americans (TfAA) project have been prolific. A review of

The Technology Teacher since the mid 1990's showed that a standards-related article has appeared in almost every issue (eight issues annually).

Research on interdisciplinary approaches to technology education has focused mostly on technology, science, and mathematics integration (Childress, 1996; Foster & Wright, 1996; LaPorte & Sanders, 1995; Merrill, 2001; Wicklein & Schell, 1995). However, research of additional academic standards (i.e. language and social studies) indicates opportunities for broader interdisciplinary approaches (Foster, 2005).

Political support for technology education has been strong over the past twelve years. The National Aeronautics and Space Administration (NASA) and National Science Foundation (NSF) funded the TfAAP. Additionally, the National Research Council (NRC) and National Academy of Engineering have formed committees, hosted conferences, and published several books supporting the need for technological literacy and calling for research (Garmire, & Pearson, 2006; Pearson & Young, 2002; Weiss, Knapp, Hollweg, & Burrill, 2002). Despite these efforts, there is a dearth of research regarding business, industry, and political support. Materials have been developed for positioning technology education (Reed & Ritz, 1999) but, to borrow an old blacksmithing term, researchers need to strike while the iron is hot.

Research on the Standards for Technological Literacy

Problems and issues clearly highlight what we value in technology education but they do not show the complete research picture. For example, it is very ironic that the top problems and issues from both studies do not address the influence of technology education on students. This section will look at standards-based research since student achievement is at the core of the TfAAP and the external support (e.g. AAAS, NSF, NASA, and the National Academies).

To investigate standards-based research, the model developed in the National Research Council's *Investigating the influence of standards: A framework for research in Mathematics, Science, and Technology education* (Weiss, Knapp, Hollweg, & Burrill, 2002) was utilized. Figure 1 illustrates the NRC model with student learning as the outcome. Steps in the model leading to student learning include contextual forces, channels of influence within the educational system, and teachers and teaching practice.

The minimal research on contextual forces (e.g. politicians, policymakers, the public, business and industry, and professional organizations) was discussed above. Similarly, the channels of influence in the NRC model have received token research attention. Loveland (2004) showed favorable acceptance of STL in large Florida districts and national acceptance has been shown by Meade & Dugger (2004) and Newberry (2001). Additionally, Donan (2003) developed an instrument to assess acceptance of STL and Russell's (2005) survey at three ITEA conferences regarding awareness and implementation of STL had very positive findings. A broad review of curricular materials published since 2000 found there was wide variation but the materials generally reflected STL (Britton, Long-Cotty, & Levenson, 2004).

Teachers and teaching practice have received considerable attention in the literature but research is negligible. Russell (2005) surveyed teacher preparation programs and found strong acceptance and use of STL. Professional development standards (ITEA, 2003) and a

CTTE yearbook on standards implementation (Ritz, Dugger, & Israel, 2002) have helped shape teacher education. Nevertheless, a review of ITEA institutional members showed that only 24 of 70 universities (34%) had received ITEA/CTTE/NCATE accreditation which is an important barometer for acceptance of STL (data retrieved September 3, 2006 from http://www.iteaconnect.org/Resources/institutionalmembers.htm).

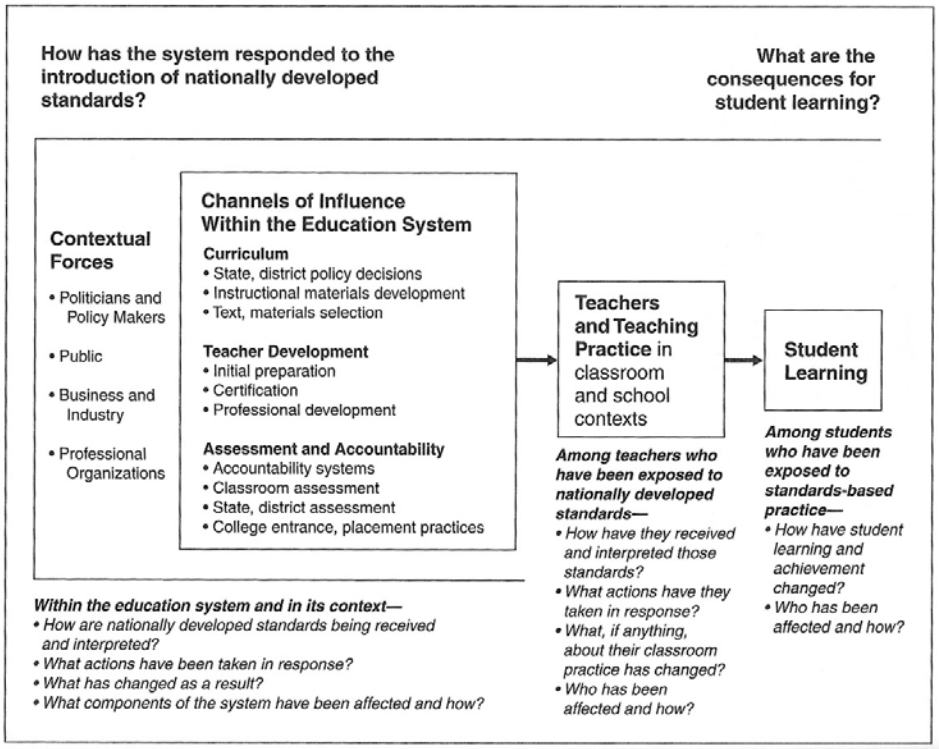

Figure 1
A framework for investigating the influence of nationally developed standards for mathematics, science, and technology education (Weiss, Knapp, Hollweg, & Burrill, 2002).

Student learning is the ultimate goal of the NRC model. ITEA has developed student assessment standards (ITEA, 2003) and monographs on assessment strategies and interpreting STL (Meyer, 2000a, 2000b). Nevertheless, there is a lack of research on student learning. Technological literacy assessments have been developed by several researchers however, large scale studies have not been conducted. A new publication by the National Academy of Engineering and National Research Council, *Tech Tally: Approaches to Assessing Technological Literacy* (Garmire & Pearson, 2006) review instruments, portfolio assessments, and other methods for assessing technological literacy. Recommendations are made for researchers to begin pursuing data in this area.

Conclusion
This study has attempted to identify research that addressed problems, issues, and standards over the past twelve years. All areas have been addressed by the profession, if some in only a cursory fashion via developmental projects. However, the largest question looms: What are we doing for students? A common method is emerging to address this in several ways. First, state and local school systems are creating crosswalks between academic standards and the

Standards for Technological Literacy. Second, researchers are investigating the role technology education has on student's achievement in the academic areas (Culbertson, Daugherty, & Merrill, 2004; Dyer, Reed, & Berry, 2006; Ebrahim, 2001). This method of inquiry is a step in the right direction but not as robust as direct assessment of technological literacy. We must conduct the right research. We must conduct research that adds value to technology education practice. In addition to researching smartly, we must also encourage researchers to publish and present their findings. Research that is not published or shared with the profession is merely academic exercise, not scholarship.

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