Chapter 7

Teaching and Learning Across Disciplines: A Preliminary Assessment

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There are many efforts to develop new materials to aid in learning complex interdisciplinary and multidisciplinary engineering concepts. It is instructive to determine how students utilize the various components of traditional learning approaches in courses delivering single discipline and interdisciplinary engineering content. Experience is being accumulated in one discipline, aerospace engineering, to evaluate learning across disciplines. Results are presented from a study of the approaches and utilization of different teaching instruments in four aerospace engineering courses taught by three different professors from the sophomore to graduate levels. Quantitative evaluations of the student usage of these instruments, augmented by student perceptions, provide further understanding of the strengths and deficiencies of various aspects of these courses. Learning across disciplines demands initiative and independent exploration by the learner, and many students may be challenged by these demands. Communication between the student and faculty on expectations is an important part of the success in such instances.

INTRODUCTION

Engineering students have always been asked to innovate well beyond the basic concepts and theories provided in their textbooks and handbooks, merging different ideas to solve problems that cross traditional discipline boundaries. As technology advances, cross-disciplinary learning is becoming increasingly important. Engineered products and systems have reached a level of complexity that no longer allows certain design and analysis problems to be decoupled into the once-common disciplinary vertical columns of learning. It is therefore crucial that teachers gain an understanding of how students learn and assimilate data across disciplines in order to create learning resources that help learners to adapt to this millennium's explosive growth in technology. Well-known concepts such as experiential learning and teamwork are recognized, but these are not sufficient to address the demands of both depth and breadth placed upon the modern engineering student. It must also be recognized that in any classroom, the presentation method depends strongly on the particular learning style preferred by the instructor, and while this style may resonate with some students, it may not be as instructive to others. Finally, the realities of the numerous pressures that serve to compress an already dense curriculum, the rising cost of formal schooling, and the fact that many students are still in their formative years must all be taken into account.

This paper reports progress on understanding learning and building resources to help engineers innovate solutions that draw on many disciplines. The need for such resources has been recognized at various stages of learning [1-5]. In prior related efforts, reference [6] laid out some of the individual issues and concepts to address cross-disciplinary learning in an aerospace engineering curriculum at a top-tier engineering university. German [7] reported on an experience with case studies in junior level courses, while Komerath [8] explored advanced concept development using depth in one discipline to address conceptual design, including not only technical but also demographic and public policy issues.

The approach here is to enable learners to gain confidence with new concepts and the process of solving problems, by permitting them to follow their own learning preferences, whether it is theory, worked problems, the reason for the concept, or other aspects. It is postulated that as students gain confidence and depth in their home disciplines, they can then venture into other fields and apply similar learning strategies to locate and filter the appropriate knowledge needed to resolve cross-disciplinary engineering problems. The first step in this new approach is to examine how students react to and learn from the rigor of depth and breadth in cross-disciplinary topics using a variety of traditional and innovative resources to introduce the topics in a problem-solving context.

LEARNING TECHNIQUES AND APPROACHES

There are many different techniques and approaches to teaching complex material in technical fields such as engineering. The authors have identified the following principles as important to facilitate cross-disciplinary learning in engineering:

- **Interact and iterate.** Interaction with the instructor and classmates is paramount. Students should engage actively and improve their work based on what they learn in discussions with others. Experience has shown that this active engagement helps to improve problem-solving skills and to cement learning.
- **Design early and often.** Design is inherently multidisciplinary, and design projects are strong catalysts to experiential learning. Design stimulates creativity, innovation, and confidence, and it reconnects students with their motivation to pursue engineering.
- **Balance disciplinary breadth and depth.** Students must be fluent across the spectrum of relevant disciplines; however, they should have sufficient knowledge and aptitude in each to perform basic tasks competently. At minimum, students should be able to (1) conduct informed technical communication about the interaction between disciplines using appropriate terminology, (2) perform fundamental multi-disciplinary analyses with basic

equations, (3) conduct deep analyses in each disciplinary area, (4) identify and locate resources to increase cross-disciplinary knowledge on an as-needed basis.

A number of different learning approaches based on these principles have been evaluated with respect to the aerospace engineering cohort in the two decades prior to this cross-disciplinary study:

Learning by iteration: One of the first two NSF awards in engineering under the Leadership in Laboratory Development initiative in 1993 was a project awarded to the first author to bring the essence of practical experience into coursework in a fundamental way. Flow visualization and other experimental resources were used first to illustrate to students the physics of fluid mechanics and aerodynamics, and then students were allowed to experiment with flow diagnostics and control techniques [9]. The lessons from this effort were then successfully iterated via the core aerodynamics courses to enhance the understanding of the concepts [10].

Learning fundamentals through conceptual design: The most obvious use of iteration in a systematic learning process is via conceptual design, where a solution concept is logically tested against a set of requirements and iterated to satisfaction. Conceptual design also provides a practical context to learn and apply engineering fundamentals simultaneously, while engaging the student by intricately tying theory and sophisticated applications with basic theoretical fundamentals. The freshman *Introduction to Aerospace Engineering* course was modified [11] so that concepts were integrated through team designs of aircraft using engineering experience combined with the fundamentals (concepts of engineering mechanics, characteristics of the atmosphere, etc.). Students did not yet have the depth of knowledge to understand how to develop the engineering databases themselves; they were able only to use the databases with their limited knowledge to design their vehicle within the design constraints provided. Students were encouraged to review and learn from current and past vehicle designs using information available in the library or on the Internet. Multiple sections of the course taught in this manner over the course of several years have demonstrated the success of this approach. Freshmen, within their first weeks in college, could and did perform very well in the cross-disciplinary, high-level processes of aircraft conceptual design. The topic of conceptual design, interestingly occupies the first eight weeks (one-half semester) of the year-long senior capstone design sequence. One implication of this finding is that students who are unconditioned to artificial constraints about what they should or should not know (as they are when they first begin their university matriculation) can be very successful at cross-disciplinary learning within the time constraints of the standard curriculum.

Providing depth via vertical streams of technical content: The Aerospace Digital Library (ADL) was designed to provide electronic aerospace resources to augment course textbooks by data gleaned from professors' notes and other technical material. This resource, which has been in continuous use for over thirteen years, contains vertical streams of rigorous content in several aerospace subdisciplines, and statistics indicate that it has been used by learners from across the globe. The utility and sustainability of this testbed [12, 13] are evidence of the success of the concept. This resource has played an important part in enabling a generation of students not only to learn in the traditional course setting but also to participate in technical experiments [14] and concept-development efforts, for example with the NASA Institute of Advanced Concepts [15].

These experiences again provide impetus to the theory that engineering students can venture outside their traditional disciplines to solve problems.

Providing breadth via cross-discipline linking: An early concern in the development of learning resources was how to overcome any mental blocks that students might encounter to discover and integrate relevant content across disciplines. Early experiences indicated that students were overwhelmed with data that were, in many cases, not relevant and distracting with respect to the problem under consideration. Various instruments that were considered included guided flowcharts, question-answer sessions to guide learners, and neural networks to track learner preferences, to name a few. However, advances in technology have improved the ability of Internet search engines to parse and extract data when the appropriate keywords are utilized, and learners have become increasingly adept in adapting with these changes. In addition, there are many more technically appropriate and detailed resources available on the Internet in 2011 than in 2000. Training in using the search engines, along with judicious cross-linking of basic concepts, appears to be sufficient at this time.

LEARNING RESOURCE ASSESSMENT

It is necessary before the investment and development of cross-disciplinary resources to understand how students use their current learning assets. Surveys of an assortment of widely varying content and teaching approaches in lower (sophomore undergraduate), upper (senior undergraduate), and graduate courses were undertaken over the past year to identify how students use current and traditional learning resources available to them. Descriptions of the courses, their teaching approaches, and their learning resources are provided for reference and correlation with the assessments.

Undergraduate (UG) Course A: This is the first of three courses on fluid mechanics and low speed aerodynamics, typically taken in the sophomore year. It starts by relating the laws of physics to the conservation equations for fluid mechanics and then relates these concepts to potential and viscous flow methods. This course is usually the student's first application of differential equations beyond the mathematics courses, yet it must also convey the practical aspects of airfoil, wing, and aircraft aerodynamics. Differential calculus theory must be transformed into engineering formulations to obtain practical results through mathematical logic. The three-credit course uses lectures and problem solving. Students use their MATLAB computing skills (learned in a prior computer science prerequisite) to solve flow problems. Early conceptual design exercises seek to convey a sense of numbers and magnitudes, while the last five weeks introduce students to open-ended assignments allowing individual creativity. The required textbook is one used in the entire three-course sequence of undergraduate fluid mechanics/aerodynamics. Students depend heavily on class notes provided through a (restricted) class website and an early version of an e-book generated from class notes. There were four fifty-minute tests and a three-hour final examination, in addition to graded homework project assignments.

Undergraduate (UG) Course B: This three-hour course on high-speed aerodynamics caps the sequence of three fluid mechanics/aerodynamics courses commenced with UG Course A. Most students take this course in their final undergraduate year, having completed a vehicle performance course. At this point in the curriculum, the students have completed or are taking concurrently jet propulsion and the first course in the capstone design sequence. In addition to four quizzes and the final examination, individual homework assignments lead to a six-week integrative team project with two students per team. Course notes are the primary learning resource, complemented by the textbook and recommended readings from various sources. Conceptual design assignments at the start of the course seek to convey a sense of numbers and encourage students to use what they have learned from the engineering curriculum that they have completed prior to this course. The integrative assignment is an opportunity to exercise cross-disciplinary innovation by applying content learned in this course along with knowledge from the aircraft performance course to explore advanced aerospace vehicle concepts. The required textbook is one used in the entire aerospace engineering fluid mechanics/aerodynamics sequence, augmented with class notes provided through a (restricted) class website and a preliminary e-book specifically designed for the course.

Undergraduate (UG) Course C: This course is a senior class that is most typically taken during the students' last semester before graduation. The course is interdisciplinary, combining the fields of fluid mechanics, structural mechanics and controls to address fluid-structure interaction or aeroelasticity. Students must complete prerequisites in each of these areas before taking the course. The course is lecture-based for three semester credit hours. The course religiously follows the textbook, which was written by faculty teaching the course, so that no additional professor notes are necessary to provide technical content to the students. Assessments consist of two one-hour closed book midterms, a three-hour final and seven graded homework assignments, with five assigned during the first eight weeks and two during the final five weeks of the semester, typically due one to two weeks after being assigned. In each major topic taught during the course, there are also problems assigned with answers that are not graded. Homework problems assigned for a grade are to be solved using individual efforts; approximately 10% of these problems are open-ended. Three hours of interaction with the professor are scheduled each week, and three additional hours of TA-group interaction each week are also scheduled. These out-of-class interactions are scheduled so that minimal student conflicts with other courses/work occurred during these times. This scheduling was based on student provided schedules at the end of the first week of the semester when classes are finalized. This course is anecdotally considered by the student population to be one of the most technically complex courses in the curriculum.

Graduate (G) Course D: This graduate course provides an introduction to aircraft propulsion system cycle analysis and design at the conceptual and preliminary levels with emphasis on gas turbine engines. There are four primary learning objectives: (1) develop a working understanding of relevant technical disciplines including engine cycle analysis, basic component performance, engine installation effects, and operability for aircraft gas turbine propulsion systems; (2) learn the basics of the conceptual and preliminary design process for both the commercial and military engine markets; (3) explore emerging and proposed propulsion system concepts intended to address the ever-increasing needs for improved fuel efficiency, reduced noise, and increased aircraft performance; and (4) apply multi-disciplinary analyses and design processes for representative engine design problems. The course is structured in a traditional lecture format with presentation slides supplemented with mathematical derivations on the whiteboard. Later lectures focusing on the design process and emerging engine concepts are covered in a more interactive format with significant class participation. Vignettes and case studies from historical propulsion system development programs are interspersed during the lectures. The course grades are based on one midterm exam, a final exam, and two case study computer projects focused on typical current or historical aircraft engines. The projects require a combination of computer programming, literature research, and design creativity. The programming language may be chosen by students based on personal preference, but MATLAB or the NASA Numerical Propulsion System Simulation (NPSS) tool [16] is recommended. Each project typically requires 20-40 hours of effort for students with experience in computer programming.

Independent surveys and focus group discussions were conducted in these different courses to serve as a baseline on current learning and identification of areas of future development. Tables 1-3 tally some of the quantitative results of these surveys. There are notable similarities and differences across the courses and at the different stages of matriculation. The results are scored on a basis of 1 to 5, with 1 corresponding to "never or not important at all" and 5 to "always or very important."

The written material, either the textbook or course notes from the professor, score commensurate with the emphasis accorded the instrument by the faculty member, as well as its correlation to the lectures, as shown in Table 1. This is most significant in UG Course C where the textbook was an offshoot of the course lecture notes, and G Course D where the professor provides course notes and the assigned textbook is only supplementary. Students' own notes and prior exams provided by the professor for practice appear to be more important in the undergraduate curriculum than the graduate course. Engagement in study groups or working with friends is consistent across all levels and courses, as is the use of rapid estimation ("back-of-the-envelope" estimates). Internet searches of content developed external to the university are more prevalent in the lower level courses, but this may well be due to the emphasis on open-ended assignments by the faculty teaching those courses. Examination of the solved problems on the ADL is only significant in one course, UG Course B. Most of the worked examples available on ADL relate primarily to UG Courses A and B, so this is also consistent with the faculty emphasis and availability of the resource.

Traditional office hours and/or voluntary recitation with teaching assistants have been a classic teaching instrument in universities to increase the instructor-student time of interaction, as well as to add individual instruction. From the survey results in Table 2, there is a clear divide in the use of this resource by the students. UG Courses A and B, taught by the same faculty member, indicate less dependence on instructor meetings than do UG Course C and G Course D. The doubling of the number of students who meet with the professor outside of class indicates the recognition as the student matures of the importance of this instrument of learning. Anecdotal evidence from faculty teaching these courses is that the more successful students (those with higher grade point averages) tend to utilize office hours or informal meetings immediately after the lecture to answer questions or remove confusion from material presented during the lectures. There is not a correlation of this metric with course grades, as the undergraduate course grade point average varies from 2.1 to 3.0, depending on the course and semester taught.

Student utilization of the course websites that are restricted to the class and include assignments, handouts, and grades is fairly consistent and indicates the familiarity of students with electronic resources (Table 3). The lower utilization of this resource appears to be consistent as the faculty member teaching UG Course C noted that most material was handed out in class and the textbook was written from class notes (i.e., little need for professor-augmented notes).

Learning Resource	UG Course A	UG Course B	UG Course C	G Course D
Textbook	3.9	3.6	4.2	2.7
Course notes provided by instructor	3.8	3.8	3.4	4.3
Student notes from class, verifying instruction	4.1	3.5	3.4	3.2
Exams from previous terms	3.1	3.8	3.4	2.6
Working with friends	3.8	3.5	3.3	3.8
Examples via internet, other schools	3.1	3.2	2.1	2.5
"Back-of-the-envelope" estimates	2.6	2.6	2.1	2.5
Solved problems using the ADL	1.6	2.9	1.3	1.1

TABLE 1
STUDENT RESOURCE USAGE

	UG Course A	UG Course B	UG Course C	G Course D
Yes	20%	40%	70%	80%
No	60%	50%	30%	20%
No response	20%	10%	0%	0%

TABLE 2
ASSISTANCE FROM INSTRUCTORS AND TEACHING ASSISTANTS

Frequency	UG Course A	UG Course B	UG Course C	G Course D
Daily/Weekly	85%	75%	60%	80%
Few times	10%	15%	10%	5%
None	0%	0%	10%	10%
No response	5%	10%	20%	5%

TABLE 3
ACCESS TRADITIONAL COURSE WEBSITE

DISCUSSION AND CONCLUSION

In addition to the surveys, students were engaged in focus group discussions so that motivations could be assessed. The conclusions associated with these discussions are summarized here.

That students learn is *the* objective of teaching. At the conclusion of these courses, students rated the courses relatively high in preparing them to "tackle problems, projects or follow-on courses." Faculty members were commended when students described highlights of the courses, with comments like "awesome" and "I actually learned."

Communication, coaching and collaboration are key to engaging students in the learning process. Throughout the discussions, students expressed the importance of communication in their interactions with other students, faculty and teaching assistants for building confidence and fostering interest in topics. One of the best comments came from a student in UG Course C who acknowledged that communication was a shared responsibility by suggesting that students take responsibility for preparing themselves for classes and discussions with faculty. Whether referring to the textbook or classroom presentations, even the most enthusiastic students expressed a concern over missing steps or gaps in discussions and derivations. It is to be noted that because of the collaborative environment in the G Course D, the projects received high rankings even though students had expressed concern over the additional burdens associated with learning the programming language and the codes.

Students consider homework and exams to be very useful learning tools. While it may be true that some are not motivated to learn, most students consider homework and exams to be useful learning tools. Both received high rankings in UG Course C, with the students noting that the "amount was perfect, not overwhelming, and helped one to learn." Students in both UG Course B and G Course D suggested that more homework and exams, covering fewer units of material, would be helpful.

Students become engaged in topics that relate to or can be described by case studies, real-world examples and applications. Enough cannot be said to encourage the use of case studies or application throughout these courses. Undoubtedly, some topics lend themselves more easily to such approaches than others, but there still may be a possibility of cross-linking topics to applications in research and industry. Judging from the positive response by students in all four courses, such an approach is proving to be one of the best ways to implement cross-disciplinary concepts into the classroom.

Students would benefit from access to more aerospace engineering references. Students have already begun to note the benefits from the development of the ebook online. In addition to its introduction in the classroom as a resource for the course, ADL has the potential for becoming a resource for graduates pursuing lifelong learning as they continue their education in aerospace and related engineering fields.

THE NEXT STEP: CROSS-DISCIPLINARY RESOURCES

A postulate of cross-disciplinary learning is that learning and innovating across disciplines is substantially self-driven, requiring initiative, confidence, and persistence. Based on the outcomes of the focus groups and surveys, as well as past experience in prior initiatives, the hypothesis driving this learning approach is that enabling people to learn within their "zone of comfort" will sustain initiative and enhance confidence. Based on the exploratory analysis of the different learning instruments, it is clear that technology coupled with a long-term investment in resource development and testing, will enable this approach to be accommodated within the usual constraints of time and cost. This approach, entitled EXTROVERT tackles the depth problem in cross-disciplinary learning, central to aerospace projects [17, 18]. The students appear to be comfortable with a combination of technology and traditional learning instruments, but they also appear to be guided significantly by the use or recommendation of specific tools by the individual professor. The use of case studies or linkages to “real world” applications appears to be a learning tool that resonates with students for all cross-disciplinary topics where they were applied. Traditional graded homework remains a key learning device, and students concur that a blend of open-ended and classic one-answer problems is helpful, as long as they do not encompass too large a sampling of new material in order to complete them. It is clear that the successful development and implementation of these tools and resources cannot be accomplished *in vacuo* but requires communication between both the faculty and students engaged in cross-disciplinary learning.

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REFERENCES

1. R. S. Walker et al., *Final Report of the Commission on the Future of the United States Aerospace Industry,* Crystal Gateway 1, Suite 940, 1235 Jefferson Davis Highway, Arlington, Virginia 22202, *http://www.history.nasa.gov/AeroCommissionFinalReport.pdf*, November 2002. Last accessed 12/24/2011.

2. A. Hargadon, *How Breakthroughs Happen: The Surprising Truth About How Companies Innovate*, Harvard Business School Press, 2003.

3. R. M. Felder, D. R. Woods, J. E. Stice, A. Rugarcia, “The Future of Engineering Education. Teaching Methods That Work,” *Chem. Engr. Education*, Vol. 34, No. 1, 2000, pp. 26–39.

4. W. Clough et al., *The Engineer of 2020: Visions of Engineering in the New Century*, National Academy Press, Washington DC, 2004, ISBN 0-309-53065-2.

5. S. J. Fishback, *The Cognitive Development of Adult Undergraduate Students*, Dissertation, Kansas State University, June 1998.

6. N. M. Komerath, M. J. Smith, B. German, “EXTROVERT: System for Learning Across Disciplines,” *Proceedings of the ASEE Annual Conference*, Louisville, KY, June 2010.

7. B. German, “A Case Study Approach to Teaching Aircraft Performance: Reverse Engineering the SR-71 Blackbird,” *Proceedings of the ASEE Annual Conference,* Louisville, KY, June 2010.

8. N. M. Komerath, "Undergraduate Studies of Supersonic Transport Development," *Proceedings of the ASEE Annual Conference*, June 2010.

9. N. M. Komerath, "Experimental Curriculum in Diagnostics and Control of Unsteady Flows," *Journal of Engineering Education*, Vol. 85, No. 3, 1996, pp. 263-268.

10. N. M. Komerath, "Progress towards Iterative Learning," *Proceedings of the American Society of Engineering Education Annual Conference*, Session 3536, Paper No. 2, Anaheim, CA, June 1995.

11. N. M. Komerath, "Design-Centered Freshman Introduction to Aerospace Engineering," *Proceedings of the ASEE Annual Conference*, Seattle, WA, June 1998.

12. N. M. Komerath, M. J. Smith, "Integrated Knowledge Resources for Cross-Disciplinary Learning," Session D-7, *Proceedings of ICEE 2001, the International Conference on Engineering Education*, Trondheim, Norway, August 2001.

13. M. J. Smith, N. M. Komerath, "Aerospace Engineering: Integrator for Cross-Disciplinary Learning," *Proceedings of the ASEE Annual Conference*, Albuquerque, NM, June 2001.

14. S. Wanis, J. Akovenko, T. Cofer, R. G. Ames, N. M. Komerath, "Acoustic Shaping in Microgravity," AIAA Paper 98-1065, *Proceedings of the 36th Aerospace Sciences Meeting*, Reno, NV, January 1998.

15. N. M. Komerath, "Dreams to Reality: Bringing Far Out Back Home to Aerospace Education Through Concept Development," Paper 2008-1849, *Proceedings of the ASEE Annual Conference*, Pittsburgh, PA, June 2008.

16. L. J. Stauber, C. G. Naiman, "Numerical Propulsion System Simulation (NPSS): An Award Winning Propulsion System Simulation Tool," http://www.grc.nasa.gov/WWW/RT/RT2001/9000/9400naiman.html. Last accessed 12/24/2011.

17. N. M. Komerath, M. J. Smith, B. German, "EXTROVERT: System For Learning Across Disciplines," *Proceedings of the ASEE Annual Conference*, Louisville, KY, June 2010.

18. N. M. Komerath, M. J. Smith, D. S. Krausche, B. German, E. Armanios, "EXTROVERT: Experience with Cross-Disciplinary Learning," *Proceedings of the ASEE Annual Conference*, Vancouver BC, Canada, June 2011.

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