Leadership Development for Engineering Technology Faculty: Becoming an Educational Leader through Knowledge Generation, Application, and Contribution

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Elaine L. Craft (Florence-Darlington Technical College, Florence, SC) holds a baccalaureate degree in chemical engineering from the University of Mississippi and a MBA from the University of South Carolina with additional graduate studies in mathematics. Her experience includes working as an engineer in industry as well as teaching and administration at community college and state levels. She has served as Director of the South Carolina Advanced Technological (SC ATE) Center of Excellence since 1994, leading initiatives and grant-funded projects to develop educational leadership and increase the quantity, quality and diversity of highly skilled technicians to support the American economy. Currently serving as Principal Investigator, Mentor-Connect: Leadership Development and Outreach for ATE; Co-Principal Investigator, SC ATE National Resource Center for Expanding Excellence in Technician Education; and Co-Principal Investigator, ATE Regional Center for Aviation and Automotive Technology Education Using Virtual E-Schools (CA2VES). The SC ATE Center is widely known for developing and broadly sharing successful educational models and practices in technician education, with a particular emphasis on faculty development in problem-based learning, the first year of study for success in engineering and technology majors, and mentoring educators nationally.

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Executive Summary

Leaders understand that knowledge is power. They also know knowledge creates resilience, flexibility, and adaptability, and therefore provides a competitive edge for those using and applying that knowledge. This paper explores how engineering technology faculty and administrators at two-year colleges can gain, use, and share critical knowledge of what works, and does not work, in technician education.

Faculty members who generate, apply, and contribute their knowledge of research-in-action and effective practices give their students, their technical programs, and their colleges a strategic and competitive advantage. Knowledge shared with and by peers in the greater community of practitioners enables faculty to: 1) broaden their own knowledge base and improve their professional practice; 2) strengthen student outcomes across engineering technology courses and programs; and 3) develop more competitive grant proposals built on an existing body of knowledge. Further, knowledge acquisition and effective dissemination informs and supports the development of leadership skills, thereby enhancing individual faculty status and visibility at home institutions and in the broader community.

This paper introduces and showcases the **Compendium of Research on Technician Education** – a new way relevant targeted research is being published and delivered to the doorstep of faculty leaders – at www.TeachingTechnicians.org. This comprehensive database resource, developed in part with funding from the National Science Foundation (NSF), includes promising and proven practices to assist two-year college faculty in keeping their teaching practice and students' learning rigorous, current, and relevant. The Compendium offers targeted research on a wide array of topics such as technology programs, technician education and workforce needs, student recruitment, and student outcomes.

Motivating Rationale

> *"Leadership and learning are indispensable to each other."* John F. Kennedy

Exciting innovations and shifts in thought and practice are now trending in the post-secondary teaching profession. Two-year college faculty in engineering/engineering technology disciplines can now easily adapt and enhance their: 1) Teaching practices through research and evidenced-based design and outcomes; and 2) Competitive national and local research and development efforts. Faculty leaders can do this through increased scholarship efforts and activities. This paper examines the context and confluence of <u>two motivating trends</u>, and <u>one ready-to-use strategic resource</u> for STEM faculty leaders pursuing the scholarship of teaching and learning.

The two motivating trends are: 1) The body of work and practices known as "Scholarship of Teaching and Learning;[1] and 2) The need for strong, competitive teaching professionals at two-year colleges who continue to develop their faculty leadership skills through knowledge generation, acquisition, and contribution to the greater community of teachers and scholars. The ready-to-use strategic resource is the **Compendium of Research on Technician Education** from the South Carolina ATE Center of Excellence (SC ATE). A direct link to the Compendium within the *Promising and Proven Practices* section of the www.TeachingTechnicians.org website follows: http://www.teachingtechnicians.org/Resources/PPP/.

Research-based design, practice, assessment, and implementation is *how the scholarship of teaching and learning translates* into STEM faculty leaders advancing their own and others' scholarship and the teaching profession as a whole.[2] Fairweather's commissioned paper, "Linking Evidence and Promising Practices in Science, Technology, Engineering, and Mathematics (STEM) Undergraduate Education: A Status Report for the National Academies Research Council Board of Science Education," supports the premise of this paper with state-of-the-profession ideas and strategies for using evidence-based design, and advancing scholarship, teaching, and learning. Successful projects are highlighted in which faculty development is designed to "help current and future faculty succeed in the changing landscape of science, engineering, and mathematics higher education."

Faculty leaders actively participate in, and give back to, the larger community through scholarship and dissemination for peers. These shared contributions of teaching profession practices, strategies, and experiences become available and usable in both the scholarly community and the general community. SC ATE is leading the way in disseminating research on advanced technological education.[3] SC ATE invites and facilitates more faculty leaders, and "teachers-as-scholars," into the greater advanced technological education and scholarship of teaching and learning community.[4]

Faculty Leadership Development through Scholarship

The specific aspect of leadership we are addressing is the need for STEM faculty members to develop themselves as faculty leaders. One key approach to this leadership development is through increased scholarship, and by faculty leaders becoming active participants and contributors to the greater community involved with research around the question of what works and what does not work in technician education. The SC ATE Center, and its collective work in advanced technological education and the academic community, supports engineering/ engineering technology faculty professional development through scholarship. This approach can help drive successful teaching and learning outcomes for students, programs, and their colleges nationwide.

SC ATE continues to advance STEM faculty leadership development through its: 1) Dissemination of research on technician education; and 2) Development and dissemination of promising practices and evidence-based design and assessment throughout the broader academic and educational community. SC ATE has learned, through National Science Foundation (NSF) funding of applied research and development activities, that when faculty document and share their research and practices, they become stronger, more competitive **faculty leaders** for their students, peers, colleges, and communities.[5] When faculty are engaged with the scholarship of teaching and learning, they strengthen and develop themselves. They develop themselves personally and professionally as faculty leaders in the community—with and for their students, peers, and colleges.

Becoming aware of the literature on relevant topics and conducting research to learn what has been previously funded by the National Science Foundation Advanced Technological Education Program (NSF ATE) have become increasingly important in the development of competitive grant proposals. For many who teach at two-year technical and community colleges, this is a daunting task; to date, **there has been no one searchable database related to technician education**. The Compendium of Research on Technician Education – described in more detail below – has been created to meet this need.

The Compendium of Research on Technician Education

The Compendium is a database of targeted research content that supports, enhances, and provides information to facilitate the improvement of ongoing scholarship of teaching and learning. The power of the Compendium lies in the way it was created – using empirical, research-based methods to develop a comprehensive collection of information that underlies the on-line, searchable database.

Research Methods and Compendium Resources

The first step in the Compendium development process was creating a preliminary list of key search terms for use in identifying technician education research resources. The list was circulated to key stakeholders for feedback, resulting in the 49 search terms. (For the complete list, see www.teachingtechnicians.org). Next, the research team compiled a list of "searchable sources" for the Compendium. Including more than 30 NSF-funded Centers and Web Sites, as well as more than a dozen Scholarly Journals. (Note that the focus was technician education, rather than an attempt to include only loosely related topics.) This list of searchable sources was generated in the same manner as the list of key seach terms, expanding the list as the research progressed.

The team also identified researchers involved with ATE-related studies. This was used to search specifically in NSF's Fastlane for projects in which these researchers were involved. As of

December 2012, this included 62 individuals (For the complete list, see www.teachingtechnicians.org).

Collectively, these approaches were essential to executing the most comprehensive search for technician education research possible. Ultimately, 332 items were inputted into the Compendium database as of March 2013. See Table 1 and Figure 1 for the final breakdown of resources by categories.

Table 1. Resources Available in the Compendium of Research on Technician Education

Categories	Total # of items inputted
Book Chapter	2
Books	3
Briefing Papers	6
Brochure	2
Conference Papers	12
Executive Summary	1
Literature Review	2
Miscellaneous	7
NSF Awards	35
Journal / Peer Reviewed Articles	73
Presentations/Posters	58
Projects	33
Reports	88
Research Brief	2
Technical Reports	2
Thesis/Dissertation	1
White Papers	2
Working Papers	3
Total	**332**

Figure 1.
Breakdown of Resources in the
Compendium of Research on Technician Education
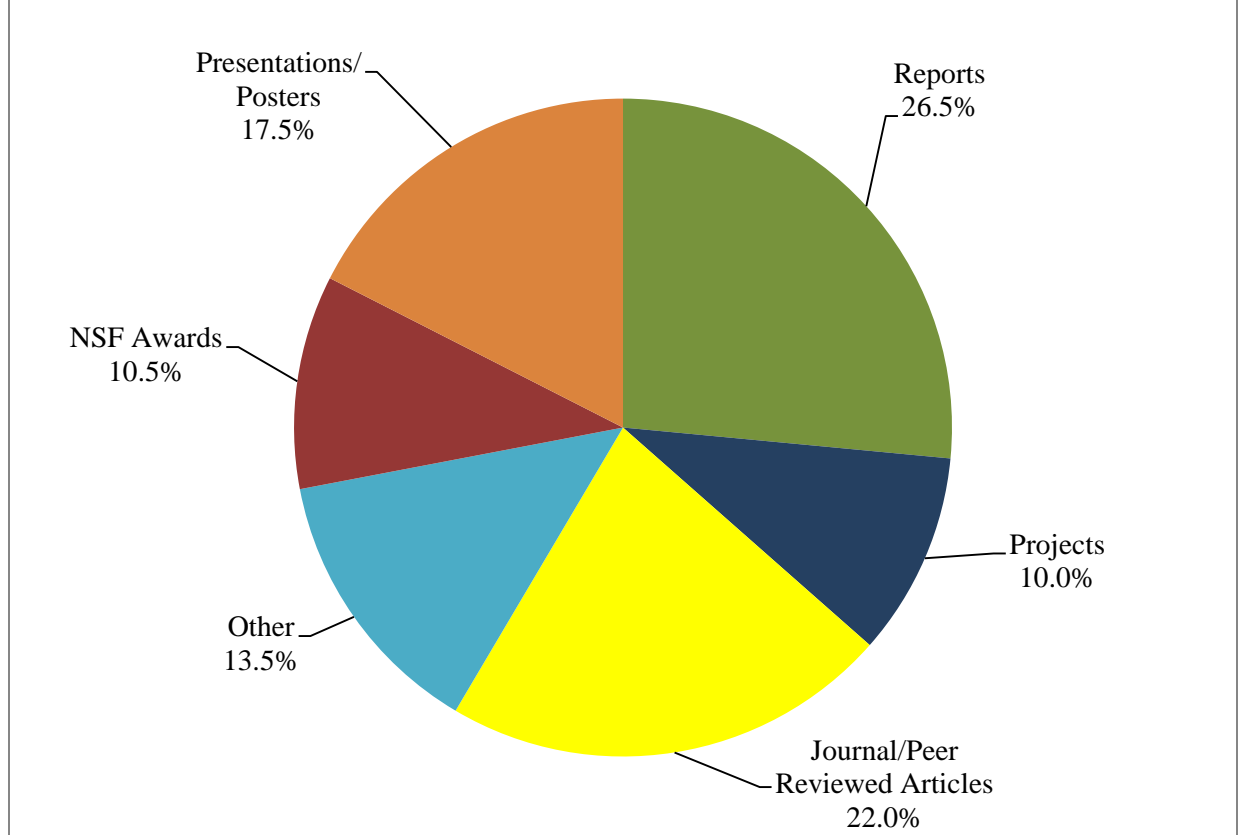
Within these major categories of resources is research on a broad spectrum of rich topics, including but not limited to: students, student recruitment, and retention; research on innovations in scholarship/teaching/learning; measuring student success and outcomes; effectiveness and sustainability of National Science Foundation-funded Advanced Technological Education (ATE) centers and projects; accessible, trending ideas for learner-centered programs; and problem-based learning methods such as case studies.

Using the Compendium of Research on Technician Education to Support Faculty Leadership

Defining Faculty Leadership

Initial research by SC ATE's project "Mentor-Connect: Leadership Development and Outreach Initiative for ATE," showed that much of the literature addressed the behaviors and traits needed by leaders in a variety of settings including education, but little information was found on the leadership skills specific to faculty leaders.

There was also limited information on the specific performance tasks required to develop faculty leaders. The following task analysis summary is excerpted from work in progress developed by Mentor-Connect that tentatively identifies the specific duties and tasks expected of ATE faculty leaders, the skills and knowledge required to perform those tasks, and the traits and attitudes that characterize ATE faculty leaders. The Mentor-Connect project team is in the process of further refining and validating this task analysis information with various ATE stakeholders.[6]

Faculty Leadership Task Analysis: Major Responsibilities & Specific Tasks

Faculty leadership skills and competencies can be defined along two dimensions: (1) increasingly more complex and demanding duties and tasks that competent leaders must perform; and, (2) the underlying traits and attitudes and key areas of enabling knowledge and skills that support performance of the required duties and tasks. While the context for the analysis presented below is centered on NSF grant implementation, it is understood that these same elements will be a part of the faculty member's role in the larger college organization in which s/he operates.

- Prepare Funding Proposals
- Build and Manage Grant/Project Teams
- Facilitate Meetings and Activities with Various Internal & External Team Members
- Perform Formal & Informal Leadership Roles and Responsibilities
- Prepare Various Communication Documents, Reports and Materials
- Maintain Positive Working Relationships with Internal and External Project/Grant Faculty, Staff, Administrators and Industry Partners
- Recruit Students, Faculty, Administrators, Staff Members, and External partners for Grant/Project Activities
- Perform Increasingly Complex Budget & Financial Management Responsibilities
- Develop a Positive Work Environment & Culture for Students & Faculty
- Develop & Implement Grant/Project Programs and Activities
- Evaluate Program/Grant Progress & Effectiveness
- Maintain Required Program/Grant Documentation and Records
- Provide Professional Development Opportunities For Yourself & Others

Traits & Attitudes

The traits & attitudes <u>most critical</u> to the development of increasingly more complex and demanding leadership skills include the following:

- A forward-looking philosophy that prepares one for change
- A willingness to take risks informed by research and data
- An entrepreneurial perspective on activities and opportunities
- A willingness to take ownership and personal responsibility for decisions

- A high value on Integrity and trustworthiness
- Flexibility and adaptability in implementing goals, objectives and activities
- Personal self-care and balance
- Driven to achieve excellence
- A visionary approach
- A yearning for learning
- Preoccupation with simplicity and innovation
- A change catalyst—wwilling to embrace change and challenge tradition and the status quo
- Personal charisma and Inspirational leadership–use power to influence, generate excitement, create a sense of purpose and right action
- Democratic approach – everyone has a voice
- Influence with respect – understands the power of diversity
- Demonstrate intellectual curiosity – calculated risk taker
- Emotional self-awareness coupled with accurate self-assessment and emotional self-control
- Self confidence
- Optimism

Knowledge & Skills

The key duties and tasks identified above imply the need for specific knowledge and skills to perform those duties and tasks effectively. In addition to the implied knowledge and skills from the duty and task statements above, those listed below are <u>most critical</u> to the development of increasingly more complex and demanding leadership skills.

- Understand the mission, vision, goals and values of community colleges, and how one's role supports them
- Understand the organizational structure of the community college, and the function that one's unit plays in supporting institutional goals achievement
- Organizational and time management
- Reading an institution's budget
- Understands that opportunity resides within challenge
- Strong presentation skills
- Being articulate
- Listening, speaking, writing and presentation skills
- Building Relationships/Negotiation skills
- Ability to transform old mental maps- critical thinking/thought leadership
- Creative Problem Solving
- Conflict management
- Turn disruption and challenge into opportunity

The Compendium of Research on Technician Education supports the development of a number of these core leadership skills and abilities. More effective use of current research within the engineering/engineering technology discipline for scholarship purposes is supported by this new research tool. In *A Short Supplement to A Future of Leadership Development*, Ken Williams make the following relevant points:

- For emerging leaders, it is usually smart to place an emphasis on stretch assignments and self-generated projects.
- Leaders should be armed with data.
- Leadership is largely about facilitating contribution.[7]

Navigating the On-line Compendium of Research on Technician Education

The user-friendly on-line Compendium is designed to be accessible and simple. The Compendium enables engineering/engineering technology faculty to mine research sources on technician education and expand their current knowledge base and practices.

The Compendium offers direct faculty access to the latest STEM and advanced technological education connections. With the Compendium, faculty leader colleagues can: 1) Expand their own knowledge base; 2) Inform and improve their teaching profession practice and scholarship; and 3) Use the research and content from the Compendium to develop and write competitive grants. Use of the Compendium can help faculty leaders develop themselves professionally through hands-on research and practices, and via dissemination to peers and/or peer reviews.

Searches within the Compendium can be tailored to specific program and/or course needs for up-to-date and pertinent models, examples, and implementation practices. Sample search/research entries range from: "Maximizing Retention in Engineering/Engineering Technology" to "Using Problem-based Learning to Modify Curriculum to Meet Industry Needs" to "Learning and the New Workplace: Impacts of Technology Change on Postsecondary and Technical Education."

The ability to customize searches can assist faculty in developing competitive grant concepts and strong, evidence- and research-based proposals. The Compendium enables faculty leaders to access and use the latest applied research on a comprehensive set of topics, tools, and sources. It supports faculty leaders conducting their own research; facilitates strategic literature reviews of other scholars/faculty leaders' contributions; and finally, delivers a wealth of application ideas and new knowledge (research-in-action) on programs, methods, and implementation strategies. In addition, faculty members can become active contributors to the Compendium, thereby expanding the body of knowledge generated and applied in the field, and gaining or expanding their own leadership skills.

SC ATE invites engineering/engineering technology faculty leaders to "play around with" the actual database at http://www.teachingtechnicians.org/Resources/PPP/. Just type in search words like "experiential learning" or "sustainability" or "evidence-based design," and explore the results.

Sample Screen Shots

To demonstrate how to conduct a search using the Compendium of Research on Technician Education, several screen shots are provided. This example is for a search for "females" using the Compendium:

Here are partial results of the search:

From the search, abstracts are identified that are available for reading and downloading:

2008 STEM Recruitment Survey

Summary

As part of our ATE grant (DUE # 0501971), we conducted a two-week online survey using SurveyMonkey.com in February 2008. Our sample for this survey consisted active ATE projects and centers funded under DUE in the 2006-2007 academic year. We required each grant in the sample to have started before 6/30/06 and been in operation until at least 12/31/06 to allow for the preparation of activities. Special grants concerning such topics as research, library collections, and planning grants, were excluded from the sample, because they were not expected to be doing recruitment. This left 202 projects and centers to which email invitations were sent. The final number of respondents participating in the survey was 81 of which 47 (58%) completed the entire survey. 10 emailed saying they do not target women specifically, and 8 more emailed with technical issues. We responded to the technical issues and encouraged those who experienced them to complete the survey. The total response rate for the survey was 45% (91 out of 202).

There were thirteen questions in the survey. The results of the first close ended question show that the majority of respondents recruit the following underrepresented populations: women specifically (71.4%), Blacks/Africans (61.0%), and Hispanics (58.4%). The results of the second close ended question show that the majority of respondents recruit students in high school (75.6%), followed closely with 2-year college students (59.0%), and people already in or

When engineering/engineering faculty use the Compendium, they demonstrate leadership by helping to sustain and invigorate the practice and profession of teaching in fields of advanced technology and related STEM disciplines. This is the essence of scholarship in teaching and learning. Scholarly teachers teaching and learning practices integrate evidence-gathering and reporting, research methods, and relevant standards with the discipline and profession. As faculty leaders use the Compendium and their own and others' state-of-the-art research, they advance scholarship, teaching, and learning, along with their own personal and professional practice.

Dissemination opportunities for faculty leaders to share good work can be local (within the advanced technology and related STEM department, college, or state) to regional and national (e.g., professional annual conferences). Scholarship results may be peer-reviewed and published for broader impact and contribution.

Benefitting from and Contributing to the Compendium

It is easy to benefit from, and contribute to, the Compendium of Research on Technician Education, and thus enhance and improve scholarship in teaching and learning practice. Here is the basic process for knowledge search, retrieval, and implementation for applied research and scholarship gains. Faculty leaders:

1) Decide what is relevant to their topic/program/discipline/grant proposal.
2) Discover what can be found in an active review of the literature.
3) Extract some jewels that can help inform their work; implement and assess them.
4) Raise research questions for future investigation and work. What to study next?

5) Share results, outcomes, and inquiries (new learning and achievement in practice) with peers and colleagues for broad impact.

It is vital to collaborate with others, present and disseminate with and through others. It takes the proverbial "village" of individuals/faculty leaders to advance and sustain scholarship in teaching and learning for generations to come. Engineering/engineering technology faculty can reap great benefit from an enhanced, informed approach to scholarship at the same time they can actively benefit from, and contribute to, the Compendium. In doing so, they participate in the wider community of scholars and educators.

The Compendium is designed to grow as the community of practice grows and adds value to the scholarship of teaching and learning, especially in relation to technician education.[6] Furthermore, it is organized to promote and support proven and promising practices among engineering and engineering technology faculty. With this growing database of easy-to-access and rich content of research on technician education, faculty can use the database and body of work, to inform and improve their practice. Further, faculty can develop and distinguish themselves, becoming an integral and active part of the legacy of work as the database is improved and expanded (future versions) over time. This ensures broad impact throughout the technician education community, led by faculty leaders sharing research and practices.

Conclusion

Current research suggests sharing knowledge and methods results in stronger leadership skills in educators. Those who lead are those who seek and use knowledge most effectively to create visions, respond to the changing world, learn from the work of others, update their knowledge/skills, etc. There is a new tool – the Compendium of Research on Technician Education– available to help technician educators to develop or improve leadership skills/traits in this area of using research to advance scholarship.

Using and expanding the Compendium supports the national picture on innovative technician education and the growing trend toward increased scholarship goals and activities among two-year college engineering/engineering technology faculty. Developing STEM faculty as faculty leaders within two-year colleges and programs can be a strategic and competitive direction for community colleges and the greater education community.

An ongoing and rigorous look into the scholarship of teaching and learning may well raise more research questions for future work. This is important and appropriate. It is incumbent upon engineering/engineering faculty to advance their own knowledge base and professional practice. Accessing and applying targeted research and knowledge gained from using the Compendium will help support faculty leaders, and engineering/engineering technology educators and their students nationwide. Additionally, evidence-based assessment and broad dissemination of

technician education outcomes and inquiries will help ensure broad impact of the Compendium and technician education research over time.

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