Essential Components of Doctoral Programs for Industrial Technology Education

Doctoral programs in industrial technology education (ITE) in the United States have received considerable attention and discussion in the literature during the past five decades. Research efforts by Buffer (1979), Kovac (1985), Miller (1984), Tan (1985), and Wolansky and Miller (1981) have contributed insights regarding the developments and changes taking place in doctoral programs over time. Others such as Beach (1991) are proposing possible new directions for doctoral programs.

Members of any discipline must have well-defined structures or taxonomies to use as a guide when developing new knowledge or examining current practices. The development or establishment of this structure requires the knowledge and skills gained in a doctoral program. Therefore, in order for members of the discipline to continue to advance it, doctoral programs in ITE must provide strong, effective leadership.

Currently, leadership within the field of industrial technology education is being provided, for the most part, by people who have doctoral degrees. For example, the membership of the committees within the International Technology Education Association is composed predominately of persons holding doctoral degrees. Moreover, 75% of the committee chairs within this organization have doctorates. It follows then that the doctoral programs preparing future leaders in the profession must provide the coursework and experiences that will achieve the desired results. To accomplish this end it is necessary for these programs to be based on consistent, well-defined mission statements and appropriate goals. Presently, each department offering a doctoral program creates its own mission statement, goals, and requirements. As a result, programs vary significantly.

The intent of our research was to identify the essential components of future doctoral programs in industrial technology education in the United States. The following two objectives were addressed in this study: (a) to identify and classify the major components of doctoral programs and (b) to identify content areas that could be used to form these major components.

METHODOLOGY

We used a modified Delphi technique to address these objectives. This technique has proven to be a successful method of addressing future needs and practices. Consensus building among knowledgeable participants is the primary activity of this technique. We utilized the following steps:

1. Develop questions regarding ITE doctoral programs.
2. Select panel.
3. Develop round-one instrument.
4. Analyze round-one responses.
5. Develop round-two instrument.
6. Analyze round-two responses.
7. Develop round-three instrument.
8. Analyze round-three responses.
9. Draft final report.

In order to assure appropriate representation, we identified the following categories of participants:

1. Faculty from ITE doctoral-granting institutions.
2. Male, female, and minority faculty and ITE doctoral program graduates.
3. Personnel from industry with ITE doctorates.
4. Experienced and recent (since 1986) ITE doctoral graduates.
5. Administrators of ITE programs.

To ensure representation from each of these categories, recommendations of potential participants were solicited from personnel at the doctoral-granting institutions listed in the 1990-91 *National Association of Industrial and Technical Teacher Educators (NAITTE) Directory* (Dennis, 1991). The researchers then created a prioritized list of potential participants based on the names provided. After contacting each potential participant, 16 were selected as respondents for this study. The criteria for selection were interest in the topic, availability, and representation of the appropriate groups.

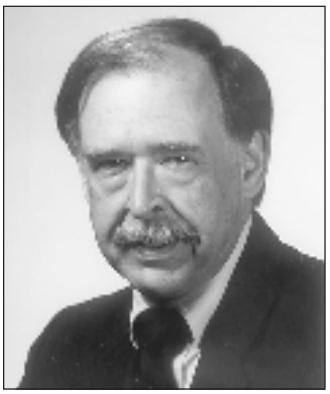
Figure 1 identifies the major tasks addressed during each of the Delphi rounds.

RESULTS

Each of the round-one responses was consolidated, classified, and placed in the appropriate category. The resulting items developed by this process were used to form the instrument for the subsequent rounds. The mission component categories were teaching, research, and service. The course categories were general education courses, courses within a major, research skill courses, and cognate or minor courses.

Mission Components

Once the primary mission components were identified by the Delphi panel, the perception



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ROUND	TASKS
1	a) Identify the teaching, research, and service components of a doctoral program's mission statement. b) Identify specific courses that are representative of doctoral program requirements. c) Identify desired behaviors that result from the completion of a doctoral program.
2	a) Rate on a Likert-type scale each of the desired mission statement components in teaching, research, and service. b) Rate the importance of the content areas for an ideal doctoral program. c) Rate the desired behaviors of graduates.
3	a) Categorize each of the mission components as either "essential/necessary," "useful/beneficial," or "marginally useful." b) Categorize each of the content areas as either "essential/necessary," "useful/beneficial," or "marginally useful." c) Categorize each of the desired behaviors as either "essential/necessary," "useful/beneficial," or "marginally useful."

***Figure 1*. Delphi rounds and associated tasks.**

of each member of the panel regarding the importance of each of the components was solicited. The results of the analysis of these data can be found under importance ratings on the right-hand side of Table 1. Research components were identified as the most important among those factors rated by members of the panel. Components dealing with teaching, advising, and program evaluation were perceived as being least important. Of lesser importance than research was the positive professional attitude component.

During round three, the members of the panel were asked to classify each item under "essential/necessary," "useful/beneficial," or "marginally useful." The responses to several of the items provided in round three sometimes conflicted with the original mean ratings calculated during round two. One of the most interesting conflicts was the first item under the "useful/beneficial" category in Table 1, which stated that the mission should "provide opportunities for students to interact with leaders at local, state, and national levels." The mean rating for this item in round two was 6.00. However, when asked to classify this item as either "essential/necessary," "useful/beneficial," or "marginally useful," the members of the panel felt that this item was not essential to a doctoral program. In addition, two items that had relatively low means but still were perceived by the panel as being essential to the program included (a) the dissemination of research results as they relate to classroom practices and (b) providing opportunities to review and summarize research on teaching.

It appears that the teaching components of the mission were rated somewhat lower than the research and service components. Perhaps this perception may be due, in part, to the expectation that teaching skills are the primary focus of the bachelor's or master's degree programs rather than the doctoral programs.

Course Content for Doctoral Programs

A similar approach was used regarding course content. During round two, importance ratings for each of the course content areas were gathered from the respondents and then analyzed. During round three, the respondents were asked to classify the course content areas under one of the three categories mentioned previously (see Table 2). Course content related to research was perceived as most important. Several content areas were rated as "marginally useful." These included business management, technical courses, and a foreign language. Experiences in these areas were not perceived as particularly valuable in doctoral programs.

Although receiving relatively low ratings, program assessment and evaluation, curriculum development, and history and philosophy were perceived as essential by the respondents during the third-round classification process. The converse was true regarding the analysis and synthesis of technology systems, proposal writing, and future applications of technology. These three items were rated relatively high, yet they were not perceived as essential.

The descriptors used for the course content areas included courses within the major, research courses, and general education courses. It is interesting to note that no items under general education content were perceived as being essential or necessary for the doctoral program. The research courses were perceived as being much more important than other courses. It appears that the essential elements of the coursework for doctoral programs should center around research design, statistics, and content within the major. This conclusion is reinforced by the respondents indicating a need for another area of course concentration outside the major in the form of a cognate or a minor.

Cognate or minor course content areas that were considered "essential/necessary" by the respondents for doctoral programs in ITE were statistics and research design. Other areas

Table 1

Mission Components Related to Teaching, Research, and Service For Doctoral Programs

Perceived Value	Item	Importance Ratings Mean	*SD*
Essential/ Necessary			
**	Develop a range of appropriate research skills.	6.67	0.62
**	Produce a quality dissertation and disseminate results.	6.67	0.62
***	Develop a positive professional attitude and desire to contribute to the future direction of the profession.	6.50	0.65
***	Promote active participation in professional associations, societies, conferences, committees, and other activities.	6.08	0.87
**	Enable students to become knowledgeable and critical consumers of research.	6.00	1.00
*	Develop leadership skills for use in educational and industrial settings.	5.91	1.04
*	Provide opportunities for improving teaching through research and experimentation.	5.83	1.21
*	Provide opportunities to design and devise instructional methodologies for teaching complex technological systems.	5.83	1.28
*	Disseminate research results as they relate to classroom practices.	5.50	1.04
*	Provide opportunities to review and summarize research on teaching.	5.36	1.03
***	Provide opportunities for students to interact with leaders at local, state, and national levels.	6.00	1.00
**	Prepare and present scholarly research papers.	5.83	0.80
**	Develop scholarly manuscripts for refereed journals.	5.75	0.92
**	Provide opportunities for enhancing effective communication skills.	5.58	1.04
*	Provide opportunities for acquiring a global perspective through familiarization with cultural implications and their impact on education.	5.58	1.04
**	Author or coauthor grant proposals.	5.27	1.29
*	Provide opportunities for critical analysis in the evaluation of teaching effectiveness.	5.25	1.69
***	Provide opportunities to serve as student members on departmental committees to acquire insight into university committee service.	5.00	0.71
*	Provide opportunities for directing and managing program evaluation.	4.83	1.28
*	Enhance pedagogical skills (teaching, advising, counseling).	4.81	1.70

* Teaching
** Research
*** Service

considered as "useful/beneficial" were technology and social change, management/administration, curriculum/instruction, and evaluation.

Research Component

The research component categories included those activities designed to help the doctoral student conceptualize, plan, implement, and report a research study. Although these activities may or may not be a part of formal coursework, they may be addressed by the major professor during the credits/hours for research that are a normal part of all doctoral programs. The product of this research component should be a dissertation produced by the student utilizing proper research techniques with a sufficient degree of effort to be classified as a quality contribution to existing knowledge.

The results of a research effort that culminates in a quality dissertation in ITE doctoral programs would enable the student to show evidence that he or she can (a) demonstrate problem-solving skills, (b) utilize quantitative research methods, (c) contribute to the body of knowledge of ITE, (d) employ a thorough literature review, and (e) utilize clear and concise communication.

As indicated in Table 3, the "useful/beneficial" requirements for a dissertation and/or other scholarly activity might include, among others, a qualitative research component and multiple publications in refereed journals.

Desired Behaviors for Program Completers

Behaviors that are essential for graduates to exhibit prior to completing a doctoral program in ITE are identified in Table 4. Foremost among those essential behaviors is the ability to think critically and reflectively. A philosophical foundation was considered the behavior least important of the essential items that should be exhibited by a graduate.

Table 2

Course Content Areas for Doctoral Programs

Perceived Value	Item	Importance Ratings Mean	*SD*
Essential/ Necessary			
**	Research design	6.58	0.64
**	Statistics	6.50	0.65
**	Professional writing	6.08	1.04
*	Problems and issues	5.83	0.99
*	Program assessment and evaluation	5.58	1.12
*	Curriculum development	5.42	1.16
*	History and philosophy	5.00	1.53
Useful/ Beneficial			
*	Analysis and synthesis of technology systems	5.83	1.07
**	Proposal writing	5.75	1.23
*	Future implications of technology	5.45	0.99
***	Evaluation	5.42	0.76
***	International studies	5.33	1.31
***	Curriculum	5.17	0.99
**	Technology assessment	5.16	1.68
***	History of technology	5.08	1.61
**	Invention and innovation	4.91	1.04
***	Instructional technology	4.58	1.61
***	Psychology	4.58	1.38
***	Teaching methods	4.50	1.26
*	Administration and supervision of ITE programs	4.42	1.19
***	Sociology	4.33	1.18
Marginally Useful			
***	Business management	4.75	1.74
*	Technical courses	3.64	1.43
***	Foreign language	3.00	1.85

* Doctoral program course content within the major
** Doctoral program research content within the major
*** Doctoral program general education content

Table 3

Research Component Categories for Doctoral Programs

Perceived Value	Item	Importance Ratings Mean	*SD*
Essential/ Necessary			
	Problem-solving skills (research methods)	6.50	0.65
	Quantitative research	6.33	0.75
	Contribute to body of knowledge of ITE	6.08	0.96
	Learn from existing research	6.00	0.82
	Clear, concise communication abilities should be a prerequisite to program	6.00	1.21
Useful/ Beneficial			
	Qualitative research	5.50	1.32
	Field research	5.42	1.11
	Interdisciplinary research	5.25	0.83
	Research and development yielding a product	4.92	1.55
	Multiple publications in refereed journals	4.08	1.55

Table 4

Desired Behaviors for Graduates of Doctoral Programs

Perceived Value	Item	Importance Ratings Mean	*SD*
Essential/ Necessary			
	Ability to think critically and reflectively	6.58	0.64
	Develop a professional attitude	6.58	0.64
	Enthusiasm for one's chosen career	6.58	0.76
	Formulate vision of future of ITE	6.50	0.65
	Ability to conduct research	6.50	0.76
	Scholarly and technical presentation abilities	6.50	0.76
	Understand research methodology	6.42	0.76
	Scholarly and technical writing ability	6.33	1.03
	Apply research findings to ITE field	6.25	0.92
	Analyze research	6.25	1.23
	Synthesize research	6.17	1.21
	Evaluate research	6.17	1.46
	Become knowledgeable in various forms of educational research	6.08	1.44
	Contribute to further development of ITE	6.00	0.91
	Interdisciplinary perspective of ITE	5.92	0.95
	Philosophical foundation	5.25	1.36
Useful/ Beneficial			
	Combine theory with practice	6.08	1.11
	Technological impacts on society	5.76	0.92
	Broad cultural and international perspective	5.58	1.04
	Understand emerging technologies	5.50	0.76
	Skills in curriculum development and articulation	5.50	1.04
	Management and leadership ability	5.42	1.26
	Understanding of historical basis for ITE	4.83	1.77

Behaviors identified in the last portion of Table 4 are those that were perceived as being "useful/beneficial" but not "essential" to quality doctoral programs. Combining theory with practice was perceived as being "useful"; however, when we examined the rating, it was higher than some of the "essential" items listed. An understanding of a historical basis for the field of ITE was perceived as being the least important within the "useful/beneficial" category. We can speculate that the respondents believe that the historical basis for ITE and perhaps other items under the "useful/beneficial" category may already have been adequately addressed during the master's and bachelor's programs.

RECOMMENDATIONS

This research can serve two purposes. First, it can serve as a benchmark for local administrators of doctoral programs in ITE for analyzing and improving their programs at the institutional level. Second, it can serve as a basic document that can be useful for longitudinal comparative research.

Industrial technology education was the focus of this research because it appeared to be the largest coherent discipline needing attention. There is a critical need for identification and clarification of the essential components of doctoral programs in ITE and related disciplines. A study such as this establishes a focus and appropriate parameters. Related disciplines such as vocational education or occupational education can also benefit from this work. With the exception of specific content areas, the remaining components of these doctoral programs appear to be similar.

We recognize that universities exercise considerable influence in maintaining quality graduate programs and that doctoral programs in particular are subject to critical institutional review. The majority of these programs are subject to internal, rather than external, review. This research was conducted to achieve consensus regarding doctoral program missions and principal components. The intent was not to create uniform programs but to determine how doctoral programs may be redirected to meet the contemporary needs of both students and the profession.

When reviewing existing doctoral programs, administrators may want to examine Table 1 in this document to help identify critical com-

ponents for their missions. The primary component must be research; however, secondary components may be identified from this list. Decisions regarding which components to include in a mission statement must be consistent with university formats and guidelines. Clearly, the principal component of the doctoral program mission must be research; however, an additional component that must be included is that of developing professional attitudes regarding our profession.

Doctoral program administrators also may want to examine Table 2 to identify course content areas for the formalized coursework that constitutes the doctoral program. The most important course content areas, again, appear to be those related to research design and statistics. Secondary, but necessary, components are those that relate directly to ITE.

The research component, in addition to the formalized coursework, must lead to a quality dissertation that both exhibits qualitative and quantitative skills and contributes to the body of knowledge in ITE. A thorough review of the literature and this study reveals that both oral and written communication skills are also extremely important in addressing the need to produce and report quality research.

Those desired behaviors for graduate doctoral programs listed in Table 4 would be useful when creating instrumentation to measure the effectiveness of particular doctoral programs. These items could be incorporated into measurement instruments, or they could direct the creation of other evaluation devices that determine the degree to which these behaviors are addressed by a particular doctoral program.

In summary, it appears clear that at this stage in the development of ITE programs, even leaders in the field are still grappling with inconsistencies in mission statements and desired outcomes. For example, when rating components dealing with interacting with leaders at local, state, and national levels and preparing and presenting scholarly research, the results (means) were fairly high. However, when classified, these items ended in the "useful/beneficial" category rather than the "essential/necessary" category. In addition, related to course content areas, an analysis and synthesis of technological systems and proposal writings were rated highly during round two, whereas during round three they were categorized at a lower level than "essential/necessary." One consistent factor among responses was a focus on developing a professional attitude and contributing to the body of knowledge related to ITE. These appear to be items that may not have been addressed adequately by existing doctoral programs.

Leadership within the field of ITE was rated low in desired outcomes. However, this may be one of the greatest needs in our field at this time. Those currently in leadership roles are most certainly providing the direction for ITE now and in the future. It is essential that doctoral programs provide prospective leaders with the experiences that help develop these necessary leadership abilities, assuring a bright future for ITE.

If members of ITE are to continue to develop this discipline and address the challenges of the future, doctoral-granting institutions must provide the leadership. This leadership must come in the form of providing programs that have a research focus directed toward contributing to the body of knowledge and that are aimed at developing and providing future leaders with the background and experiences that are needed to move the profession forward into the 21st century.

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