Journal of STEM Teacher Education

Volume 54 | Issue 1 Article 4

February 2020

The Impact on Technology and Engineering Education Programs Based on their Academic Homes

Ryan A. Brown
Illinois State University, rbrown@ilstu.edu

Recommended Citation
Brown, Ryan A. (2020) "The Impact on Technology and Engineering Education Programs Based on their Academic Homes," *Journal of STEM Teacher Education*: Vol. 54 : Iss. 1 , Article 4.
DOI: https://doi.org/10.30707/JSTE54.1/FULL6067
Available at: https://ir.library.illinoisstate.edu/jste/vol54/iss1/4

Journal of STEM Teacher Education
2019, Vol. 54, No. 1, 58-66

The Impact on Technology and Engineering Education Programs Based on their Academic Homes

Ryan A. Brown
Illinois State University

ABSTRACT

Technology and Engineering Education programs are housed in a number of different types of colleges and departments. This paper explores the curricular impact on technology and engineering programs based on the college and department that are the academic home for the program. The study found that there were four categories of colleges (Education, Technology, Engineering, and Arts and Sciences) and departments (Education, Technology, Technology Education, and Engineering) that serve as the academic homes of the 40 technology and engineering education programs that were examined. The plans of study for each program were examined and courses were divided into 12 codes within the categories of general education, content courses, and education and methods courses. An ANOVA was used to determine if any significant differences existed between the quantity of credit hours in each code and whether the program was housed in an education or non-education department. No significant differences in the coursework were found between programs housed in education departments and programs in non-education departments.

Keywords: Technology and engineering education; pre-service teachers

Over the past 20 years the literature has presented the reality of technology education programs closing at a worrying pace (Volk, 1997; Litowitz, 2014). In some cases, those programs that have remained open have shifted academic homes as they have moved from a technology department to a consolidated program within a college of education or otherwise. However, some programs have always lived in a variety of academic homes across college campuses in the United States.

The purpose of this paper is to explore the impact that the academic home has on technology and engineering education programs. To explore this topic, research has been conducted to compare the programs of study for active undergraduate technology and engineering education programs in relation to their academic home on their respective campuses. This study will help technology and engineering educators understand the relationship that exists between a technology and engineering education program and the college and department in which it resides.

Research Question and Methodology

The guiding question in this study is:

> Are technology and engineering teacher education programs more appropriately located in pure teacher education departments, or departments where the primary focus is not on teacher education?

Many approaches could have been taken to determine appropriateness, as it is both relative and subjective. Appropriateness could have been viewed through the eyes of students/graduates or faculty members or explored using graduate success and placement rates. This study, however, used coursework to provide a foundation for appropriateness and a source of comparison between the academic homes of technology and engineering education programs.

The resulting study is a quantitative analysis of the variances that exist in the plans of study of technology education programs based on their academic home. To conduct the study, a list of existing technology and engineering education programs was created. Each program was then researched to find the program name and their academic department/school and college (or similar depending on the institutional structure). Programs of study, course lists, and advising documents were then located and coded into 3 different categories (General Education, Content Courses, and Education and Methods) with several codes in each category (see Table 1). After all programs were coded and the quantity of credit hours in each code were calculated, a One-Way Analysis of Variance (ANOVA) was used to determine if there were any significant differences between the programs based on their academic home.

Table 1
Categories and Codes Used in the Analysis

General Education	Content Courses	Education and Methods
General Education	Technology Content	Technology Education Methods
Directed General Education	Industrial Technology Content	STEM Methods
	Design	Education Methods
	Engineering Content	Education Foundations
	Technology and Society	Student Teaching

The sample in this study includes 40 programs that certify teachers at the undergraduate level for technology and engineering education (or related) certification. Initially, 53 programs were examined. However, six of the programs on the initial list were either closed or are no longer accepting students and seven programs were MAT or Certification-Only programs. MAT or Certification-only programs were excluded from the study because the entire plan of study would not have been able to be determined and the program would not have been able to be analyzed in comparison with the full undergraduate programs.

Limitations

There are several limitations to this study that include:

- Only undergraduate programs in which all degree coursework could be determined were used in analysis. There may be different and innovative programs that were excluded from this study that reside at the Master's or Certification-Only level.
- The analysis is based solely on the coursework titles. The courses were coded based only on the titles in either the plan of study or the undergraduate catalog.
- No interactions were had with program faculty or students.
- While an attempt was made to include all technology and engineering education (or related) programs, some may have been unintentionally left out of the analysis.

https://ir.library.illinoisstate.edu/jste/vol54/iss1/4
DOI: https://doi.org/10.30707/JSTE54.1/FULL6067

Findings

The findings for this study include both the academic homes and their use as a factor of analysis in relation to the coding categories.

Academic Homes

The first tier of the academic home was determined for each program. This was the first level of division of the institution and in most cases, was either a college or school. This tier was grouped into four categories; Education, Technology, Engineering, Arts and Sciences. The quantity of each category and the titles it contains can be found in Table 2.

The second tier of the academic institutions was typically the department level. The following categories were created for second tier for each program: Education, Technology, Technology Education, and Engineering. The organization of the second tier can be seen in Table 3. The major analysis in this study was completed at the second-tier level by comparing the Education category with a master category that combined the other three non-education categories.

The last tier of the academic home that was examined was the program level. The names of each of the 40 programs were organized into four categories: Technology Education, Technology and Engineering Education, Industrial Technology and Career and Technical Education, and Engineering Education. Table 4 lists the categories and titles of the programs.

Table 2
First Tier Categories and Titles

Education (N=13)	Technology (N=15)	Engineering (N=7)	Arts and Science (N=5)
College of Education (x5)	Business and Technology Division	College of Engineering	College of Agriculture and Applied Sciences
College of Education, Health, and Human Development	College of Applied Science and Technology	College of Engineering and Technology (x2)	College of Arts and Sciences
College of Education, Health, and Human Sciences	College of Business and Applied Sciences	College of Science and Engineering	College of Arts, Sciences, and Professional Studies
College of Education and Health Professions	College of Business, Industry, Life Science, and Agriculture	College of Science and Engineering Technology	College of Humanities, Arts and Sciences
College of Education, Hospitality, Health and Human Services	College (or School) of Business and Technology (x3)	School of Engineering	School of Professional Studies
College of Education and Professional Studies	College of Science and Technology (x2)	School of Engineering, Science and Technology	
School of Education (x2)	College of Science, Technology, and Mathematics		
Teachers College	College of Technology (x4)		
	Polytechnic Institute		

Table 3
Second Tier Categories and Titles

Education (N=7)	Technology (N=17)	Technology Education (N=6)	Engineering (N=10)
Department of Curriculum and Instruction (x3)	Applied Technology Division	Career and Technology Teacher Education Department (x2)	Applied Engineering, Safety, and Technology
Department of Education	Department of Applied Technology	Department of Family, Consumer, and Technology Education	Department of Agricultural Sciences and Engineering Technology
Department of Middle, Secondary, and Adult Education	Department of Industrial Studies	Department of STEM Education	Department of Applied Engineering and Technology (x2)
Department of Secondary Education and Foundations	Department of Technological Studies	Department of STEM Education and Professional Studies	Department of Applied Engineering and Technology Management
School of Education	Department of Technology (x6)	Department of Teaching Leadership and Innovation	Department of Technology and Engineering
	Department of Technology & Workforce Learning		Engineering Technologies, Safety and Construction
	Environmental and Technological Studies		Engineering Technology
	Industrial Technology Department		School of Engineering (x2)
	School of Applied Sciences, Technology and Education		
	School of Technology		
	Tech and Applied Science Department		
	Technology and Applied Design Department		

https://ir.library.illinoisstate.edu/jste/vol54/iss1/4
DOI: https://doi.org/10.30707/JSTE54.1/FULL6067

Table 4
Program Categories and Titles

Technology Education (N=18)	Technology and Engineering Education (N=17)	Industrial Technology and CTE (N=4)	Engineering Education (N=1)
Technological Studies	Engineering and Technology Education (x15)	Career and Technical Education	Engineering Education
Technology Education (x16)	Technology Engineering and Design Education (x2)	Industrial Technology Education (x3)	
Technology Teacher Education			

Coursework Analysis

The coursework was analyzed and will be presented in three categories: General Education, Content Courses, and Education and Methods Courses.

General Education. General education courses were present in each program that was analyzed. Two codes were used to analyze general education courses. The first code "GE" was used for general education courses that were required for all Bachelor's degree students at each institution. In most cases these were not specific courses but were categories in which the students were required to earn a specific amount of credit hours. The second general education code was "GE+" which was used for directed general education courses. GE+ courses were typically specific math, science, or psychology courses that were required general education courses for education majors. Table 5 provides descriptive statistics related to GE codes. The ALLGE code is a code that was created by combining GE and GE+ to determine the total of GE courses required in that program.

Table 5
General Education Descriptive Statistics

Codes	*N*	*Min*	*Max*	*M*	*SD*
GenED	40	22	55	38.65	6.439
GenEDPlus	40	0	18	4.93	5.609
AllGE	40	34	55	43.58	5.344

The GE codes were analyzed using an ANOVA to determine if there was a significant difference between the number of general education courses taken in programs housed in education departments compared to non-education departments. As seen in Table 6, no significant differences were found.

Table 6
One-Way Analysis of Variance of General Education Codes by Department

Code	*Source*	*SS*	*df*	*MS*	*F*	*p*
GenED	Between Groups	1.126	1	1.126	.026	.872
	Within Groups	1615.974	38	42.526		
	Total	1617.100	39			
GenEDPlus	Between Groups	3.468	1	3.468	.108	.745
	Within Groups	1223.307	38	32.192		
	Total	1226.775	39			
AllGE	Between Groups	8.546	1	8.546	.294	.591
	Within Groups	1105.229	38	29.085		
	Total	1113.775	39			

Content Courses. The content courses category was used for courses that were non-general education courses that provided content knowledge to students, but that were not educational methods or clinical courses. Five different codes were used in this category to differentiate between the types of content courses that were required in each program. When a program required content area electives in which students could select from a list, the number of credit hours required were coded as "TE/C" which served as both a code for any technology content course and a content elective course. Specific courses that were coded as TE/C included courses such as Transportation Systems, Construction Systems, Manufacturing Systems, and Communication Technology. Content courses that were more traditional in nature, such as Metals Technology, Welding, and Ag. Mechanics were coded as Industrial Technology Content (IT/C). Courses that involved design, such as CAD, Architectural Drawing, and Engineering Graphics were coded as Design Courses (TE/D). Engineering content courses (E/C) included courses that are traditionally taught in engineering programs such as Statics, Dynamics, and Thermodynamics. The final content code was Technology and Society (TE/S) which included Technology and Society and Technology and the Future course titles. Table 7 provides descriptive statistics related to Content codes.

Table 7
Content Course Descriptive Statistics

Codes	N	Min	Max	M	SD
TEC	40	2	39	24.73	7.867
ITC	40	0	32	4.80	7.697
TED	40	0	18	7.75	3.801
EC	40	0	38	1.88	6.178
TES	40	0	9	1.52	2.172
AllC	40	15	55	31.40	8.022

https://ir.library.illinoisstate.edu/jste/vol54/iss1/4
DOI: https://doi.org/10.30707/JSTE54.1/FULL6067

The Content codes were analyzed using an ANOVA to determine if there was a significant difference between the types of Content courses taken in programs housed in education departments compared to non-education departments. As seen in Table 8, no significant differences were found.

Table 8

One-Way Analysis of Variance of Content Course Codes by Department

Code	*Source*	*SS*	*df*	*MS*	*F*	*p*
TEC	Between Groups	.148	1	.148	.002	.962
	Within Groups	2413.827	38	63.522		
	Total	2413.975	39			
ITC	Between Groups	42.140	1	42.140	.706	.406
	Within Groups	2268.260	38	59.691		
	Total	2310.400	39			
TED	Between Groups	3.128	1	3.128	.212	.648
	Within Groups	560.372	38	14.747		
	Total	563.500	39			
EC	Between Groups	11.431	1	11.431	.294	.591
	Within Groups	1476.944	38	38.867		
	Total	1488.375	39			
TES	Between Groups	9.291	1	9.291	2.021	.163
	Within Groups	174.684	38	4.597		
	Total	183.975	39			
AllC	Between Groups	90.016	1	90.016	1.414	.242
	Within Groups	2419.584	38	63.673		
	Total	2509.600	39			

Education and Method Courses. The Education and Method courses category was used for courses that focused on classroom instruction. Five codes were used in this category to differentiate between several types of Education and Methods courses. The first code, Technology Education Methods (TE/M) includes courses in technology education, technology and engineering education, and career and technical education that focus on classroom teaching methods and/or have clinical hours in technology classrooms. Course titles in this code included Curriculum in Technology Education, Technology and Engineering Education Methods, and Teaching Engineering and Design. The STEM Methods code (STEM/M) was used for methods and/or clinical courses that specifically listed STEM education in the title. Only 8 of the 40 programs had at least one course that met the requirements of this code. The Educational Methods (ED/M) code was used for courses in general methods, assessment, and classroom management that were not content-specific such as Educational Evaluation and Strategies and Teaching Literacy in Secondary Schools. Educational Foundations (ED/F) courses included non-clinical diversity courses and educational psychology courses. The Student Teaching code (ED/ST) was used for student teaching hours and any related seminars that occurred in the student teaching semester. Table 9 provides descriptive statistics related to Content codes.

Table 9
Education and Method Courses Descriptive Statistics

Codes	*N*	*Min*	*Max*	*M*	*SD*
TEM	40	3	21	10.70	4.778
STEM	40	0	11	.85	2.082
EDM	40	0	24	12.02	5.859
EDF	40	0	12	4.57	2.827
EDST	40	6	19	11.75	2.488
AllED	40	9	42	28.35	7.499

The Education and Method codes were analyzed using an ANOVA to determine if there was a significant difference between the types of Education and Methods courses taken in programs housed in education departments compared to non-education departments. As seen in Table 10, no significant differences were found.

Table 10
One-Way Analysis of Variance of Education and Methods Codes by Department

Code	Source	*SS*	*df*	*MS*	*F*	*p*
TEM	Between Groups	34.426	1	34.426	1.528	.224
	Within Groups	855.974	38	22.526		
	Total	890.400	39			
STEM	Between Groups	1.507	1	1.507	.342	.562
	Within Groups	167.593	38	4.410		
	Total	169.100	39			
EDM	Between Groups	38.057	1	38.057	1.112	.298
	Within Groups	1300.918	38	34.235		
	Total	1338.975	39			
EDF	Between Groups	2.805	1	2.805	.345	.560
	Within Groups	308.970	38	8.131		
	Total	311.775	39			
EDST	Between Groups	1.310	1	1.310	.207	.652
	Within Groups	240.190	38	6.321		
	Total	241.500	39			
AllED	Between Groups	31.793	1	31.793	.559	.459
	Within Groups	2161.307	38	56.877		
	Total	2193.100	39			

Conclusions and Implications

This study provides information regarding the location of technology and engineering teacher education programs in pure teacher education departments, or departments where the primary focus is not on teacher education. The study was approached through use of programs of study as a representation of the experiences that students have in each program. In terms of the courses that

https://ir.library.illinoisstate.edu/jste/vol54/iss1/4
DOI: https://doi.org/10.30707/JSTE54.1/FULL6067

students in technology education (and related) programs take, there is no significant difference between programs housed in education departments and programs in non-education departments.

This may be due to the amount of control that institutions and state licensing boards have on degree programs. Most, if not all, institutions have a set number of general education courses that students must take. While, at the same time programs must make sure that they are meeting the credit hour requirements that are placed on them from the state level. That leaves very few credit hours to use in innovative ways and still make sure that the students meet both the general education and certification requirements so that they can both graduate and be certified to teach.

One implication of the conclusions, however, is that in an era of consolidation and movement of programs (often making the choice to restructure over closure) the academic home of the program does not make a significant difference in terms of the types of courses that students complete in their technology teacher education program. This is certainly not to say that there are not challenges or impacts on other aspects of the program or faculty (i.e. resources, tenure, faculty morale). I recommend that additional research be conducted to examine other aspects of appropriateness in relation to the academic home of technology and engineering education programs. Studies of resource allocation, faculty expertise, and graduate retention could all be potential avenues for additional research.

References

Litowitz, L. S. (2014). A Curricular Analysis of Undergraduate Technology & Engineering Teacher Preparation Programs in the United States. *Journal of Technology Education*, *25*(2), 73-84.

Volk, K. S. (1997). Going, Going, Gone? Recent Trends in Technology Teacher Education Programs. *Journal of Technology Education*, *8*(2), 66.

Author

Ryan A. Brown
Professor
Illinois State University, School of Teaching and Learning
Email: rbrown@ilstu.edu