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Message from the Chair

Dennis K. Lieu
University of California at Berkeley

When talking to ordinary people, the term “graphical communication” usually conjures up images of paper media with static drawings or charts. This interpretation, however, is only a subset of conveying information by (what can be more accurately described as) “visual” means. The terms “graphical” and “visual” became synonymous due to the tools and techniques that were historically available to create such presentations. Throughout history, the wider purpose of visual communication has been to transmit the maximum amount of information possible in the shortest time possible, with as great an understanding as possible and with as few errors possible. We have obviously evolved beyond traditional media. The ever increasing power of computing and display technologies have initiated searches for new, more effective way to communicate visually, as well as new applications for visual communication tools. CAD, for example, was developed by computer scientists in research laboratories, but has now gone main-stream. We cannot imagine engineering design today without the use of this wonderful tool. Paper media seems to be slowly disappearing, replaced by other visual media, including three-dimensional and time-based presentations in the form of, for example, augmented reality and virtual reality on electronic and holographic displays. Although currently used mostly for presentation of geometry, visually-based three and four dimensional presentations can also be extended to the organization, retrieval, and interpretation of data.

Our Division must place itself in a position develop and implement these technologies, and use them to their full advantage in engineering design when they go main-stream. I can already see this happening, as articles that are being submitted to this *Journal* are slowly turning from studies on tools for building three-dimensional models toward techniques for higher level visual communication and understanding this type of communication. The variety of new topics being presented at our conferences and submitted to our *Journal* is refreshing and exciting, and we must do our best to encourage more of this material. I’ll even go as far as proposing that we reconsider using the terms “graphics” and “graphical” in our Division Bylaws and even in the name of our Division to relieve us of the historical burden that these terms carry, and to encourage a broader scope and mission for our Division. This proposal seems to be an appropriate challenge for next year’s Board of Officers for the Division, led by incoming Chair Kevin Devine, and supported by Lulu Sun who is new to the elected Board as the Director of Communications.

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Thank you for your support this past year. I hope you can attend the 69th Annual Midyear Conference at Illinois State University in Normal, IL, where the site Chair will be Kevin Devine and the Program Chair will be Judy Birchman.

Dennis K. Lieu

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Message from the Editor

Robert A. Chin
East Carolina University

Thanks to the Engineering Design Graphics Division's membership, the *Engineering Design Graphics Journal* continues to publish a sufficient number of manuscripts, and it continues to be a viable means for members of the Division and other readers to stay current with news of the Division and leading practices and trends in graphics education. I would, however, like to encourage the Division and its members and other readers to continue reaching out to colleagues, especially those who may not necessarily be Division members, and encourage them to submit their manuscripts to the *Journal* for publication.

The effect we should be attempting to achieve is the pursuit of a broader number of ways for communicating visually. I think we all recognize that others possess different ways of looking at problems, different skill sets, and many different ways of approaching problems. With the assistance of others' insight we can achieve a synergy that we would otherwise not be able to achieve on communicating visually.

While I'm on the submission bandwagon and within the context of the aforementioned, let's help our colleagues submit their manuscripts. Recall that the submission process requires us to LOG IN—see Figure 1.

Figure 1. *Engineering Design Graphics Journal* Homepage.

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Logging in however requires one be a site user. If one is not a site user, they must REGISTER with this site—see Figure 1.

After registering as a site user and logging in, we can begin the submission process by clicking on USER HOME—see Figure 2, and then Author > START A NEW SUBMISSION. The Section in which all new feature article manuscripts are submitted is Articles—see Figure 2.

Figure 2. The Submission Process.

Finally, while the *Journal* use to publish EDGD Mid-Year Conference papers, we no longer do so because the papers are available through the Division's website—see http://edgd.asee.org/conferences/proceedings.htm. Moreover, the publication of conference papers in the *Journal* now distorts what is being done and can result in copyright violations—see http://www.apa.org/pubs/authors/openletter.pdf.

However, because conference papers are more often than not considered to be reports on the current status of projects or other works in progress, they are considered semiformal means of disseminating findings. The formal means include dissemination in journals and other periodicals and books and suggests that projects and other works are complete. So, if the status of projects and other works in progress was presented at a Mid-Year Conference or any other conference, and the work is now complete, you're encouraged to present and share your findings by means of the *Journal*.

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EDGD Calendar of Events

Future ASEE Engineering Design Graphics Division Mid-Year Conferences

69th Mid-Year Conference - October 12-14, 2014, Illinois State University
Site Chair - Kevin Devine.

70th Mid-Year Conference - January 24-26, 2016, Embry-Riddle Aeronautical University
Site Co-Chairs - Heidi Steinhauer and Lulu Sun.

Future ASEE Annual Conferences

Year	Dates	Location
2014	June 15 - 18	Indianapolis, Indiana
2015	June 14 - 17	Seattle, Washington
2016	June 26 - 29	New Orleans, Louisiana
2017	June 25 - 28	Columbus, Ohio
2018	June 24 - 27	Salt Lake City, Utah
2019	June 16 - 19	Tampa, Florida
2020	June 21 - 24	Montréal, Québec, Canada

If you're interested in serving as the Division's program chair for any of the future ASEE annual conferences, please make your interest known.

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Secondary Engineering Design Graphics Educator Service Load of Students with Identified Categorical Disabilities and Limited English Proficiency

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Abstract

The ever-changing student population of engineering design graphics students necessitates broader sets of instructor adeptness. Specifically, preparedness to educate and provide adequate educational access to content for students with identified categorical disabilities and Limited English Proficiency (LEP) is now an essential readiness skill for engineering design graphics educators at the secondary level (see Appendix A for a full list of acronyms). Through the School and Staffing Survey Teacher Questionnaire (SASS TQ), engineering design graphics educator service load results for students with disabilities and LEP were identified. Of specific note was the upward service load trend between the 2007-2008 SASS TQ and the 2011-2012 SASS TQ and the implications for high school engineering design graphics courses, learning environments, and teacher abilities.

Introduction

Engineering design graphics coursework and curricula at the secondary level provides an essential foundation in supporting the further student development of engineering graphics competencies and abilities in higher education. Additionally, this foundation is of particular importance to students currently studying or having the intention to concentrate study in a STEM content area at the post-secondary level (Busby, Ernst, & Clark, 2011). However, schools continually struggle, with current learning environments and methods of instruction, in extending full educational access to all students (Shaw, 2011). To offer the educational benefit to learners that are directly applicable to further education and career preparedness, it is necessary to make classroom activities and assignments accessible and impactful to all learners from all backgrounds. Even with this goal, curricula and structure may prohibit full access for certain learner groups within secondary engineering design graphics classrooms.

Increasing numbers of students with disabilities and students who speak English as second language are included in regular courses (Burgstahler, 2011). The number of individuals in the United States with Limited English Proficiency (LEP) increased by 80 percent from 1990 to 2010 (Pandya, Batalova, & McHugh, 2011). Individuals with Disabilities Education Act (IDEA) listed 13 different disability categories under which 3-through 21-year-olds may be eligible for services, including 1) autism; 2) deaf-blindness; 3) deafness; 4) emotional disturbance; 5) hearing impairment; 6) intellectual disability;

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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 (including blindness) (National Dissemination Center for Children with Disabilities, 2012).

Under IDEA, LEP is not considered as a type of disability. "Individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand English can be limited English proficient, or LEP" (Federal Coordination and Compliance Section [FCS], 2011, para. 1). LEP students vary academically, in their motivation to learn, in parental support, and other personal and academics support capacities. Some do not achieve an adequate writing or reading literacy, or lack knowledge of English (Canney, Kennedy, Schroeder, & Miles, 1999). However, these individuals are rightfully entitled to language assistance in the classroom (FCS, 2011). In special education services, educators take responsibility of consultation, special education assignment assistance, and collaborative teaching in daily tasks; furthermore, they are also expected to host observations in special education settings, conduct collaborative problem solving, and provide information related to IEPs (Individualized Education Programs) and behavior management (Voltz, 2001). To meet the needs of these students with LEP or categorical disabilities, teachers may consider applying universal design features to adapt courses in insuring that lectures, discussions, visual aids, videos, printed materials, labs, and fieldwork are accessible to all students (Burgstahler, 2011). "Providing adaptive instruction requires that alternate means of instruction are matched to students on the basis of knowledge about each individual's background, talents, interests, and past performance" (Wang, 1980). Adaptive education approaches, through which the learning outcomes of students with special needs could be improved, have been noted by researchers and practitioners as a promising alternative approach for accommodation (Leiding, 2009). In an effective adaptive instruction program educators typically direct efforts toward diagnosis and monitoring of student learning progress, and design and conduct a variety of activities and classroom management strategies to adapt to student interest and needs as well as the school resources and requirements (Wang, 1980). With longstanding and contemporary approaches and adaptations for students with LEP and categorical disabilities, it is still unclear what the individual service load capacity, and subsequently the degree of accommodation expectation, is for in-service engineering design graphics educators.

Research Questions

The purpose of this study was to determine the average academic service load of engineering design graphics teachers of students identified with categorical disabilities or LEP. Additionally, the study examined increases, if any, in teacher at-risk service load over the past four years. Through the use of the two most recent Schools and Staffing Surveys (2007-2008, 2011-2012), the following research questions were explored:

1) What is the typical service load of an engineering design graphics teacher concerning students at-risk identified as having a categorical disabilities and Limited English Proficiency (LEP)?

2) Is the at-risk service load of engineering design graphics teachers increasing or decreasing in frequency?

This secondary dataset analysis provided weighted descriptive and frequency-based accounts of current and historical prevalence of engineering design graphics teacher service to students identified as at-risk.

Instrumentation

The Schools and Staffing Survey (SASS) is conducted by the NCES on behalf of the United States 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.

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 BIE (Bureau of Indian Education) 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). Therefore, SASS is an excellent resource for analysis and reporting on elementary and secondary educational issues (Tourkin et al., 2010).

SASS consists of five questionnaires: School District Questionnaire, Principal Questionnaire, School Questionnaire, Teacher Questionnaire (SASS TQ), and a School Library Media Center Questionnaire. The researchers specifically chose the public school 2007-2008 SASS TQ and the 2011-2012 SASS TQ as the instruments for the purpose of this study. The SASS TQ was designed to collect information on teachers' education and training, teaching assignment, certification, workload, professional development, perceptions and attitudes about teaching, and income from school and non–school jobs. There were in total 75 items in the 2007-2008 SASS TQ and 85 items in the 2011-2012 SASS TQ.

In this study, the participants who gave a subject-matter code as 246 (CADD and Drafting) to question number 15 in the 2007-2008 SASS TQ and corresponding question16 in the 2011-2012 SASS TQ, "This school year, what is your MAIN teaching assignment field at THIS school?" were identified as engineering graphics design teachers. To fulfill the purpose of the research and specifically address the research

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questions, data derived from question number 13 and 14 of the 2007-2008 SASS TQ and corresponding questions number 14 and 15 from 2011-2012 SASS TQ were analyzed. Data used to determine teacher service load concerning students with categorical disabilities were derived from the question, “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, data used to determine teacher service load concerning students with LEP were derived from the question, “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.)” Teachers checked none or entered an integer for each question.

Methodology

This study consisted of a secondary analysis of the SASS TQ dataset administered by the NCES. Initial access was applied for and authorized by the NCES to Virginia Tech. The access provided a member of the research team with designated single-site user admittance. Specific protocol and reporting information was submitted and subsequently accepted, where the NCES authorized approval and release.

With the 2007-2008 SASS TQ, 10,120 instances populate within the weighted results for engineering design graphics education. For the 2011-2012 SASS TQ, 12,240 instances populate within the weighted results for engineering design graphics education. The NCES and IES require that weighted all *n*’s be rounded to the nearest 10 for SASS to assure participant anonymity. Therefore data in tables and narrative may not add to the total N reported because of rounding requirements.

The two study research questions were explored through the 10,120 and 12,240 instances within the two SASS datasets. For the purpose of analyses, Engineering Design Graphics Educator results were categorically summarized and represented in terms of service load of students with categorical disabilities (Research Question #1) and students with LEP (Research Question #2). The primary variables of interest in this study were the number of Categorized and limited English proficiency (LEP) students served by the participant teacher groups. The number of categorized students served was determined by responses from teachers who reported teaching students with recognized disabilities requiring an individualized education plan. The number of students identified as LEP was determined by responses from teachers who reported teaching students who were individuals 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 2007-2008 SASS TQ and the 2011-2012 SASS TQ items for this group was extracted and analyzed using descriptive statistics. Demographic information regarding the race and gender of the participants was also tabulated.

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Results

Based on the 2007-2008 SASS TQ data, engineering design graphics teachers in high school were selected to form a weighted case dataset of 10,130 and 12,240 engineering design graphics teachers formed a weighted dataset from the 2011-2012 SASS TQ. Demographic information about participant gender, and race was collected through the survey and is reported for the purposes of establishing a demographical make-up of participants. The percentage of participants who were male or white were notably larger than that of the other groups for the 2007-2008 SASS TQ data and the 2011-2012 SASS TQ data. More detailed information on teacher demographics is identified in Table 1.

Table 1

Engineering Design Teacher Demographics by SASS TQ Year

		Year 2007-08	Year 2011-12
N		10130	12240
Gender n – (%)	Male	9430 – (93.1%)	11470 – (93.7%)
	Female	700 – (6.9%)	770 – (6.3%)
Race n – (%)	White/Caucasian	9120 – (90.1%)	11620 – (95.0%)
	Black/African American	810 – (8.0%)	480 – (3.9%)
	Asian	20 – (0.2%)	80 – (0.7%)
	Pacific Islander	0 – (0%)	0 – (0%)
	American Indian	160 – (1.6%)	170 – (1.4%)
	Hispanic	120 – (1.2%)	620 – (5.1%)

NOTE: IES requires that sample sizes be rounded to the nearest 10 for each variable listed, therefore, items listed in the rows may not equal the total N.

The service load of secondary engineering design graphics educators pertaining to education of students at-risk identified as having a categorical disability or having LEP was gauged by the SASS TQ datasets. The service load of secondary engineering design graphics educators concerning 2007-2008 SASS TQ students with categorical disability on average (mean=9.56, median=8) was identifiably larger than that concerning LEP students (mean=3.19, median=0). Both categories represented a considerable proportion of the total number of students served by engineering design graphics teachers (mean=69.41, median=68). This is similar within the 2011-2012 SASS TQ data report. With a total service mean of 72.39, engineering design graphics educators reported students with categorical disabilities having a collective mean of 12.45, students with LEP having a mean of 3.58, while both calculated medians are unchanged from the 2007-2008 SASS TQ data. The service load varied greatly in different classrooms among the two datasets with most educators in this study reporting that they did not have LEP students in their classes. This is further demonstrated with identical maximum service load and range of service load frequencies. Table 2 provides details of the 2007-2008 SASS TQ and the 2011-2012 SASS TQ educators reported service loads.

Table 2

Total, Categorical and LEP Service Load

Student Group	Mean	Median	Std. Deviation	Range	Maximum
Students Served 2007-08	69.41	68	52.805	226	234
Categorical Disability 2007-08	9.56	8	8.595	50	50
LEP 2007-08	3.19	0	11.013	67	67
Students Served 2011-12	72.39	59	.539	262	262
Categorical Disability 2011-12	12.45	8	12.556	90	90
LEP 2011-12	3.58	0	10.061	110	110

Conclusions and Implications

Teachers have encountered inclusive environments and incorporated modifications for students with disabilities for years (Bateman & Linden, 1998; Tomlinson, 1995). In this current study, teacher's service loads for 2007-2008 SASS TQ students with categorical disabilities was identified as 9.56 on average while service load on LEP students was 3.19 on average and this increased for the 2011-2012 SASS TQ analysis. The total average service load for both categories was 12.75 during the 2007-2008 SASS TQ data and 16.03 during the 2011-2012 SASS TQ data. In extreme cases, teachers addressed almost a whole class of students with categorical disabilities and/or with LEP. The teachers who had large service loads likely require higher degrees of academic accommodations within their classrooms and may be required to seek alternative support services.

According to the descriptive analysis of demographic information, 83.2%-90.1% (at least 83.2% and at most 90.1%) of cases among the weighted sample of engineering design graphics educators were white males. The large percentage of single group represented a lack of diversity in the team of engineering design graphics instruction. Teacher's diversity was called to increase (H. Yopp, R. Yopp, & Taylor, 2012). Although currently in most engineering design graphics classrooms, the educators did not have LEP students as reported, the increase of LEP residents was significant (Pandya, Batalova, & McHugh, 2011). When teachers went into classrooms with students who were not English proficient, the challenge of language and cultural barriers were considerable.

Adaptive curriculum and pedagogy are needed to meet student learning needs. Both in-service teachers and pre-service teachers need to be aware of and adapt to the ongoing shift. On the other hand, teacher preparation programs and professional development programs might involve diversity education in order to further enhance teacher performance in the classroom.

Teacher‘s awareness of inclusive classroom should be heightened and strengthened. Principles and applications of universal design need to be embedded into teacher education and professional development programs. Pre- and in-service teachers need to be aware of and be able to apply alternative approaches as well as new technologies that facilitate the accessibility of students with categorical disabilities and LEP. Furthermore, to shift the paradigm of teaching is an essential but difficult work for teachers to conduct adaptive instruction to students with categorical disabilities and LEP. Instructors may often claim that they have difficulties in adjusting pedagogy due to lack of time and resources, or in understanding and implementing new concepts, or in seeing the effect on students from culturally, socio economically, and academically diverse backgrounds (Shaw, 2011). Therefore, opportunities of exposure to diverse settings should be created for teachers through professional development and teacher preparation programs. Easily accessible resources such as handbooks, websites, and the training of using them for instruction could be provided to teachers. Exemplary models in this discipline and those determined to be transferable, should be shared among teachers in a collaborative peer support climate.

Adaptive curriculum does not necessarily rely on additional classroom technologies. More commonly, differentiated instruction and collaborative activities without requirement of much alteration to the physical setting could provide accommodations in inclusive classrooms. To adapt to the learning needs of all the learners in such inclusive classrooms, Universal Design (UD) is considered as an effective approach that enables educators to design and teach their courses in ways that make learning accessible to all learners (Michigan State University, 2013).

In the approach of universal design for instruction (UDI), teachers seek to create an appropriate learning environment for all students, which benefit those with disabilities and LEP as well as other students. In engineering graphics design classes, teachers could assign students to design groups to accomplish design project with peers. Through collaboration, students strengthen ability and bypass the barriers resulting from disabilities or language. Also, multiple representations of meaning should be provided in graphics (2D/3D), process simulations, written words, and spoken language in order to adapt to student ability and preference of gathering information. Clear and complete instruction as well as assigned materials should concern the level of language literacy of students. LEP students from different cultural backgrounds may not be familiar with some common objects or events in American daily life. When determining topics for their design projects, teachers may consider allowing students to choose topics that they are interested in (Dolan & Hall, 2001). Likewise, Shaw (2011) identified that teachers should allow students to express opinions and demonstrate knowledge via multiple means, for example, oral presentation/written examination, in-class/take-home assignments and examinations, exercises, group projects, tutorials, and web searches (See Table 3 for recommendations to improve teaching).

Table 3

Recommendations to Improve Teaching of Engineering Design Graphics to the Students with Categorical Disabilities and LEP

Aspects	Approaches
Teacher preparation and professional development	Raise the awareness of inclusion Being exposed to diverse settings Peer sharing and supporting
Universal design strategies	Assign pair/group projects to students Employ multiple means of representations Provide clear and complete instruction and assigned materials Allow self-selected topics of student's interest Encourage alternative expression/reporting means

Different types of learning preferences (visual, aural, reading/writing, kinesthetic, and multiple) also affect the engagement and performance in engineering design graphics courses. Visual learners are engaged and learning is enhanced by traditional presentation methods, however students identified as kinesthetic and multimodal learners, which contribute a considerably large part of the population, may not receive such advantages (McGrath & Brown, 2005).The adaptive curricula design targets underserved students as well as benefits students in general and should be considered for engineering design graphics curricula to improve student engagement and motivation in the inclusive environment (Clark & Ernst, 2012). In essence, what is beneficial for groups of students with categorical and disabilities and LEP is also beneficial for the general population within engineering design graphics courses.

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Appendix A. List of Acronyms

2D/3D: Two dimensional/Three dimensional
BIE: Bureau of Indian Education
CADD: Computer–aided design and drafting
FCS: Federal Coordination and Compliance Section
IDEA: Individuals with Disabilities Education Act
IEP: Individualized Education Program
LEP: Limited English Proficiency
NCES: National Center for Education Statistics
SASS: School and Staffing Survey
SASS TQ: School and Staffing Survey Teacher Questionnaire
STEM: Science, Technology, Engineering, and Mathematics
UDI: Universal design for instruction

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