Technology and Engineering Education Accommodation Service Profile: An Ex Post Facto Research Design

Technology and engineering educators have an opportunity to serve a vital role in contributing to or assisting in the guidance of educational programming for students qualifying for accommodation services. Specifically, students identified as having categorical disabilities or Limited English Proficiency (LEP) may have transitional goals (Plotner, Trach, & Shogren, 2012), adaptive instructional needs (Fasting, 2010), positive behavior support requirements (Thelen & Klifman, 2011), or other necessary academic accommodations.

The Individuals with Disabilities Education Act (IDEA) identifies 13 different categorical disabilities: (1) autism, (2) deaf-blindness, (3) deafness, (4) emotional disturbance, (5) hearing impairment, (6) intellectual disability, (7) multiple disabilities, (8) orthopedic impairment, (9) other health impairment, (10) specific learning disability, (11) speech or language impairment, (12) traumatic brain injury, or (13) visual impairment (National Dissemination Center for Children with Disabilities, 2012). The IDEA specifies that an individual cannot be identified under a disability service category due to English reading, comprehension, or speech if it is not his or her primary language for communication. However, alternative services are extended to students with LEP until a level of English proficiency is achieved to participate meaningfully in standard educational programming (U.S. Department of Education, Office for Civil Rights, 2005). Similar to students with disabilities, students with LEP have special testing and academic accommodations.

Accommodation services are vast in array for students with categorical disabilities and LEP, but all encompass necessary academic adjustments that are essential to the educational participation of students qualifying for assistance. Academic modifications can include prolonged time on assessments and involve the provision of supplementary supports and aids. Auxiliary support services include “note-takers, readers, recording devices, sign language interpreters, screen-readers, voice recognition and other adaptive software or hardware for computers, and other devices designed to ensure the participation of students with impaired sensory, manual or speaking skills in an institution’s programs and activities” (U.S. Department of Education, Office for Civil Rights, 2011, p. 4).

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Tavakolian & Howell (2012) note a broader educational subgroup category, at-risk students, which is inclusive of students with disabilities and LEP. *At-risk students* are described as students who are susceptible to non-continuation of academic studies stemming from both school-based and individual factors. Further, at-risk students have an elevated prospect of academic failure and are from special populations. According to the Carl D. Perkins Career and Technical Education Improvement Act of 2006, *special populations,* as a student subgroup, are defined as:

- Individuals with categorical disabilities;
- Individuals from economically disadvantaged families, including foster children;
- Individuals preparing for non-traditional fields;
- Single parents, including single pregnant women;
- Displaced homemakers; and
- Individuals with limited English proficiency. (p. 7)

Within this article, students referred to as at-risk were from two specific special populations within this group, individuals with disabilities and individuals with limited English proficiency.

"Legislation and the inclusion movement have not just relocated children from self-contained to inclusive classrooms. The movement has had a serious impact on the roles and responsibilities of teachers. General educators are responsible for the performance of growing numbers of diverse students in their classroom" (Green & Casale-Ciannola, 2011, p.12). Teachers in inclusive settings generally support the degree of student access to learning experiences that inclusion requires; however, teachers typically identify themselves as unprepared to deliver instruction to students with disabilities or students requiring educational intervention (Bender, 2008; Bender, 2002; Bender & Shores, 2007). However, outside of disabilities services, the necessary resources and support for these subgroups have not been provided to the level required.

The speculative shift in enrollment patterns of these students is becoming a reality (Green & Casale-Ciannola, 2011), although discipline specific and content area prevalence is largely unreported. Additionally, "for an undetermined reason, students identified as at-risk exhibit tendencies to engage in technology education courses" (Ernst & Moye, 2013, p.11). This elicits the questions: What is the typical service load (number of students taught) of technology and engineering teachers of regarding students with at-risk indicators (specifically, categorical disabilities and LEP)? Also, are there specific course offerings within technology and engineering education that have higher service loads for at-risk students than others?

Research Questions

The purpose of this study was to determine the normative service capacity of technology and engineering teachers for students qualifying for accommodation services and to investigate potential service load differences based on course offerings. Using the most currently available Schools and Staffing Survey results, two guiding research questions were explored:

1) What is the typical service load of a technology and engineering educator pertaining to students who qualify for accommodation services (identified as having a categorical disability or classified as having Limited English Proficiency)?
2) Are there differences among specific categorical course offerings within technology and engineering education regarding service load for students who qualify for accommodation services (identified as having a categorical disability or classified as having Limited English Proficiency)?

Research Question 1 was investigated through frequency and proportional accounts of weighted technology and engineering education teacher reports of students with identified categorical disabilities and LEP whom they taught within the duration of a single academic year. Research Question 2 was explored through testing associated investigational hypotheses:

a) There is no difference in service load (categorical disability and LEP) of technology and engineering educators teaching manufacturing technology and construction technology courses.
b) There is no difference in service load (categorical disability and LEP) of technology and engineering educators teaching communication technology and construction technology courses.
c) There is no difference in service load (categorical disability and LEP) of technology and engineering educators teaching communication technology and manufacturing technology courses.
d) There is no difference in service load (categorical disability and LEP) of technology and engineering educators teaching general technology education and construction technology courses.
e) There is no difference in service load (categorical disability and LEP) of technology and engineering educators teaching general technology education and manufacturing technology courses.
f) There is no difference in service load (categorical disability and LEP) of technology and engineering educators teaching general technology education and communication technology courses.

This research examined collective and stratified technology and engineering educator service load regarding students with categorical disabilities and LEP through secondary dataset analysis. The 2007–2008 Schools and Staffing Survey (SASS), administered by the National Center for Education Statistics (NCES), was chosen as the dataset for this this study largely due to the intricacy and size of the information provided. Use of this dataset allowed for weighted identification and analysis between offerings regarding accommodation services of technology and engineering educators from a national perspective.

Instrumentation

The SASS is conducted by the NCES "on behalf of the U.S. Department of Education in order to collect extensive data on American public and private elementary and secondary schools. SASS provides data on the characteristics and qualifications of teachers and principals, teacher hiring practices, professional development, class size, and other conditions in schools across the nation. SASS is a large-scale sample survey of K–12 school districts, schools, teachers, library media centers, and administrators in the United States" (Tourkin et al., 2010, p. 1).

"SASS was designed to produce national, regional, and state estimates for public elementary and secondary schools and related components (e.g., schools, teachers, principals, school districts, and school library media centers); national estimates for [Bureau of Indian Education] BIE-funded and public charter schools and related components (e.g., schools, teachers, principals, and school library media centers); and national, regional, and affiliation strata estimates for the private school sector (e.g., schools, teachers, and principals)" (p. 9). "Therefore, SASS is an excellent resource for analysis and reporting on elementary and secondary educational issues" (p. 1).

The "SASS consisted of five types of questionnaires: a School District Questionnaire, Principal Questionnaires, School Questionnaires, Teacher Questionnaires, and a School Library Media Center Questionnaire" (p. 2). This study used data from the SASS Teacher Questionnaire to address the research questions. Because "the overall objective of SASS is to collect the information necessary for a comprehensive picture of elementary and secondary education" (p. 2), the SASS Teacher Questionnaire component was used "to obtain information about teachers, such as education and training, teaching assignment, certification, workload, and perceptions and attitudes about teaching" (p. 6).

Participant groups for this study were defined as General Technology, Manufacturing Technology, Communication Technology, and Construction Technology teachers. The groups were defined by teacher responses to SASS Question 15: "This school year, what is your MAIN teaching assignment field at THIS school?" Their responses were given a numerical code by SASS interviewers indicating their main teaching subject area. The researchers chose the four codes that corresponded most closely to the target participant groups.

The number of students with categorical disabilities and LEP for each teaching group was examined in this study. To determine the number of students with categorical disabilities, the researchers used teacher responses to SASS Question 13: "Of all the students you teach at this school, how many have an Individualized Education Program (IEP) because they have disabilities or are special education students?" Likewise, to determine the number of students with LEP, the researchers used teacher responses to SASS Question 14: "Of all the students you teach at this school, how many are of Limited English Proficiency? (Students of Limited English Proficiency [LEP] are those whose native or dominant language is other than English and who have sufficient difficulty speaking, reading, writing, or understanding the English language as to deny them the opportunity to learn successfully in an English-speaking-only classroom)."

Methodology

The methodology in this study is based upon a similar study (Ernst, Li, & Williams, 2014) on Engineering Design Graphics, which also used the SASS dataset . This current study consisted of a secondary analysis of the dataset from the SASS administered by the NCES. Initial access was applied for and authorized by the NCES. The access provided a member of the research team at Virginia Tech with designated single-site user admittance of the restricted user data license. Specific protocol and reporting information was submitted and subsequently accepted, and the NCES authorized approval and release. With the SASS dataset, 52,140 instances populate within the weighted SASS results for technology and engineering education. The two research questions for this study were explored through the 52,140 instances within the SASS outcome datasets. For the purpose of analyses, technology and engineering educator results were both categorically merged for an overall profile (Research Question 1) and stratified by offering (Research Question 2). This permitted not only overall service load identification for technology and engineering educators but also the investigation of specific categorical course offerings pertaining to service load identification.

Participants for this study were four identified groups of public school teachers: Communication Technology, Construction Technology, Manufacturing Technology, and General Technology. The primary variables of interest in this study were the number of students with categorical disabilities or LEP served by the participant teacher groups. The number of students with categorical disabilities served was determined by responses from teachers who reported teaching students with recognized disabilities requiring an individualized education program. The number of students identified as having LEP was determined by responses from teachers who reported teaching students who did not speak English as their primary language and who had a limited ability to read, speak, write, or understand English. Data from the SASS items for these groups were extracted and analyzed using descriptive statistics and independent sample *t*-tests. Independent sample *t*-tests were conducted to determine if there was a statistically significant difference in the mean number of at-risk students served for teachers who identified their primary teaching assignment as Communication Technology, Construction Technology, Manufacturing Technology, or General Technology in public schools.

The *t*-test for independent samples was selected because each group's observations were independent and not influenced by the other group's observations. This resulted in six *t*-test comparisons between the four teacher groups. Because "SASS was designed to produce national, regional, and state estimates for public elementary and secondary schools and their related components" (Tourkin et al., 2010, p. 9), the reported results were obtained from using a balanced repeated replication procedure utilizing 88 replicate weights as required by SASS for statistical analyses. Descriptive information is provided in Table 1.

Table 1
Descriptive Information for Teacher Areas

	Const. Tech.	Manuf. Tech.	Comm. Tech.	General Tech.	Total Technology
Weighted Sample	10,130	3,100	8,170	30,740	52,140
Mean Years Experience	12.30	12.69	13.28	15.58	14.41
Male	9,430	2,970	4,520	22,710	39,620
Female	700	130	3,650	8,030	12,510
Mean Categorical	9.78	14.21	10.64	16.87	14.51
Mean LEP	2.90	2.75	3.80	6.66	5.24
Mean Service Load	12.68	16.96	14.44	23.53	19.75

Note. Weighed sample values are rounded to the nearest 10 per IES protocol.

Data Analysis and Findings

General Technology teachers, on average, had a higher mean service load ($M = 23.53$, $SD = 24.53$) than Construction Technology ($M = 12.68$, $SD = 13.27$), Communication Technology ($M = 14.44$, $SD = 12.13$), and Manufacturing Technology ($M = 16.96$, $SD = 16.33$). There were statistically significant differences found when comparing General Technology and Construction Technology, $t(88) = 3.51$, $p < .001$, and when comparing General Technology and Communication Technology, $t(88) = 2.66$, $p < .009$. These results show that General Technology teachers have a higher average number of students with categorical disabilities and LEP when compared to Construction Technology and Communication Technology teachers than would have been expected due to chance. No statistically significant differences were found in any of the other comparisons. Table 2 shows descriptive accounts of the subject areas regarding at-risk students, and Table 3 displays the results from the *t*-test analyses.

Table 2
Subject Area Comparisons for Students At-Risk

Subject Area	Weighted *N*	Mean At-Risk Students Per Teacher	*SE* (Mean)	Stan. Dev.	Min.	Max.
Comm. Tech.	8350	14.44	1.76	12.13	0	95
Const. Tech.	9900	12.68	1.72	13.27	0	69
Manuf. Tech.	3140	16.96	2.75	16.33	0	120
Gen. Tech.	31330	23.53	2.78	24.53	0	140

Note. Weighed sample values are rounded to the nearest 10 per IES protocol.

Table 3
Results from t-Test for At-Risk Comparisons

Subject Area Comparison			*M* Diff.	*SE* Diff.	*df*	*t*-value	*p*
Gen. Tech.	–	Comm. Tech.	9.09	3.41	88	2.66	0.009*
Gen. Tech.	–	Const. Tech.	10.859	3.10	88	3.51	0.001*
Gen. Tech.	–	Manuf. Tech.	6.57	4.18	88	1.57	0.120
Manuf. Tech.	–	Comm. Tech.	2.51	3.17	88	0.79	0.430
Manuf. Tech.	–	Const. Tech.	4.27	3.37	88	1.27	0.208
Comm. Tech.	–	Const. Tech.	1.76	2.22	88	0.79	0.430

*$p < .05$

Limitations of the Study

The SASS instrument results, and therefore this study, are dependent upon individual responses to target questions and perception-based options. Although cross-referenced for accuracy among items, the results were organized from self-reported/structured interview prompts. Weighted values were applied during analysis of results to control for nonresponse as well as specific participant bias. This process factors established estimates of the population of interest, specifically technology and engineering educators. Additionally, the analyses and findings are based on a single point in time. However, the SASS instrument administration is ongoing with periodic dataset updates.

Conclusions

The findings of this study offer specific insight pertaining to accommodation service responsibilities of technology and engineering educators. The restricted use license, granted by NCES, permitted the generation of a population-based profile of service load. Offering a complete spectrum of service load accountability provides an authentic glimpse into not only enrollment patterns and the student population in technology and engineering education but also the breadth of duty for technology and engineering educators. Specifically, the breadth of duty illuminated through this study is the quantity of students with categorical disabilities and LEP whom technology and engineering educators teach and the associated instructional and environmental demands that are necessary for a quality inclusive educational experience.

The analysis of data in this study indicated technology and engineering educator service load ranging from 0 students to 140 students per academic year. Also, based on collective analysis there was a somewhat elevated mean service load (19.75) pertaining to students identified as having categorical disabilities or LEP, which answers Research Question 1: What is the typical service load of a technology and engineering educator pertaining to students who qualify for accommodation services (identified as having a categorical disability or classified as having Limited English Proficiency)?

Significant differences in service load were identified between (a) General Technology Education and Communication Technology and (b) General Technology Education and Construction Technology. This finding corresponds to Research Question 2: Are there differences among specific categorical course offerings within technology and engineering education regarding service load for students who qualify for accommodation services (identified as having a categorical disability or classified as having Limited English Proficiency)?

Recommendations

The makeup of these student populations, including specific subgroup identification, directly factors in instructional decisions, course structures, and even proposed course sequences. Core or “base” educational practices are should be further adapted to academically and socially engage learners to promote robust student experiences and an overall strong educational climate. Instructional approaches, practices, and processes are to be continually evaluated in terms of student receptivity and academic effectiveness. Academic, behavioral, psychological, and social disengagement are cited factors of school detachment (Hammond, Smink & Drew, 2007). The determination of best practices suitable for a specific educational environment and student group largely depends upon learner aspirations, needs, and preferences. These have the potential to greatly vary from course to course as well as from student to student. Given these expectations, there is an expanding knowledge set and skill base for technology and engineering educators concerning accommodation services.

In relation to study follow up and recommendations for research, there are preparatory and retention elements associated with the education of students with disabilities and LEP and at-risk students that merit specific investigation given their prospective impact. Aside from immediate classroom-based factors and implications, there are also educator variables. In addition to general demographic considerations, we also need to consider retention, support, and teacher learning. STEM educator retention is an identifiable issue in current K–12 education. Is this exacerbated by preparedness to educate students with categorical disabilities and LEP or lack thereof? Is this consistent across STEM education disciplines? Are there ample professional development offerings within technology and engineering education, or STEM education in general, specific to the education of students with categorical disabilities and LEP or students at-risk? Additional examination of these questions, within the context of educators of at-risk students and related subgroups, will assist in building a technology and engineering educator profile that professional development providers, professional associations, higher education, and other interested parties may structure to support offerings that are relevant, balanced, and timely.

Considering the established propensity of students with at-risk indicators to engage in technology and engineering education coursework paired with the approximated service load of technology and engineering educator service load for students with categorical disabilities and LEP, there are significant practitioner implications. Among these are abilities to manage, monitor, and adjust instruction; adapt curricula; manage behavior; and create an accessible environment (both physical and instructional). Continued pursuit of teacher learning opportunities to further prepare for effective engagement with students with categorical disabilities and LEP is important in equipping teachers for future progressions of inclusive settings. Finally, collaborative work with special education and English as a second language teachers can assist in providing learner specific accommodations, thus heightening the impact of technology and engineering education for students with at-risk indicators.

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