

Improving Communication Skills of Construction Students by Linking English Courses in an Integrated First-Year Curriculum

Kelly Strong, Ph.D. and Carla Lopez del Puerto, Ph.D.

Colorado State University

Fort Collins, Colorado

This paper presents the findings from a study of written communication skill development comparing first-year learning community students in linked-English classes to their peers who were not in linked-English classes. The findings suggest that written communication skill assessments were better in students participating in linked-English courses, but written communication skill development over the course of a semester did not improve as fast among students in linked-English classes compared to those not in linked English classes. The paper discusses possible reasons for the differences found. The benefits of students taking English classes with their peers from the same major include integration of departmental course offerings with English assignments centered on a common theme of interest to the students (e.g. “construction”) as well as increased student performance as defined by independently scored written communication assignments. However, the lack of disciplinary diversity in the linked English classes may not promote intellectual development and the corresponding improvement in critical analysis skills over the course of an academic program. The implications of slower communication skill development in students participating in linked-English classes suggest the need for curricular innovations and increased collaboration among related disciplines such as those that would naturally occur in the construction industry such as design, engineering, finance, and construction.

Key Words: integrated curriculum, communication skills, curriculum effectiveness

Introduction

Written and oral communication skills have become increasingly important in the construction industry (Bureau of Labor Statistics, 2010). Construction professionals need to communicate with architects, engineers, construction crews and other construction personnel on a regular basis. The increased use of alternative project delivery methods that provide best value to the owner has resulted in the need for architects, engineers and contractors to write competitive proposals and give oral presentations to owners to compete for construction projects (Institute of Management and Administration, 2006). Engineering and construction programs have taken many different approaches to developing students’ communication skills. Some programs have included liberal arts subjects in their curricula while others have integrated communication throughout the curriculum (McGregor, 2000).

Many academic programs are using linked-first year courses as part of an overall strategy of teaching effectiveness and student achievement (Strong et al 2008). The logic behind this strategy is that students who are in linked classes using cases and examples from the student’s discipline are more confident and engaged in the general education program. Linked classes taken with peers from the student’s chosen major are typical of many universities’ first year learning community curricula. However, little empirical testing of this logic has been produced in the literature. Critics of the linked course strategy argue that it runs counter to the interdisciplinary nature of general education and will actually detract from student learning.

The study presented here assesses the written communication skills and skill development between first year learning community students in linked-English courses compared to first-year learning community students who are not in linked-English courses. The manuscript begins with a brief literature review, followed by a description of the

learning community and first year curriculum that served as the test site for this study. After the literature review and program description, the research methodology is described, followed by an analysis of results and conclusions. The manuscript concludes with a discussion of limitations and future research.

Literature Review

Written communication capabilities are critical to effective engineering and construction education, but many undergraduate programs have grappled with delivering effective professional communication skill development in their curricula (Plumb and Scott, 2002). Many programs have attempted to more fully integrate written communication skill development into several courses throughout the curriculum with program-level assessment and curricular enhancement designed to maintain effective instruction (Grady & Davis, 1999; Bonk, Imhoff & Cheng, 2002). Other programs have developed methods of interdisciplinary collaboration between departments such as writing centers and on-line resource libraries (Ford & Riley, 2003). Still other programs have relied on active-learning assignments using frameworks for project roles and responsibilities to develop communication skills (Jennings & Ferguson, 1996). Analysis of writing tasks during co-operative educational terms (e.g. internships) has also been used to examine the communication skill development of students (Kreth, 2000).

In a selective review of research in the scholarship of discovery (Turns, Atman, Adams, & Barker, 2005), only one study used direct analysis of student work as an assessment of student learning (Miller, Ely, Baldwin & Olds, 1998), and that study analyzed lab reports written by senior engineering students. None of the studies sampled in the study examined communication skills of first-year students. Turns and her colleagues suggest future research should examine different populations at different points in time as a means of assessing the effectiveness of curricular innovations. Both the Accreditation Board for Engineering and Technology (ABET) and the American Council for Construction Education (ACCE) include effective communication as a requirement of undergraduate education. However, since professional skills such as communication are typically acquired through a series of courses and extracurricular activities, rather than in a single class, integrated curricula including experiential pedagogies such as service learning may prove more effective in delivering communications skills (Shuman, Besterfield-Sacre, & McGourty, 2005). There has been much less research on the effectiveness of integrated curricula in development of student knowledge and professional skill. Integrated curricula are frequently supported by learning communities, cohort groups, first-year advising, and peer mentor programs, but results of such integrations are not well defined in the literature (Floyd & Ohland, 2005).

In addition to integration and collaboration within existing, traditional educational structures, some institutions have experimented with innovative delivery. Use of case studies in communication delivered via distance education (Levitt, 2001), web-based teams (Utschig, 2001), project-based spiral learning (DiBiasio, Clark, Dixon, Comparini, & O'Connor, 1999), capstone courses addressing community needs (Katti & Padmanabhan, 2002) and learning communities (Rutar & Mason, 2005) have been reported, but systematic assessment of innovative approaches to written communication skill development has been lacking in the engineering literature. Most of the research on the effectiveness of learning communities has focused on student retention and satisfaction, with little attention in the literature to curricular effectiveness and student learning (Taylor, Moore, MacGregor & Lindblad, 2003).

This paper describes an innovative approach to written communication skill development in first-year construction engineering students and reports preliminary assessment data regarding student performance. The approach to written communication skills incorporates many of the individual programs described in the literature, including integrated curriculum, cross-disciplinary collaboration, learning communities, active-learning, and community based projects. The program is described in more detail in the following section.

Description of Program

The program that served as a test site for this study was a first-year construction engineering learning community in a department of civil, construction, and environmental engineering at a large, public, Midwestern university. The learning community is a course to integrate curricular and extracurricular learning for construction engineering

students. The learning community was a required course for all first year construction engineering students and was designed to create curricular integration into the first-year experience through horizontal learning, achieved through the coordination of communication, math, science and introductory engineering courses, and vertical learning, achieved by weaving common themes through several classes intra-departmentally. Students were assigned randomly by their academic advisor.

The learning community is a required course for first-year and transfer students intended to welcome students into the college and the department, introduce them to the curriculum, familiarize them with the industry, and initiate them into the construction industry. Learning community students are divided into teams of 4-6 for projects and assignments. Each team has a peer mentor (upper class student) and an industry mentor. The developmental issues of personal growth, academic success, and professional development are the unifying themes of the first year curriculum. Vertical integration is designed to promote academic success, professional development, and personal development through coordinated assignments in the learning community and the first year orientation courses within the department. Each assignment or project in these courses is designed to foster deeper student learning through multiple skill development, reinforcement of what they are learning in other courses, and/or to build diverse types of communication skills. Examples of the assignments for vertical integration are shown in Table 1.

Goal setting for student success	Professional development plan
Career Fair attendance	Mock interviews
Take a faculty member to lunch	Job site tours
Service learning projects	Plan an interview trip
Team presentations	Construction plans scavenger hunt

The vertical integration of common themes in the first-year learning community has been successfully implemented. For instance, in the area of professional development, students have a formal, sit-down dinner with industry members at each table to develop social and professional skills. In addition, the students are asked to write a resume, participate in a mock interview with their industry mentor, and work with their peer mentors in preparing for the annual career fair. Assessments for academic success as measured by retention rates and informal faculty reviews of performance are indicative of student achievement through vertical integration. Personal growth as measured by exit interviews with peer mentors and student performance reviews by the industry advisory council also suggest that the vertical integration is beneficial to the students.

A thorough examination of the effectiveness of the vertical integration aspects of the first year program exceed the scope of this paper and have been reported elsewhere (Shane et al, 2012). The focus of this manuscript is to report the effectiveness of the horizontal course integration, specifically the differences in written communication skills between students participating in a linked curriculum compared to those who are not in linked first year classes as explained below.

Horizontal integration is achieved by linking five basic program courses in the first year construction engineering program with the learning community courses each semester as described in Table 2 below. The basic program courses are co-scheduled with the learning community courses during registration.

Fall	Spring
Calculus I (4)	Calculus II (4)
Chemistry for engineers (3 or 4)	Chemistry for engineers (4)
Problem Solving and Computation (3)	Graphics and Design (3)
English I (3)	English II (3)
Introduction to Engineering (R)	Introduction to ConE (1)

In the linked English course, there is an entire section of English I dedicated to learning community students, who work with an instructor familiar with construction issues. This facilitates the use of engineering and construction

topics in the linked English class. Both linked English classes reinforce WOVE (written, oral, verbal, electronic) communication skills through the use of shared assignments, including written and oral communication assignments that are given in the learning community and revised in the linked English classes, or topics that are researched in the learning community and presented in English. The learning community coordinators and the English instructors occasionally attend each other's' classes as do the learning community peer mentors.

An overall assessment of the integrated first year curriculum is on-going. The study presented below presents the findings from comparing evaluations of written communication skills of students in the linked-English class to those who were not linked to assess the effectiveness of the linked English course.

Methodology

The objective of this study is to compare student performance in the linked English class to those in non-linked English class. This objective is achieved by evaluating linked and non-linked student performance on an early semester assignment on goals statement and a late semester assignment on project structure. Each assignment was evaluated independently by three English instructors using a standard 12-factor scoring rubric developed specifically for assessment of written communication skills. There were 18 students in the linked sample and 25 students in the unlinked sample. The interjudge correlations as shown in Table 3 are all 0.50 or above, which yields satisfactory reliability for experimental designs (Cronbach, 1970).

	Judge 1	Judge 2	Judge 3
Judge 1	-----	0.55	0.50
Judge 2	0.55	-----	0.55
Judge 3	0.50	0.55	-----

Because English ACT scores varied considerably within the sample, English evaluation scores were controlled for ACT English score. Each student's average score from all three judges was divided by the student's ACT English score to create a Performance Index (PI). The mean Performance Index score of the linked students was compared to the mean Performance Index score of the unlinked students using a two sample t-test with unequal variance. Comparison of skill development was achieved by comparing the early assignment mean Performance Index to the late assignment mean Performance Index for each group using pairwise t-tests.

Hypothesis 1 is:

$$H1: \mu PI_{\text{linked}} > \mu PI_{\text{unlinked}}$$

Hypothesis 2 is:

$$H2: \mu PI_{\text{linked assign2}} - \mu PI_{\text{linked assign1}} > \mu PI_{\text{unlinked assign2}} - \mu PI_{\text{unlinked assign1}}$$

Results

Results of the statistical tests are shown in Table 4 and 5. The Performance Index on assignment 1 from the linked students was higher than the Performance Index on assignment 1 from the non-linked students, with statistical significance ($p < .05$). The Performance Index on assignment 2 from the linked students was higher than the Performance Index on assignment 2 from the non-linked students, with moderate statistical significance ($p < .10$), providing general support for Hypothesis 1. The results indicate that students in the linked English section did perform better on written composition assignments than did non-linked students when controlling for ACT English scores.

Table 4: Mean Comparison T-Tests for Linked vs. Non-Linked Students

	Performance Index	p value
Early Assignment Linked Students	9.455	p<.05
Early Assignment Unlinked students	7.29	
Late Assignment Linked Students	8.34	P<.10
Late Assignment Unlinked Students	7.60	

Mean differences of pair-wise comparisons examining individual student improvement from assignment 1 to assignment 2 did not achieve statistical inference (p. <.38; p<.31). However, indications are that performance actually declined over the semester for students in the linked-English course while performance improved during the semester among the unlinked students. The lack of statistical significance raises the possibility that the difference in means from the pairwise comparisons is random, but the direction of change suggests lack of support for Hypothesis 2.

Table 5: Pairwise Mean Differences in Assignment 1 and Assignment 2 for Linked vs. Non-Linked Students

	Assignment 1 μ PI	Assignment 2 μ PI	Mean PI change	p value
Linked Students	9.46	9.10	-0.36	p<.38
Unlinked Students	7.28	7.66	+0.38	p<.31

Conclusion

The findings suggest that students in English classes linked to the learning community in their major department perform better on written communication assignments. The logic behind linked English classes, that students write better when they write about topics of interest to them, appears sound. When topics, assignments, and subject matter are integrated between learning community and English classes in an integrated first year curriculum, student performance is improved. This logic could extend to Math, Science and Humanities courses by using construction-related examples. For instance, calculus applications could examine optimization points for equipment allocations and other construction related issues. Science applications, such as chemical reactions of admixtures in Portland cement concrete or wave action on bridge piers, could be tailored to construction topics. Social Science and Humanities courses could examine the impact of new bridge and road technologies and designs on the westward expansion of the United States and the economic boom in automobile production. Integrations other than English were not examined in this study, but if student learning and performance were improved in linked English courses, the same benefits may derive from additional linkages in other general education courses.

Although the test of Hypothesis 2 did not achieve statistical significance, the direction of performance change merits discussion. There appears to be slower development of written composition skills when students are in English classes representing a single-major constituency. In other words, diversity may matter. It is possible that the exchange of ideas and opinions is broader in an English class composed of students representing a variety of majors, and that exchange of ideas and insights leads to better development of written communication skills. This issue is particularly important since students will need strong “cross-boundary” skills to compete in an increasingly global market (Plumb & Reis, 2007). There may be other reasons to explain the lack of short-term improvement in communication skills that may be related to student development factors that cannot be controlled in curriculum design.

These findings are not surprising when interpreted in the context of student development models. Early in their academic careers, students operate at the level of absolute knowing (Baxter Magolda, 1992), where there is little uncertainty and “one best way” of solving problems. In this stage of development, an English course comprised of students from a single major, analyzing topics from a single discipline, will present a much more comfortable environment. However, students need to progress toward a level of contextual knowing, where the informed opinions of others are considered and uncertainty is accepted, although students do not progress past the absolute

knowing stage until their final year of college, if at all (Felder & Brent, 2004). First-year students in dedicated linked English courses are probably operating at the intellectual stage at which they are most conformable. However, they make little progression toward contextual knowing, because they are not exposed to the benefits of multidisciplinary analysis. In order to address this issue, the authors suggest having an English section in which students in disciplines that typically work together are given an assignment in which their different skills are incorporated. A good example of a project in which several disciplines must work together to develop a written deliverable is a design-build proposal.

Some of the drawbacks to homogeneity may be overcome by allowing students from liberal arts, science, management, and other disciplines to choose English sections focusing on construction topics. Many students outside of construction and engineering degree programs may be interested in the development of the built environment and efficient use of material resources, for example. Another option is for the dedicated instructor of the linked English section to integrate the class with a non-linked section from time to time for a more multidisciplinary analysis of a topic.

The dedicated English instructor could be invited to departmental first-year activities such as the industry dinner and the service learning project to point out examples of how solutions cut across disciplines. Written communication assignments could be integrated across more than just English and departmental classes. An assignment could ask students to analyze a proposed pipeline project from a technical perspective in construction classes, from an economic perspective in a first-year economics course, from a political perspective in a political science course, a sociological perspective in a sociology course, and so on. Integrated, cross-class assignments would provide students valuable skills in analyzing issues from different viewpoints. The evidence from the research suggests that students perform better when assignments and topics are related to the student's major field of study. The potential drawback of homogeneity of thought could be overcome with creative curricular design and innovative instruction.

The challenge for curriculum designers is to integrate classes in a way that balances the familiarity of subject matter with the challenge of new knowledge. The objective is to develop curricular innovations that engage students by using assignments and exercises that appeal to their interest without sacrificing the "boundary stretching" that is a critical aspect of higher education. Continued experiments in curricular integration and development are required to achieve this objective.

Limitations

A limitation of this study may be the single semester time lapse between assessments. It is quite possible that development of communication skills in college students is a much longer term process, and the success of linked first year English courses may not manifest itself until several semesters later.

Another limitation of looking at particular courses for improvement of communication skills is that the development of communication skills in undergraduates is an incremental process extending over multiple semesters.

We acknowledge that there are multiple statistical tests that could be used to analyze the data. There may be additional statistical test that can provide insight with larger sample sizes and a broader array of English assignments.

Future Research

The problem of class homogeneity may benefit from researching the opinions and insights of industry leaders. Executives from design and construction companies could give examples of how their projects have benefited from gathering information from a cross-section of clientele. Large, complex projects may have dozens of stakeholders whose concerns must be addressed. Such examples from "industry mentors" would provide insight on why other views must be considered to arrive at the "best" solution to a problem involving the built environment.

Future research should include more longitudinal research designs with follow up assessment in sophomore, junior, and senior years. Such a follow up study would yield more robust results on the lasting impacts of linked first year English courses.

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