Infusing a Collaborative and Pervasive Approach to Information Literacy at the United States Coast Guard Academy

Hudson Jackson[1], Alina M. Zapalska[2], Sharon Zelmanowitz[3]

[1,2,3]United States Coast Guard Academy

([1]Hudson.V.Jackson@uscga.edu, [2]Alina.M.Zapalska@uscga.edu, [3]Sharon.Zelmanowitz@uscga.edu)

Abstract- Information literacy education creates opportunities for self-directed and independent learning where students become engaged in using a wide variety of information sources to expand their knowledge, construct knowledge, ask informed questions, and increase their critical thinking skills. This approach is evident in the increasingly widespread introduction of student centered constructivist pedagogy such as inquiry based, problem based, and resource based learning. As academic institutions respond to the challenges of developing and enhancing their information literacy initiatives, it is imperative that faculty, librarians, and administrative staff work in collaboration. The paper presents an integrated approach of teaching and assessing information literacy at the United States Coast Guard Academy, with specific examples from the Civil Engineering Program.

Keywords Assessment, education, engineering, information literacy, library services

I. INTRODUCTION

Information Literacy (IL) has become an important element of undergraduate education in response to the growing number of information sources. Developing information literacy competency is critical for students' continued professional career and lifelong learning [1]. Most studies on IL advocate the integration and development of IL skills across curricula and recommend application of these skills in real-life situations across various assignments, research papers, and presentations [2]. Specifically, customized IL programs at any college level benefit students by moving them from basic IL skills to a higher level of IL confidence, fluency, and proficiency. Initiatives can be instilled throughout the curriculum and could morph into IL educational instruction that ranges from an undergraduate to a graduate program experience [3].

IL instruction has been developed across all eight majors at the United States Coast Guard Academy (CGA). Some of the IL initiatives have been introduced and used by individual faculty members for several years and are now integrated throughout the CGA curriculum across all majors. The development of IL at CGA is fully supported by the library staff. Since the initial development of the program, several changes to the curriculum across various courses within all majors have been accomplished. The IL objectives are based on the Association of College and Research Libraries (ACRL) outcomes that were adopted for the development and assessment of students from freshman to senior year. The IL program is regularly assessed for continuous improvement. As the amount and reliability of available information changes, CGA students are expected to continuously improve their abilities to learn how to find, organize, evaluate, and select information that is available from various sources.

The major goal of this paper is to present an approach to IL, that can be integrated and implemented in any undergraduate program, with a focus on IL modules, outcomes, and assessment tools. The paper also discusses a framework and development strategy for IL education that includes: IL competencies, IL library instruction, IL across curriculum, evidence of student learning of IL skills, resources for assessment of IL skills, and beyond the library.

II. INFORMATIOIN LITERACY BACKGROUND AND PURPOSE

The concept of IL originated in 1914 [4]. Since that time, the term has gone through numerous changes in its definition, application, and assessment. As computer technology advanced, information available to students increased and access improved, it became vital to tie fundamental concepts of learning skills across all fields to the development of of IL skills. Cox and Lindsay [5] argue that IL supports development of critical thinking skills, reflection skills, and independent learning skills in the context of the increasingly extensive amounts of information that is available through a wide range of technologies, sources, and modes. These skills are required as they enable students to access and navigate the growing spheres of information, to appropriately select credible and reliable information, to read critically and think independently as they create their own ideas, and to use that refined information in a variety of venues.

According to the literature on IL, some of the attributes of an information literate individual include the ability to: (1) obtain and use information; (2) make use of available technologies, (3) acquire and use all other available resources effectively to find and manage information, and (4) critically evaluate and ethically apply that information to solve a problem and conduct basic research analysis. Other characteristics of an information literate individual include the spirit of inquiry and perseverance to find out what is necessary to get the job done. Some authors define IL as a skill or learning tool, others refer to information attitude or study and research skills or how to think critically, but all definitions of

IL contain some common elements [6, 7, 8]. Each definition mentions possession of an integrated set of skills, knowledge of resources from which to retrieve information and the ability to analyze and use information [9, 10]. A standard definition of IL that is widely used was established by the ACRL and it defines IL as: *"...a set of abilities requiring individuals to recognize when information is needed"* and an *"ability to locate, evaluate, and use effectively the needed information"* [11].

Some of the most relevant and important aspects of information literacy from the literature review are summarized below:

- IL is seen as the domain of librarians, but research shows that collaboration between librarians and faculty is crucial for successfully producing information literate students. IL principles become most meaningful in the context of a discipline, so librarians and instructors from all disciplines must work together [12].
- Integrating IL principles into the research and writing process empowers students by teaching them expert-level skills in their information use. -By nature it makes writing a deliberate and process-based endeavor. Students often report that IL-based exercises make them feel confident, creative, and proficient [13, 14].
- Assessment of student learning is most meaningful when it is reliable and consistent. Assessment with rubrics has been shown to be a viable and effective option for authentically assessing IL based student work. Rubric assessment of writing samples has shown that this approach results in better organization of thoughts and information use, selection and interpretation, and consequently better writing overall across all disciplines.
- IL competencies at the undergraduate level are required by several accreditation agencies such as ABET. These accreditation requirements ensure that academic programs provide students with the tools needed to develop IL skills.
- In practice, IL can be taught either as an independent course or integrated into several courses within an academic major. However, it is more effective when IL is implemented and used across all courses from freshman through senior year [15].

III. INFORMATION LITERACY DEVELOPMENT STRATEGIES USCGA

As being information literate is an important skill that all students must develop, there are several strategies that have been proposed. After recent review of the core curriculum at CGA, there was consensus to infuse IL across core and program specific courses throughout the curricula. Information literacy is one of several curricular threads being developed in conjunction with a new core curriculum at CGA. Students will be progressively and consistently provided with opportunities to develop and enhance IL skill throughout their college education. As a result, the CGA has developed an IL education program that is similar to the model proposed by Indiana

University. The following section presents the strategy that has been adopted by some of the programs in the Engineering Department at CGA. The programs developed an IL education strategy that consists of six key components illustrated in Figure 1.
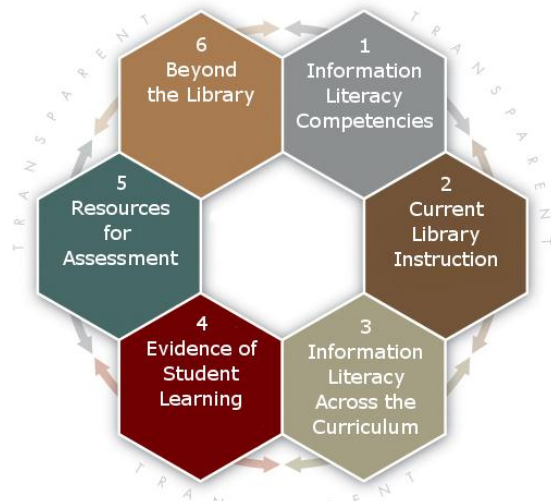

Figure 1.   IL Development Strategy (Source: Indiana University https://www.ulib.iupui.edu/research/infolit/niloa_1)

As presented in Figure 1, in order to effectively facilitate IL, an educational program, academic institutions should determine and agree on: (1) IL Competencies; (2) Current Library Instruction; (3) IL Across Curriculum; (4) Evidence of Students Learning; (5) Resources for Assessment; and (6) Beyond the Library. In addressing this strategy, implementation examples will be drawn from the CGA Civil Engineering Program. The goal is to enable students to develop and master strong analytical, critical thinking, problem-solving and research skills. Faculty members are responsible for collaborative efforts across all courses throughout CGA. All IL efforts are communicated among all majors for reliability and consistency and the process is coordinated and supervised by the CGA Information Literacy Committee.

A. IL Competencies

In order to determine the appropriate IL competencies, the CGA has adopted a working definition of IL that is provided in Figure 2. This definition was recommended by the CGA library staff and has been in use across all majors at CGA for the last several years.

National Forum's definition of Information Literacy:
"the ability to know when there is a need for information, to be able to identify, locate, evaluate and effectively use that information for the issue or problem at hand."

Figure 2.   IL National Forum Definition of Information Literacy [16]

The CGA has also adopted the Association of College and Research Libraries' (ACRL) seven competences. According to the ACRL, an IL student is someone who can: (1) determine the extent of information needed; (2) access the needed information effectively and efficiently; (3) evaluate information and its sources critically; (4) incorporate selected information into one's knowledge base; (5) use information effectively to accomplish a specific purpose; (6) understand the economic, legal, and social issues surrounding the use of information; and (7) access and use information ethically and legally [17]. As all these competencies are critical for development of IL skills, the CGA IL approach guarantees that those skills are developed across the curriculum so that every graduate is IL competent. These competencies are tiered expectations for freshman, sophomore, junior, and senior levels. The introduction and practice of IL standards across CGA curricula has been accomplished through librarian-led sessions, classroom lectures, activities, and modules related to research and writing assignments that have been carefully crafted to ensure that students are developing and mastering IL competencies and skills.

B. Current Library Instruction

Librarians have the primary responsibilities of facilitating access to information resources and providing instruction on how to use those resources. As such, access to the appropriate library resources plays an important role in helping students develop and enhance their IL skills. One challenge faculty face in building IL skills in students is to acquaint them with available library resources and how to intelligently utilize them [18]. Therefore, librarians should be active partners with faculty in the effort to promote IL and help students develop those skills.

The mission of the CGA Library is to support the Academy's educational and training missions by providing quality library services, resources, and facilities to the students, faculty, and staff. Freshman students are required to attend a library skills session where they are introduced to the library research process and shown how to find books and reference materials, and use general and multi-subject databases. The information on those sessions is built upon and expanded during the freshman year in English and History course when students are provided instruction on search strategies, specialized databases, and primary sources in order to complete a specific assignment. Beyond the first year, the library staff provides IL service at the request of faculty and can include in-class sessions of discipline specific resources and resource guides tailored to a single course. Librarians at CGA play a very active role in not only providing access to information, but also working with faculty to promote IL.

C. IL Across Curriculum

Engineering faculty have made efforts to specifically infuse components of IL into the current curriculum and emphasize its importance to life-long learning. One of the objectives is to infuse IL into the current curriculum without developing or adding new courses. Therefore, a process was established to identify the IL components related to ABET student outcomes, link them to courses and develop assessment tools [19]. A schematic representation of the process is presented in Figure 3.
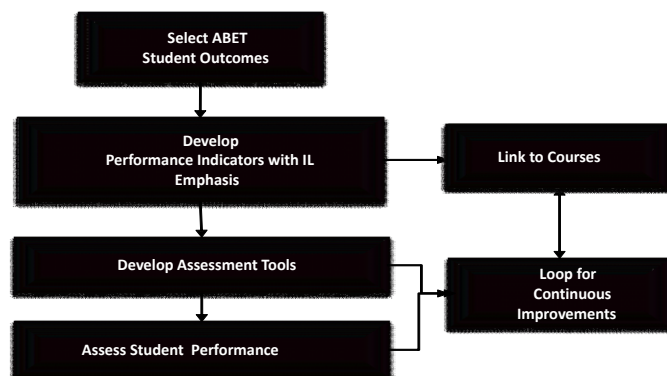

Figure 3. Process of Linking Information Literacy to ABET Student Outcome

Initially, the ABET student outcomes were reviewed and three of them, were selected for their reference to some components of IL. Performance indicators were developed, mapped, and linked to courses within the current civil engineering curriculum. Assessment tools were developed to measure achievement of each performance indicator within several courses from freshman to senior year. An example for the Civil Engineering Program indicating the coursework with IL instruction is presented in Table 1.

D. Evidence of Learning and Student Assessment

Developing lifelong learners is central to the mission of the CGA Engineering Department. The Engineering faculty ensures that engineering students acquire the intellectual capabilities of reasoning and critical thinking that provide the foundation for continued growth throughout their CG careers. IL competency extends learning beyond formal classroom settings and provides practice with self-directed investigations as engineering students move into specific research projects, internships, and professional positions as Coast Guard Officers.

As IL augments students' ability to evaluate, manage, and use information, expand knowledge, effective communication, and critical thinking ability, engineering students are regularly assessed in these areas. In addition to discipline specific content, individual course contents are designed to measure one of more selected competencies that are appropriate for the specific course.

The Civil Engineering Program developed performance indicators for each IL related ABET student outcome and linked them to upper level Civil Engineering courses. For example, the following three ABET Student outcomes became associated with IL components:

- ABET 3g: Ability to communicate effectively;
- ABET 3i: Recognition for the need for life-long learning;
- ABET 3j: Knowledge of contemporary issues.

Student performance was then assessed in each course on the established performance indicators as displayed in Table 2 for ABET 3G.

As collaboration between the library and faculty is important in promoting a learning environment conductive to developing the appropriate skill set, Table 3 illustrates shared responsibilities for learning IL skills across the Academy.

TABLE I.   CIVIL ENGINEERING CURRICULUM SHOWING COURSES WITH INFUSED IL INSTRUCTION

Fall Freshmen Year	Spring Freshmen Year
Freshman Experience or USCG History 1116 Statics & Engineering Design 2111 Eng Comp & Speech* 2141 Leaders in U.S. History 3111 Calculus I 5102 Chemistry I* *Physical Education*	2123 Writing About Literature* 3117 Calculus II 5106 Chemistry II 6101 Fundamentals of Navigation 8115 Macroeconomic Principles* *Physical Education*
Fall Sophomore Year	**Spring Sophomore Year**
1206 Mechanics of Materials* 2263 American Government 3211 Multivariable Calculus 8211 Organizational Behavior and Leadership* 5262 Physics I *4222 Prof. Rescuer*	1211 Dynamics 3213 Probability and Statistics 3215 Differential Equations 6201 Ships & Maritime Systems 6202 Applications in Navigation Lab Physics II *Physical Education*
Fall Junior Year	**Spring Junior Year**
1302 Materials for Civil/Construction Engineers* 1309 Environmental Eng. I* 1317 Structural Analysis I 1340 Fluid Mechanics 5442 Atmospheric & Marine Science *Physical Education*	1304 Soil Mechanics* 1313 Steel Design 1407 Environmental Engineering II* 2391 Criminal Justice 6301 Maritime Watch Officer *Physical Education*
Fall Senior Year	**Spring Senior Year**
1321 Electrical Circuits & Machines 1351 Thermodynamics 1401 Construction Project Management* 1411 Reinforced Conc. Design 1404 Geotechnical Eng. Design* *Physical Education*	1402 Civil Engineering Design* 2493 Maritime Law Enforcement 2393 Morals and Ethics* 6401 Coast Guard Division Officer _____Free Elective 1491 FE Exam Review (optional)

*Courses with IL instruction

TABLE II.   PERFORMANCE INDICATORS FOR ABET OUTCOME 3G

Performamce Indicator	ABET 3g: Ability to communicate effectively	
	Courses	**Assessment**
3g-1: Use appropriate presentation tools and techniques to orally communicate information, concepts and technical ideas effectively	Soil Mechanics Civil Eng. Design	Technical paper presentation Project presentation
3g-2: Prepare written documentation in standard engineering format to communicate information, concepts and technical idea effectively	Soil Mechanics Civil Eng. Design	Written technical paper Project Report
3g-3: Research information from a variety of sources, utilize information to make engineering decisions/judgement and produce a technically sound report	Enviro. Eng. I Civil Eng. Design	Technical report Project report
3g-4: Respond to questions from diverse audiences with justified and well formulated answers	Soil Mechanics Civil Eng. Design	Technical paper presentation Capstone project presentation

TABLE III.   SHARED RESPONSIBILITIES FOR LEARNING IL SKILLS

	Information Literacy Skills	**Responsibility**
Know	Determines the nature and extent of information needed	Starts with the faculty member; reinforced by librarians
Access	Efficiently & effectively accesses information sources	The librarian usually leads with faculty support
Evaluate Sources	Critically evaluates information sources	The librarian may lead initially; faculty make the ultimate determination from students' work products or performance
Evaluate Content	Critically evaluates information content; considers impact on student's prior knowledge, value system, and future direction in life	Faculty leads in classroom or other course context; student also may consult librarians, external subject experts, or peers
Use	Uses information found to accomplish a specific purpose	Faculty leads; can be reinforced by librarians
Ethic/legal aspects	Understands the economic, legal, and social issues surrounding the acquisition and use of information	Faculty and librarians jointly and continuously

Grading rubrics have been developed to ensure that the competencies are consistently assessed and evaluated by individual instructors. Students receive the grading rubric together with the assignment to ensure that the expectations of the instructors are known.

E. Resources for IL Development

The resources needed to support an IL program include personnel, fiscal responsibility, technology, and other services. The CGA faculty and librarians provide IL instruction and continue developing a curriculum in an atmosphere of collaboration, including professional development opportunities and incentives. Table 4 presents the shared responsibilities amongst library staff, faculty and the Administration at CGA.

Librarians have the primary responsibilities of facilitating access to information resources and providing instructions on how to use those resources. As such, access to the appropriate library resources plays an important role in helping students develop and enhance their information literacy skills. One challenge in building an IL program is to develop a strategy that involves a well-balanced approach to associated elements, tasks, and responsibilities among CGA library staff and academic faculty.

TABLE IV.   IL ELEMENTS, TASKS, AND RESPONSIBILITIES SHARED

Component	Tasks	Responsibility
IL Competencies	Establish definition and develop IL competencies	Academy-wide IL Development and Implementation Committee
Library Instructions	Provide access to information, assist students and faculty with specific IL needs and requests	CGA library staff
IL Across Curriculum	Standardize IL competencies across all majors, develop IL curriculum map, implement into existing assessment	Freshman Course Coordination Committee, Curriculum Committee, Department Heads/ Section Chiefs and Accreditation Teams
Evidence of Student Learning	Collect and assess data on IL competencies /standards across curriculum, propose actions for continuous improvement	Assessment coordinator, section chiefs, and department heads
Resources for Assessment	Determine the needs and provide resources to support IL standards	Dean of Academics, Director of Academic Resources, Library Director

F. Beyond the Library

A well-developed and comprehensive IL program assessment plan is essential to improve outcomes in academic IL initiatives [20]. In order to target instruction effectively, to offer needed support, and to provide appropriately challenging assignments, an ongoing and accurate understanding of students' IL capabilities is required. To meet the goal of continuous improvement, the overall assessment of the program at CGA addresses the following:

- Determines the extent to which instructional programs are successful in helping students acquire their IL skills;
- Regularly monitors the progress of students during the academic year so that appropriate adjustments can be made to ongoing instruction;
- Identify students who need intervention to advance IL performance; and
- Monitors and assesses the adequacy of available IL resources.

IL strategic approach requires providing funding for adequate resources and creating opportunities for collaboration and staff development among faculty, librarians, and other professionals. The challenge in providing an effective IL program is to continuously assess comprehensive range of strategies including resources and collaboration between faculty and library staff.

IV.   CONCLUSIONS

As technologies continue to transform learning, it is important to separate the technological tools used to access information from the skills of understanding and using the information. Students need to focus on content and its delivery in libraries, classrooms, and other learning environments. The development of good research and IL skills is vital for students, who are contending with an increasing amount of choice in the range and quality of information resources available to them. The growth of electronic resources – such as electronic books, journals, databases and websites – has increased the potential for students to learn independently as they are able to access information outside of the physical campus and in the online learning environment, however, access to so much information increases the importance of teaching students how to find, evaluate, and use reliable information sources.

CGA as an undergraduate academic institution has already responded to the challenges of developing and enhancing IL initiatives to develop student communication skills and promote life-long learning. Undoubtedly, individual faculty, librarians, and administrative staff have been addressing many aspects of IL as they promote an institution wide approach that is woven into the curriculum progressively from freshmen through senior year.

The implementation of a new core curriculum at CGA with an IL curricular thread has allowed for expansion across CGA of many IL concepts that were previously adopted in the Engineering Department to promote strong analytical, critical thinking, problem-solving and research skills. The paper described an approach at CGA that uses established courses as a starting point for the development of a more structured and integrated IL initiative and suggested IL strategies to incorporate assignments and assessment techniques into existing courses as successfully implemented at the Department of Engineering. The success of IL strategies at CGA hinges on excellent collaboration between faculty and the library staff. The CGA librarians assist faculty with the evaluation and selection of intellectual and information materials and resources and continue to provide instruction to students (and faculty) who seek information.

The CGA IL strategy described is based on the model proposed by Indiana University that uses: (1) IL Competencies; (2) Current Library Instruction; (3) IL Across Curriculum; (4) Evidence of Students Learning; (5) Resources for Assessment; and (6) Beyond the Library. All six platforms are fully integrated and must be continuously developed, assessed and revised based on the needs of the academic institution. The success of IL at CGA is based on the Indiana University framework, a successful collaborative environment, and a new core curriculum that uses a threading approach to expand IL development across disciplines and throughout the four-year curriculum. The future success of IL at CGA will depend on regular assessment and improvement of student development in this critical skill that is essential for success in college, in career advancement, and in life.

REFERENCES

[1] Niedbala, M.A. and Jay Fogleman, Taking Library 2.0 to the Next Level: Using a Course Wiki for Teaching Information Literacy to Honors Students. *Journal of Library Administration* 50 (2010): 867-82.

[2] Moll, M. (2009). Information Literacy in the New Curriculum. *South African Journal of Library & Information Science* 75, no. 1 (2009): 40-45.

[3] Grassian, E. S., and Kaplowitz, J. R. (2001). *Information literacy instruction: Theory and practice*. New York: Neal-Schuman.

[4] Doyle, C.S. (1992). *Outcomes Measures for Information Literacy Within the National Education Goals of 1990*. Final Report to National Forum on Information Literacy. (ERIC Document Reproduction Service No. 351 033).

[5] Cox, C. N., and Lindsay, E. B. (2008). *Information literacy instruction handbook*. Chicago: Association of College and Research Libraries.

[6] Bruce, C.S. (1997), *Seven Faces of Information Literacy*, Adelaide: Auslib Press.

[7] Campbell, S. (2004), *Defining Information Literacy in the 21st Century*, (Paper Presented at the World Library and Information Congress: 70th IFLA General Conference and Council, August 22-27, Buenos Aires), [www.ifla.org/IV/ifla70/papers/059e-Campbell.pdf] (Acc: 2010-10-18)

[8] Owusu-Ansah, E.K. (2003), Information Literacy and the Academic Library: A Critical Look at a Concept and the Controversies Surrounding it, *Journal of Academic Librarianship*, 29:4, pp.219-30

[9] Burkhardt, J. M., MacDonald, M. C., and Rathemacher, A. J. (2003). *Teaching information literacy: 35 practical, standards-based exercises for college students*. Chicago: American Library Association.

[10] Rockman, I. F. (2004). Integrating information literacy into the higher education curriculum: Practical models for transformation. San Francisco: Jossey-Bass.

[11] American Library Association, http://www.ala.org (accessed on 17 March, 2017)

[12] Jarson, J. (2010). Information Literacy and Higher Education: A Toolkit for Curricular Integration. *College and Research Libraries News*, 71(10), 534-528.

[13] Ratteray, O. M. T. (1985, October). Expanding roles for summarized information. *Written Communication: A Quarterly Journal of Research, Theory, and Application, 2* (4), 457-472. (Beverly Hills, CA: Sage Publications.)

[14] Ratteray, O. M. T (2000-2002). Oswald Ratteray presented the concept of shared responsibilities for information literacy instruction in at least four forums across the Middle States region.

[15] Derakhshan, M. and Singh, D. 2011. Integration of information literacy into the curriculum: a metasynthesis. *Library Review* 60 (3), pp. 218-229.

[16] National Forum on Information Literacy, http://infolit.org/definitions/ (accessed on 17 March, 2017)

[17] Association of College and Research Libraries, "Information Literacy Competency Standards for Higher Education," College Res. News, 61(3), (2000): 207-215.

[18] Roberts, J. and J. Bhatt, "Innovative Approaches to Information Literacy Instruction for Engineering Undergraduates at Drexel University," European Journal of Engineering Education, vol. 32, No. 3 (June 2007).

[19] Jackson, H., N. Rumsey, P. Daragan, and S. Zelmanowitz, "Work in Progress-Assessing Information Literacy in Civil Engineering." Proceedings of the 41st ASEE/IEEE Frontiers in Education Conference, Rapid City, SD (October, 2011).

[20] Oakleaf, M. (2008). "Dangers and Opportunities: A Conceptual Map of Information Literacy Assessment Approaches," *Portal: Libraries and the Academy* , 8(3), 233-253.

Dr. Hudson Jackson is an Associate Professor of Civil Engineering. He holds a Master's Degree from the Technical University of Darmstadt, Germany and a Doctorate in Geotechnical Engineering from Rutgers University, New Jersey, USA. He is currently the Program Chair and Section Chief of Civil Engineering at the United States Coast Guard Academy. He is a license Professional Engineer with over 30 years of consulting, academic and research experience in civil engineering. His professional experience spans the continents of Africa, Europe and North America. Dr. Jackson is active in several professional organizations and has published over 40 papers at national and international conferences. He is currently the President of the Connecticut Society of Civil Engineers.

Dr. Alina Zapalska is a Professor of Economics, Director of the USCGA Honors Program, and an advisor to Alpha Lambda Delta Honors Society at the US Coast Guard Academy. Professor Zapalska's extensive and varied teaching experience spans 30 years in the U.S. and abroad. She is a widely published author, serves as an editor and reviewer for several refereed journals, and has received several awards. Her international work and study experience has enabled her research to be focused on analyzing economies of Poland, Hungary, Czech Republic, Thailand, China, New Zealand, Sweden, U.S., Australia, Bangladesh and South Korea.

Dr. Sharon Zelmanowitz is a Professor of Civil Engineering. She holds a Master's Degree from North Carolina State University and Doctorate in Environmental Engineering from the University of Wisconsin-Madison, USA. She is a licensed Professional Engineer, the current Head of Department of Engineering at the US Coast Guard Academy and has over 30 years of experience in academe. She has published numerous articles on pedagogy including service learning, capstone project development, and ethics in engineering. She is an excellent educator and has had a profound influence on an entire generation of Coast Guard civil engineers. She is the 2012 Coast Guard Academy Alumni Association Distinguished Faculty award recipient for excellence in teaching, mentoring and leadership.