DEVELOPING AND ASSESSING A HOLISTIC LIVING-LEARNING COMMUNITY FOR ENGINEERING AND SCIENCE FRESHMEN

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To the Faculty of Washington State University:

The members of the committee appointed to examine the dissertation of JENNIFER LIGHT find it satisfactory and recommend that it be accepted.

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DEVELOPING AND ASSESING A HOLISTIC LIVING-LEARNING COMMUNITY FOR ENGINEERING AND SCIENCE FRESHMEN

Abstract

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Learning communities and their strategies for enrolling cohort groups of students in a common set of classes organized around a theme or linked with residence life have come to light over the past twenty years. However, living-learning communities (LLC) and their role in retention, engagement, and intellectual development for engineering and science students have yet to be fully explored. What aspects of a LLC are most beneficial to science and engineering students? What are the learning needs of engineering and science students that are best met with LLCs? These questions were the basis for assessment of a new LLC program developed at Washington State University specifically to increase retention, academic achievement, and engagement of engineering and science students.

A first-year semester-long pilot LLC program was developed at Washington State University specifically for entering engineering majors. The program was expanded the following year to include biotech science majors. The first LLC had 55 self-selected engineering participants. Students were housed in the same residence hall, registered for three common classes, and participated in a non-credit bearing weekly peer-facilitated study group. The second year 81 students self-selected into the program; 59 engineering and 22 biotech majors. Students were housed in a common residence hall and registered for three common classes. Students participated in a two-credit freshman seminar class instead of the once-weekly study group used the previous year.

Results indicate students were engaged with peers and in college activities, had mixed academic improvement, and engineering students were retained at higher rates in their major when compared to non-participating peers and biotech participants. Second year LLC students had higher grade averages than comparison peers despite lower incoming preparedness. Higher engagement levels were confirmed by triangulation with national survey comparisons, observations, focus groups, and student essays. The program was assessed using a mixed method approach including grade, retention, and survey comparisons with peers as well as focus groups and course evaluations.

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1.0 INTRODUCTION

1.1 Understanding and improving engineering and science education

Preparation for a diverse workforce of college graduates suited for professional practice or graduate school is a major challenge to engineering and science educators. Immense challenges occur during a student's first year in higher education where high attrition typically occurs among prospective engineering and science students.

With only one half of a percent of the average postsecondary student body enrolling in engineering and physical sciences (U.S. Department of Education, National Center for Education Statistics [NCES] 2002) and only half of those students remaining after the first year (Chang, 2002), many professional associations and governmental agencies are concerned about the state of engineering and science education and implications for the future workforce.

Factors causing students to switch from engineering and science (Seymour & Hewitt, 1997; Daempfle, 2003) include: institutional factors (i.e., the college "chilly" climate versus a more nurturing high school experience and lack of personal contact with faculty), differing high school and college faculty expectations as well as student expectations, and epistemological assumptions (relating to the belief in the certainty of knowledge).. For engineering programs this is particularly disconcerting since many will lose up to half of their students in the first year (Seymour & Hewitt, 1997; Daempfle, 2003; Hilton & Lee, 1998) - including those students who already have taken higher math and science classes in high school and have high SAT math scores (Seymour & Hewitt, 1997). As a solution to this problem, learning communities hold promise for engineering and science departments as they have been shown to increase retention, improve student attitudes and engagement, and increase academic achievement (Taylor, 2003; Blimling & Hample, 1979; Blimling, 1993; Minor, 1997; Pascarella & Terenzini, 1991).

1.2 *Learning communities*

Learning communities are described as the purposeful rearrangement of curricular time and space of both students and teachers fostering community, coherence, and connections among courses and creating sustained intellectual interaction among students. (Gabelnick, F., MacGregor, J., Matthews, R., & Smith, B. L. (1990) & Lenning, O. T., & Ebbers, L. H. (1999)) Learning communities take many forms including class linked with a seminar, two or more courses linked thematically, multi- or interdisciplinary team-taught courses, integrated block studies, and common residences linked thematically or with common programming and/or classes (Smith, MacGregor, Matthews, & Gabelnick. 2004). Learning communities in their various forms can be found in community colleges, two- and four-year colleges, and research institutions (Smith et al, 2004) and all enroll a common cohort of students.

Based on emerging research, the promise of learning communities to increase retention, engagement and academic abilities (Tinto, 1997; Cote & Levine, 1997; Stassen, 2003; Zheng, Saunders, Shelly, & Whalen, 2002) could mitigate factors of competition, isolated learning, limited diversity, and chilly climate that cause students to drop out of science and engineering programs (Seymour & Hewitt, 1997). Because of the diverse needs of first-year entering engineering and science students, a holistic living-learning community that encompassed social and cognitive learning was proposed to improve retention, increase engagement, and facilitate intellectual development.

1.3 Institutional background

Washington State University is a land grant, comprehensive research institution with an undergraduate enrollment of approximately 15,000 students. There are nine colleges and a graduate school. WSU offers 150 bachelor's degrees in all fields of study with master's and doctoral degrees available in most. The university is one of the largest residential universities in the West with a small-town living environment. The Living-learning community (LLC) program built on an existing residential program to bring in a strong academic component through common classes and an integrated seminar and called Teniwe (Nez Perce word meaning "to talk"). Students self-selected into the LLC program when making their residential arrangements and were pre-registered in up to three common classes during a summer advising program. The program was funded through grants from the Washington State University Office of Undergraduate education and private donations.

1.4 2003 Teniwe program

Beginning in the summer of 2003, a group of faculty and student researchers with university administrators designed a semester-long LLC specifically for entering engineering freshmen. The program developed from earlier learning community research but employed a holistic approach by combining three elements not commonly found together in learning communities: a common living arrangement, three common classes, and a regularly scheduled weekly group meeting facilitated by an engineering or chemistry upperclassman. The program built on an existing residential-only learning community structure and incorporated common classes with weekly structured study/discussion groups.

Weekly meetings were modeled using elements from peer-led team learning (Tien, Roth & Kampmeier, 2002; Quitadamo, I. J., Brahler, C. J., Crouch, G. J., 2005); where upperclassmen peers who are closer in age and knowledge facilitated meetings by serving as a guide and provided support as students work on problems and activities designed by instructors of the linked courses.

Linked classes included world civilizations history (GenEd 110), pre-calculus math (Math 107) or calculus (math 171), and innovations in design (Eng 120). Classrooms were reserved for the weekly groups, and peer facilitators were hired and trained to work with the groups prior to the fall 2003 semester.

During the summer linked course faculty and researchers met to develop ideas for common contextualizations between the linked classes curriculum and course content. Additional discussion items and activities to enhance students' cogitative abilities were developed for use in weekly meetings. Faculty coordinated test dates so no tests in common classes were on the same days. A schedule of activities for the weekly meetings was purposefully arranged to coincide with linked class test dates and course content. Throughout the summer and into the semester faculty and researchers met to keep abreast of peer group meetings and track student progress.

Engineering students that applied and had been accepted into WSU who were not transfer students were sent a letter describing the program and encouraging them to participate. Students self-selected into the living-learning community (LLC) program when they signed up for residential housing and were accepted into the program on a first-come first-served basis. The first year 58 students, 46 male and 12 female, signed up for the program. All students were preregistered for the three common classes during a summer registration event and assigned housing in a common residential hall. When the students went through the official registration processes, they only needed to sign up for classes other than the three linked courses.

1.5 2004 Teniwe program

The following year the program was expanded to include biotech entering freshmen in addition to engineering students. Eighty-one students signed up for the program, 59 engineering students and 22 science students. Several changes were implemented including alterations to the weekly meetings and additional assessment measures. Instead of the weekly meetings, students registered for a two-credit seminar course. The same peer-lead team learning concept was applied to the seminar course where upperclassmen facilitated the classes; the difference was that there was a graduate facilitator that worked with the upperclassmen and the students, the class was two hours twice a week, and students received credit for the class (although the credits did not count toward a degree in the engineering program). The seminar included additional transition skills including college study skills, time management, and familiarization with university resources along with linked course content activities.

Linked classes for biotech students included introductory chemistry (Chem105), pre-calculus or calculus math (Math 107 or 171), and introductory biology (Bio 106). For engineering students the classes were Chem 105, Math 107 or 171, and Innovations in Engineering, Eng 120. There were six seminar classes, four for engineering students and two for biotech science students consisting of 8-22 students each.

Faculty and researchers, similar to the previous year, met during the summer and throughout the semester to coordinate test schedules and develop activities aligned with linked course content. Activities for the seminar class were developed along with discussion topics and content refreshers for the peer facilitators.

1.6 Dissertation organization

The first paper in this dissertation found in chapter 2, *Evaluation of a Living-Learning Community for Freshmen Engineering Students*, provides an assessment of the first year's living-learning community (LLC) and suggests changes based on student feedback and academic achievement outcomes. The following paper in chapter 3, *Impacts of a Combined Living-*

Learning Community on Attitudes and College Engagement of Engineering Freshmen, outlines the results from an engagement survey comparing Teniwe 2003 students' engagement and planned persistence with a comparison group as well as testing the validity, reliability, and improving the survey instrument itself. The third paper in chapter 4, *Case Study for Developing and Evaluating a Living-Learning Community Program for Engineering and Science Majors Using a Mixed-Method Approach*, details the development and evaluation of the second year Teniwe 2004 LLC with additional quantitative and qualitative assessments and includes recommendations for improvement to the program. Two of the three papers, *Impacts of a combined living-learning community on attitudes and college engagement of engineering freshmen* and *Evaluation of a Living-Learning Community for Freshmen Engineering Students* are copyrighted proceedings. Permission to include them here has been granted by the American Society for Engineering Education.

1.7 Limitations

The three papers are foremost assessment studies as contrasted with what might be thought of as traditional research studies. The forms of inquiry are different even though they employ similar methodology (Upcraft & Schuh, 2002). A crucial difference between assessment and research is described by Erwin (1991) as:

> *Assessment guides good practice, whereas research guides theory and tests concepts. Assessment typically has implications for a single institution, whereas as research typically has broader implications for higher education.*

The living-learning community study presented here is an assessment; development and design were grounded in learning community research; yet the program faced time and resource limitations, was subject to organizational changes and design limitations, and was affected by political contexts. The terms "assessment" and "evaluation" are used here interchangeably and are defined as judgments made about the program with respect to the program goals and objectives at a single institution.

2.0 EVALUATION OF A LIVING-LEARNING COMMUNITY FOR FRESHMEN ENGINEERING STUDENTS

2.1 Abstract

The idea of learning communities is not new; however, its role in retention, engagement, and intellectual development for engineering students has yet to be fully explored. What aspects of a learning community are most beneficial for engineering students? What are the learning needs of engineering students that are best met with learning communities? These answers formed the basis for a living-learning community (LLC) program developed at Washington State University to retain and engage engineering students as well as increase their academic abilities.

Results from the LLC found higher grades in pre-calculus math and introduction to engineering although not significantly and increased group and individual study time. Engineering students were retained at higher rates in the major compared to peers although retention in college was similar to peers. All three elements — residential, common classes, facilitated groups — were necessary to reach the program goals although the majority of improvements are related to the weekly peer-facilitated group meetings.

2.2 Background

With only one half of a percent of the average postsecondary student body enrolling in engineering.(U. S. Department of Education, National Center for Education Statistics [NCES] 2002), and only half of those students remaining in engineering (Chang, J. C. 2002), many professional associations and governmental agencies are concerned about the state of engineering education. Several researchers identified factors causing students to switch from engineering (Seymour & Hewitt, 1997; Daempfle, 2003) including institutional factors (i.e., the college "chilly" climate versus a more nurturing high school experience and lack of personal contact with faculty), differing high school and college faculty expectations as well as student expectations, and epistemological assumptions (relating to the belief in the certainty of knowledge). The majority of these "switchers" change their major in their first year of college (Seymour & Hewitt, 1997; Daempfle, 2003; Hilton & Lee, 1998).

Learning communities have been shown to increase retention, improve student attitudes and engagement, and increase academic achievement (Blimling & Hample, 1979; Blimling, 1993); Minor, 1997; Pascarella & Terenzini, 1991). Adding an academic component to a residential structure has been suggested by several studies as a way to improve the college experience and increase retention and academic understanding (Blimling & Hample, 1979;Rowe, 1998; Nicklaus, 1991). Blimling & Hample (1979) found increases in academic achievement from 0.05 to 0.2 grade points per quarter when residential environments were restructured around common academic themes.

For this study, the living-learning community (LLC) consisted of entering freshmen living in a common residence hall on two floors, taking up to three co-curricular classes with each other, and attending a once-a-week peer facilitated group. The LLC design incorporates a strong academic component based on research suggesting students in a residential program without an academic component are not as likely to show any differences in academic achievement or retention as their non-participating peers (Pike, Schroeder & Berry, 1997; Ware & Miller, 1997). Furthermore, learning community research suggests that co-curricular classes can help academic achievement, but do not necessarily show any gains in students' attitudes and engagement when compared to their peers (Rice & Lightsey, 2001). Consequently, to develop a holistic living-learning community that results in academic gains, retention, and positive attitudes and engagement appears to require all three parts: the residential component coupled with the common classes and, even more important, the facilitation of collaborative learning through the small group seminars.

2.2.1 Evaluation Background

As with any program, evaluations ultimately determine the fate of a program. This presents a dilemma as judging "success" can be viewed differently depending upon the context of the reviewer. Additionally, impacts may emerge over time and not noticed in a single semester. From a strictly quantitative standpoint, grades and retention can easily be measured, however, drawing a clear line of impacts solely from the LLC to grades, retention, and engagement becomes more complicated; consequently, a wide variety of assessments have been used to evaluate learning community impacts.

Methods for evaluating learning communities have been proposed by Moore (1995), Tinto, Love, & Russo (1995), and Wilkie (1995). Moore used Perry's (1970) theory of intellectual development as a basis for measuring the effects of learning communities. A survey instrument, the Measure of Intellectual Development (MID), an essay-writing test derived from Perry's work, was used to determine impacts from the learning community. The MID was given to learning community participants and also to peers who were then scored on a 1.0 to 5.0 system relating to where they stand in Perry's intellectual development scheme. Intellectual development was then compared between the two groups. Results from this study found that learning community participants showed further developmental gains than their non-participating counterparts.

Love, Tinto, & Russo (1995) approached assessment by first assuming learning communities were effective ways to respond to the academic and social needs of students. Further, they were “casting our nets widely in an effort to be open to unexpected phenomena.” The researchers suggested that by doing this, subjective value judgments were eliminated and instead an understanding developed about how each program met the needs of students at each institution and how it shaped student learning and persistence.

Wilke (1995) proposed a more “institutional” method by responding to a series of questions divided into three categories: student performance, student retention, and student development. A mixed measures approach was used collecting both quantitative (grades, retention, course completion, credits completed) and qualitative (students’ responses to learning communities, students perceptions of themselves as learners, and difficulties encountered by students in learning communities) methods. Wilke (1995) asserts the inclusion of quantitative data offers an explanation for quantitative results in relation to the impacts from the learning communities and because there is value in building a case directed toward administrators for learning communities.

The assessment approach for this study most closely resembles Wilke’s (1995) approach using both qualitative and quantitative methods to measure living-learning community (LLC) impacts. Grades and retention, easily obtainable data for institutional databases, were analyzed in conjunction with qualitative measures consisting of surveys, mid-term assessments, and focus groups to assess the impact of this living-learning community on engineering students.

2.3 Methods

2.3.1 Living-learning community program model and participants

The design for this engineering LLC consists of three parts: a residential living arrangement, common classes (math, history of world civilizations, introduction to engineering), and a peer facilitated small group meeting. Fifty-eight students (48 male, 10 female) self-selected into the program during housing registration in May 2003 prior to entering college August 2003. Three male students dropped out of the program before mid-term and were not included in the analysis.

Students were housed on two floors in one residential hall and were registered for the three classes and were assigned a meeting time and room for the weekly small-group peer-facilitated meetings. The two-hour once-a-week peer-led groups were not credit-bearing classes.

The peer-facilitated groups were designed to provide transition skills (college study skills, campus resources, time management), cross-class connections, and an increased knowledge of linked course content through faculty-developed activities. The weekly meetings were based on the peer-lead team model where upperclassmen peers who are closer in age and knowledge facilitated meetings by serving as a guide and provided support as students work on problems and activities designed by instructors of the linked courses (Tien, Roth & Kampmeier, 2002 and Quitadamo, I. J., Brahler, C. J., Crouch, G. J., 2005).

Prior to the beginning of the semester, faculty teaching the linked classes and researchers met to develop activities specific to the linked class content for use in the peer-facilitated groups. Tests in the linked classes were coordinated so they were not on the same day and specific activity modules were scheduled to coincide with course content in the linked classes.

The program used qualitative and quantitative measures to assess impacts from LLC participation on students' grades, and retention, and engagement. The measures used for the assessment included grades from the linked classes, retention semester to semester and year to year, mid term assessments, focus groups and an engagement survey.

A comparison group of non-LLC participants was identified from students taking the same linked classes, living in the same residence hall (but not the same floors), and had graduated high school in May 2003. However, comparison groups for the grade, retention, and engagement analysis were different in other respects. Students chosen for grade comparison had characteristics as described and had indicated intended majors in engineering (general engineering, civil, mechanical, electrical, computer, bioengineering, material science), architecture, or construction management. Students chosen for the retention comparison had declared majors of engineering but not architecture or construction management. Although the curriculum for architecture and construction management is similar to engineering during the first two years (which is why they are included in the grades analysis), they are different programs and the architecture program is highly competitive with only about half of the students continuing the second year. Students chosen for engagement comparison were those taking one of the three sections of introductory engineering during the Fall 2003 semester.

Other variables known to influence students (Pascarella & Terenzini, 1991) including parent characteristics, prior experiences, self-regulation, and motivation were not controlled; however, the use of similar comparison groups serves to mitigate these effects. Additionally participants self-selected into the program after receiving a letter sent to all incoming students that identified engineering as their intended area of study soliciting participation in the program on a first-come, first-served basis. This study was carried out at a single large, research university in a predominately rural locality serving approximately 15,000 undergraduates and has a first year on campus residence requirement.

This study is foremost an assessment rather than a research study. Erwin (1991) outlined two important contrasts: 1) "Assessment guides good practice, whereas research guides theory and tests concepts." and 2) "Assessment typically has implications for a single institution, whereas research typically has broader implications for higher education." The LLC program was developed from the best possible methodological standpoint given resource and time limitations that would still produce useful and credible results.

2.3.2 Demographics of LLC and control students

The ratio of gender and ethnicity between the LLC and comparison students was similar. Tables 2-1 and 2-2 outline the demographics of the freshmen students.

Table 2-1. Gender

Gender	LLC	Control	Total
Male	45	334	379
Female	10	68	78
Total	55	402	457

Table 2-2. Ethnicity

Ethnicity	LLC	Control	Total
Asian	7	27	34
African American	2	12	14
Native American	1	3	4
Hispanic	2	15	17
Caucasian	38	316	354
Not Indicated	5	29	34
Total	55	402	457

2.3.3 Assessments

2.3.3.1 Grade comparison analysis

Final class grades were used to determine academic gains between the LLC students and control peers. Common class grades (math, chemistry, world civilization, and engineering) were analyzed by class for differences in means using the non-parametric Kruskal-Wallis tests. Grade data was collected through institutional databases by querying students using their college identification number and enrollment in the class.

2.3.3.2 Student preparedness analysis

Academic Index Number (AIN), a measure specific to Washington State institutions, was used as a measure of student preparedness and collected from the institution's official database. AIN is a formula derived by the sate of Washington that combines a student's high school GPA and SAT scores in an approximate one-third/two-third ratio, respectively. Independent-samples *t*-test was performed including Levene's test for equality-of-variance to determine differences between Teniwe students and control peers for each of the individual common classes analyzed.

A one-way analysis of variance was performed to determine the significance of participation in the seminar class on LLC student grades since the peer facilitated group meetings were voluntary. LLC student participation over the course of 12 weeks was categorized into low (attended less than five seminar meetings), and high (attended five or more meetings).

2.3.3.3 Retention analysis

Retention (fall 2003 to fall 2004) between LLC and control students was analyzed using the Crosstabs procedure in SPSS version 11.0 which applies a Pearson χ^2 for a 2x2 (LLC/control x enrolled/not enrolled) contingency table analysis. Institutional data for enrollment status was collected on the tenth day of the semester which is the date administrators use to indicate official enrollment.

Additional analysis compared the frequency of LLC students who switched from engineering to a different major and their control peers using the same Crosstabs methodology. Students who were not retained in the institution were not included in the switching analysis.

2.3.3.4 Mid-term assessment surveys

Mid-term assessments were used to gage student response to the LLC program in meeting the program goals. The formative assessment was also used to make adjustments to the curricula of the peer-facilitated meetings to meet student needs. Surveys were completed by students during the 8th week of a 15 week semester. Surveys were distributed during the regular seminar meeting and collected by the peer-facilitators. The surveys consisted of four questions: 1) What are three strengths of your engineering Teniwe peer group; 2) What are three things about the engineering Teniwe peer-group you would change; 3) How has school been going so far; and 4) Do you have any other comments.

2.3.3.5 Focus Groups

During the 13th week of the semester, all the peer-facilitated groups had focus group assessments. As an added incentive for increased participation, pizza was provided during those meeting times. Focus groups for each of the seminar meetings were conducted by a marketing doctoral candidate with prior experience conducting focus groups for the college of engineering and architecture; a copy of the questions used in the focus groups is included in the Appendix. Three focus groups were held with LLC students; two on November 17, 2003 (with 14 students in one group and three in the other) and November 18, 2003 with ten students. Each session lasted approximately one hour. A fourth focus group was held November 18 with six peer facilitators to gage their perceptions of how the program was being implemented and if they thought it was meeting the program goals. No peer facilitators or administrators associated with the program were present during student focus groups. No program administrators or associated faculty were present during the peer facilitator focus group.

The focus group session was divided into three sections. The first session consisted of questions used to discuss a wide range of issues pertaining to the Teniwe LLC and the program's perceived effect on students' attitudes and engagement (questions 1–6 in Appendix). The next section of questions focused on discussing the students' relationships with Teniwe peer facilitators (question 7). The final group of questions focused on general questions designed to gather students' perceptions regarding enrollment at WSU and in the engineering program, general praises or criticisms of the Teniwe program, and a summary of satisfaction with the program (questions 8–10). Results from the focus groups were summarized in a report to researchers.

2.3.4 Engagement Instrument

An analysis of change in engagement and attitudes toward college were measured using a pre-post survey originally developed at Iowa State University (Huba, McFadden, & Epperson, 2000). The survey was administered to all three sections of the introductory engineering class during regular class meeting times. Self-reporting surveys were used to document attitudes and activities of both the LLC participants and control students at the start and end of their first semester. Additional survey questions were asked of the LLC students soliciting their thoughts and perceptions about the program.

The survey was administered as a pre- and post-survey; the pre-survey was administered during the second week of the semester and the post-survey was administered during the fifteenth week. Survey respondents were freshmen engineering students attending one of three course sections of the introductory engineering classes. Living-learning community (LLC) participants made up the majority of students in one of those sections. Student gender and demographics for the study population are shown in Tables 2-3 and 2-4. The control group for the survey analysis is different than the control group for the grades and retention analysis although many of the control group members overlap.

Table 2-3. Survey respondents gender

	Male	Female	Total
LLC	39	12	51
Control	142	23	165
Total	181	35	216

Table 2-4. Survey respondent ethnicity

	Not Indicated	Asian	African American	Native American	Hispanic	Caucasian	Total
LLC	5	6	2	1	2	35	51
Control	24	9	2	2	4	124	165
Total	29	15	4	3	6	159	216

All analyses were performed using SPSS version 11. Frequencies were determined for all Likert scale questions and *t*-tests were run with comparison groups and LLC students on items that addressed activities promoting learning and persistence, satisfaction with learning environments, and student estimates and actual time spent on activities. Responses to the open ended questions were coded and those with the highest frequencies are reported.

For each scale a repeated measures analysis of variance was performed with data from the students who completed both pre- and post-surveys. Interactions using paired sample *t*-tests to determine significance at the 95% level were used to assess whether LLC students reported learning more during the semester than their non-participating peers.

2.4 Results

This study used a mix of quantitative and qualitative measures to evaluate the engineering LLC. Surveys of college engagement and attitudes along with focus groups and mid-term assessments provide support and explanation for the quantitative data found through class grades and retention.

2.4.1 Quantitative Analysis

Grades were used to determine academic gains between the LLC participants and nonparticipating peers. Common class grades (math, world civilization, chemistry, and engineering) of LLC students were compared with non LLC peers using non-parametric measures. An analysis of covariance was performed to control the effects of student preparedness using the Academic Index Number (AIN) as the covariate. Additional analysis comparing the participation rates in the seminar class of the LLC students compared with the control students was performed to detect any statistical differences with respect to the effects of the peer-facilitated group meetings. Retention from fall 2003 to fall 2004 was analyzed in addition to measuring how many students switched out of engineering as their major.

Initial analysis using non-parametric Kruskal-Wallis tests showed LLC students had higher grade averages in pre-calculus and significantly higher grades in introduction to engineering. Control students had higher grade averages in chemistry, world civilizations, and calculus. Table 2-5 details the grade analysis.

Table 2-5. Grade analysis results

Class	Group	Rank	Number	Significance
Introduction to Engineering	LLC	112.12	49	.043
	Comparison	94.66	148	
Chemistry	LLC	60.44	40	.457
	Comparison	65.64	87	
World Civilization	LLC	70.78	49	.309
	Comparison	79.46	104	
Pre-Calculus	LLC	39.41	32	.052
	Comparison	30.14	36	
Calculus	LLC	33.45	11	.847
	Comparison	34.70	57	

A one-way analysis of covariance holding AIN constant for the introduction to engineering and the pre-calculus math grades showed a significant interaction effect between the covariate (the AIN score) and the grade suggesting the results are not meaningful (Green & Salkind, 2003) so analysis was not continued.

Retention results for the first year were similar for the two groups: 89% for LLC students and 85% for comparison students. Results are shown in Table 2-6.

Table 2-6. Retention in college

Fall 2003 to Fall 2004	Not Retained	Retained	Total	Percent Retained
LLC	6	49	55	89.1
Control	51	280	331	84.6

When comparing the number of students that switched from engineering to another major, LLC students were retained in engineering more frequently than their control counterparts although the results were not significant at the 95% level. Table 2-7 details the results of the switching analysis.

Table 2-7. Retention in engineering

	Stayed in Engineering	Switched	Total	Percent Retained
LLC	45	10	55	81.8
Control	213	118	331	69.6

2.4.2 *Qualitative Instruments/Analysis*

Mid-term assessments and focus groups were used as feedback to adjust the aspects of the program and peer-facilitated group meeting curricula in order to maintain alignment between the program goals and the students' perceptions of those goals. End-of-semester focus groups revealed students' perceptions of the success of the program and added insight to variables that contributed to their college experiences. A survey designed to measure students' attitudes and engagement was also administered in a pre-post fashion to both the program participants and their engineering peers. The survey included several open-ended questions to further understand the first-year experience of engineering students.

Mid-term assessments were given during the eighth week of school in the seminar class to assess the impacts of the seminars. Thirty-two surveys were completed and returned out of 55 participants. Of the participants in the program 30 students attended the seminar regularly (5 or more times) and 25 attended occasionally (fewer than 5 times). Four questions were asked on the mid-term assessment surveys:

1. What are three strengths of your engineering Teniwe peer group;
2. What are three things about the engineering Teniwe peer-group you would change;
3. How has school been going so far; and
4. Do you have any other comments.

Common themes that emerged are listed in Table 2-8. Overall, the students liked the time to work together in groups and were usually doing homework but would like to have credit and have more time to work on homework.

Table 2-8. Common themes from mid-term assessment

What are three strengths of your engineering Teniwe peer-group?	Group discussions Work on homework together Same classes Social interactions No distractions Help from peer-facilitators with homework and understanding concepts Same living arrangements
What are three things about the engineering Teniwe peer-group you would change?	Offer credit Closer to dorm Don't like prepared activities *(referring to cross-class connection activities prepared by faculty for the peer-facilitated groups)* Have an agenda/calendar Two meetings a week Nothing
How has school been going so far?	Lots of homework Confusing teachers Good Fast-paced A lot more work than I thought
Any other comments?	Teniwe was a good idea Enjoy homework help Helps to have other people explain things Having pizza is good

Based on the mid-term comments, researchers altered the scheduled activities for the remainder of the semester to include more homework time and additional time for conceptual knowledge activities from the common classes.

During the last week of classes in the first semester, all the seminars had focus group assessments. As an added incentive for increased participation, pizza was provided during those meeting times. The focus group results are grouped into three general categories:

1. Issues pertaining to the LLC and perceived effects on students' attitudes and engagement;
2. The relationships with the peer-facilitators; and
3. The students' general perceptions regarding college, the engineering program, the Teniwe program with general praises or criticisms.

Overall, all of the students participating in the focus groups said they would recommend the program to family and friends. Common advantages of the program included making new friends, ready-made study groups, and motivation to spend more time on schoolwork. Table 2-9 outlines key findings from the focus groups.

Table 2-9. Key findings from focus groups.

Issues pertaining to the LLC and perceived effects on students' attitudes and engagement	• Community developed by the program helped students get on track as a new student. • Students signed up because they would have an easy time forming study groups. • Made good "academic" friends but not necessarily the friends they would hang out with on a regular basis. • Groups exceeded expectations because of the facilitated groups helping to get through homework. • Expected to meet new people and form friendships through the program and the program has lived up to their expectation – major reason they met most of their friends. • Expected program to find peers that would help each other be successful in the engineering program. • Expected program to provide forum for extra studying • Lack of accountability (i.e. credit) caused group members to be more disruptive and goof around. • Living arrangements beneficial because they know they have help outside of the classroom living next door to them. • Disagreement about what should be studied during seminar class times and concerns that class turned into social events. • Residential arrangement most important aspect of program followed by class schedule, then weekly peer group meetings • Need engineering majors for peer facilitators. • Beneficial for developing time management and scheduling skills. • Helped to study for tests effectively. • Didn't like two-hour sessions would prefer two, one-hour sessions. • Students believed they benefited more than their non-participating peers because of the peer group structure which mediated additional study group time and motivation.

Relationships with the peer-facilitators	• Helpful for issues pertaining to "navigating the college system" but not for learning course content. • Peer-facilitator was not an engineering major and therefore was unable to answer questions related to future engineering studies and careers. • Perceived as caring and hard-working. • Viewed peer-facilitators as friends and role models.
General perceptions regarding college, the engineering program, the Teniwe program with general praises or criticisms	• Students were all staying in engineering although two were changing colleges for a specialized degree in engineering not offered at the institution. • Students would recommend the program to friends and family members. • Would like forum for discussing different engineering fields. • Move seminars to dorms. • Match classes and seminars more closely.

Engagement survey results indicated that the living-learning community offers important benefits toward achieving important goals of these students and produces more positive attitudes about engineering.

Pre-survey questions asked students to rate their knowledge and abilities and the importance of certain activities that promote learning and persistence. The survey used a 9-point Likert scale that ranged from "very weak" to "strong" for knowledge and abilities questions and "not at all important" to "very important" for the activities that promote learning and persistence. In a separate section students were asked to estimate the time they expected to spend on activities related to school or work. Post-survey questions were similar and included additional sections asking students to rate their level of satisfaction with their learning environment. LLC students were asked additional questions about their satisfaction with the LLC and to rate their LLC experience overall.

Entering engineering LLC participant responses were similar in many ways to those of their peers at the beginning of the semester. At the end of the semester, differences in their college experiences began to emerge as they spent less time at paid work and more time in study groups, interacted more with their advisors and instructors, and indicated their planned persistence in engineering at a much higher frequency (94%) than their non-participating peers (78%). In-depth analysis of the survey results and instrument validation and reliability are reported in chapter three.

2.5 Conclusion

Students became immersed in engineering studies facilitated by the LLC program as evidenced by comments from the students in the mid-term assessments, focus groups, and the engagement survey. The mid-term assessments indicated students were studying more in groups and felt more prepared for tests. They were making new friends – friends that they believed they might not have found if not for the program. Students were more motivated to do homework because of the weekly peer-facilitated group meetings although only slightly more than half regularly attended.

It was surprising even though students reported increased time studying alone and in groups and that one of the most frequently cited benefits was the ability to run down the hall and ask questions of a peer at almost any time, that the academic gains were not as pronounced. Although students had higher grade averages in pre-calculus and introduction to engineering they had lower averages for chemistry, calculus, and world civilizations. This may suggest that students are spending more time studying but the time is not improving their academic abilities. Future research in students' study skills and habits would be useful for identifying components necessary for improving academic achievement in LLCs. Collaborative learning has been shown to improve intellectual development (Moore, 1995; Springer, Stanne, & Donovan, 1999). Measures to assess changes in intellectual development and critical thinking would help to elucidate academic achievement aspects of LLCs.

Retention in college was similar between LLC participants and comparison peers; however, retention in the major was 12% higher for LLC students. Considering an average incoming engineering freshmen class of 450 students, approximately 54 additional engineering students could potentially be retained. One explanation for higher retention in the major could be attributed to a higher motivation to complete an engineering degree from LLC participants as evidenced by their motivation to participate in the program in the first place. However, the similarity of the survey engagement results between LLC students and the comparison group suggest that the students in the introductory engineering course were more alike than different with respect to their attitudes toward college and engagement in activities that promote learning and persistence as well as their incoming knowledge and abilities. At the end of the semester both groups reported participating in activities that promote learning and persistence at similar levels although LLC students reported spending more time studying in groups, interacting with faculty and advisors, and less time at paid work – consistent with intended LLC activities.

A common concern of LLC students was the perception that the weekly peer-facilitated groups required them to participate in activities they believed were "busy work." Although these activities were developed by faculty from the common classes for to increase content critical thinking, the majority of activities did not have any direct effect on the student's grade in that class. This could be one explanation for the "busy work" perception. Additionally, a common student assessment problem is that benefits are not readily apparent to the students as many of these impacts emerge over time and are not captured in one semester. (Taylor, 2003).

2.5.1 Recommended changes

Although students expressed the most concerns about the weekly seminar class, this class time was crucial. Students in this study did not "naturally" form groups as might be expected by the close proximity residential arrangements and common classes – even three weeks after they started living with and taking the same classes with their peers. An additional mechanism was required that forced the students together. That force, in this study, was the weekly peer-facilitated group meetings. Because this activity was the most controversial, it is for this part of the program that the majority of recommendations are made. First, tie class activities to the common classes through assignments or as part of their grade. Second, schedule the seminar class for two, one-hour periods twice a week with time available after class if students wish to continue studying in the same room. Additionally, it is believed that two, rather than three linked classes, would accomplish the same objective (providing common study goals) and would be much easier to accomplish administratively.

Like any program, a learning community must remain fluid and responsive to its stakeholder needs. Continuous ongoing assessment and evaluation will refine this program while retaining an increasing number of engineering students.

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2.7 Appendix: Focus group questions

Questions for Teniwe participants' focus group

1) What prompted you to sign up for the Teniwe program?
2) What did you expect from the Teniwe program when you signed up?
    a. Has the program lived up to those expectations?
    b. Why or why not?
3) Do you feel you are benefiting from the Teniwe Engineering Freshmen Learning Community?
    a. In what ways are you benefiting?
    b. What do you like best about the program?
    c. Which part or the program is most important: the residential arrangements, the common classes, or the weekly Teniwe learning groups? Why?
    d. What would you change about the program?
4) Do you have a better understanding of engineering and the types of engineering work you would be interested in doing?
    a. Have you decided on a major?
    b. Has your interest in engineering changed? How? Why?
5) Do you think you have done better academically than you would have without the program?
    a. How do you think you have benefited compared to non-participating students?
    b. Do you think Teniwe has helped you with your grades?
    c. Do you think Teniwe has helped you with time management?
    d. What do you think about planned activities in your Teniwe group?
    e. Has the program helped you with your classes and exams? How?
    f. Do you study with friends or by yourself?
    g. How do you decide when to do your homework and how long to study?
    h. Who do you ask for help when you have questions?
6) Have you made new friends through the program?
7) What are your perceptions of the Teniwe group facilitators?
    a. Are you learning from your facilitators?
8) Do you plan on continuing in engineering? Do you plan on staying at WSU?
9) Is there anything in particular you would like Engineering administrators to hear that we have not talked about? Praises or criticisms?
10) Summary of satisfaction with program. Is the Teniwe learning community "valuable?"

3.0 IMPACTS OF A COMBINED LIVING-LEARNING COMMUNITY ON ATTITUDES AND COLLEGE ENGAGEMENT OF ENGINEERING FRESHMEN

3.1 Abstract

Preparation for a diverse workforce of engineering graduates suited for professional practice or graduate school is a major challenge to engineering educators. Immense challenges occur during students' first year in higher education where high attrition typically occurs among prospective engineering students. A living-learning community (LLC) model was developed for engineering students at Washington State University combing residential and academic learning community features as a means for improving retention and academic success in engineering. Living-learning community freshmen shared up to three classes, lived in a common residence hall, and engaged in facilitated group activities. Self-reporting surveys were used to document attitudes and activities of both learning community and comparison students at the start and end of their first semester. Results indicated that the living-learning community offers benefits toward achieving student goals of transitioning to college life, making friends, and produces more positive attitudes about engineering.

3.2 Introduction

The purpose of this study was to assess changes in affective and behavioral aspects of student learning during and after participating in a living-learning community for engineering freshmen. Common assessments of learning communities regularly include grade point average and retention, and this study is no different. However, an additional measure of attitudes and affective learning attributes as well as satisfaction with their living-learning community was also part of the assessment. It is the latter assessment that is detailed in this paper. Survey results from

LLC students and their non-participating peers were compared and reported along with an evaluation of the survey itself (a copy of the survey is included in the Appendix).

Measuring the attitudes and behaviors of students is an often overlooked but extremely important element of learning that occurs during college (Pascarella & Terenzini, 1991; Cove & Love, 1995; Joint Task Force on Student Learning, 1998; Brownstein, 2000;). Common markers of success – grades and retention – do not give a complete picture of a student's learning. Recently a movement to measure the engagement aspect of student learning has emerged. Several national instruments, including the National Survey of Student Engagement (NSSE), College Student Experience Questionnaire (CSEQ), and the Community College Survey of Student Engagement (CCSSE) as well as other smaller institution-oriented instruments (California Learning Community College Network – Resources for surveys available), have been developed to assess these aspects of learning. Accreditation organizations and professional associations are beginning to require evidence of student learning and development in all areas of student learning —not just the classroom. Institutions increasingly are expected to assess critical thinking skills, knowledge and cognitive abilities, student attitude development and growth, life skills, student activity involvement, student opportunities for learning, practice, feedback and support, along with student needs, experiences, and levels of satisfaction.

Emerging research on learning communities is showing promise as an instructional method for improving engineering education by increasing academic abilities, attracting participation from women and minorities, and fostering positive attitudes toward college (Tinto, 1997); Cote & Levine, 1997; Zheng, Saunders, Shelly & Whalen, 2002; Stassen, 2003). The premise of this paper is that living-learning communities structured specifically for engineering students can positively impact affective learning and associated behaviors and mitigate effects of competition, weed-out, and isolated learning that have been cited as reasons for leaving engineering (Seymour & Hewitt, 1997), and provide evidence of student attitude development and growth, student activity involvement, and student opportunities for learning through engagement survey results.

The learning community concept has roots dating back to 1264 in Oxford, England (Ryan, 1992), and has been defined many ways (Gabelnick, MacGregor, Matthews, & Smith, 1990; Lenning & Ebbers, 1999). For this study, learning community is defined as the purposeful rearrangement of curricular time and space of both students and teachers to foster community, coherence, and connections among courses and create more sustained intellectual interaction among students and their teachers. In particular, the LLC in this study is further defined as a group of students sharing the same intended major, enrolled in up to three co-curricular classes and participating in weekly peer-facilitated groups.

The engineering LLC in this study combined two existing programs, a residential learning community and a chemistry peer-facilitated team learning model (Quitadamo, Brahler, Crouch, 2005) along with common co-curricular linked classes. The 55 LLC participants were able to live with their engineering peers, attend up to three common classes together, and meet weekly with the same small group of students and an upper-classman peer-facilitator.

3.3 Method

College engagement evaluations were made from individual responses to a survey and assessed by measuring students' attitudes, participation in activities that contribute to success in college (Pascarella & Terenzini, 1991), and time students spent doing various activities. An analysis of change comparing responses from the beginning of the semester to the end and comparing LLC students to non participating peers was performed. The survey was administered as a pre- and post-survey; the pre-survey was administered during the second week of the semester and the post-survey was administered during the fifteenth week to engineering freshmen in an introductory engineering class during the fall 2003 semester.

3.3.1 Participants

Survey respondents were freshmen engineering students attending one of three course sections of Engineering 120, Innovation in Design. Innovations in Design is a required class in the engineering curriculum and is generally taken during the first semester of college. LLC members made up the majority of students in one of those sections. Student demographics for the study population are shown in Tables 3-1 and 3-2.

Table 3-1. Gender

	Male	Female	Total
LLC	39	12	51
Comparison	142	23	165
Total	181	35	216

Table 3-2. Ethnicity

	Not Indicated	Asian	African American	Native American	Latino/a	Caucasian	Total
LLC	5	6	2	1	2	35	51
Comparison	24	9	2	2	4	124	165
Total	29	15	4	3	6	159	216

3.3.2 Limitations

The subjects of this study constitute a convenience sample from those taking the Engineering 120 class. Generally students take this class during their first year and are freshmen with a declared major of engineering. Students who participated in the LLC were not randomly chosen but self-selected into the program. Although the LLC student's gender and ethnicity statistically mirror the freshmen population as well as their incoming preparedness (Green &

Salkind, 2003) there may be other influences regarding internal motivation for choosing and remaining in engineering.

3.3.3 Instrument

The Iowa State University Undergraduate Education Survey 2000 (Huba, McFadden, Epperson, 2000) was the survey instrument used for this study. Pre-survey questions asked students to rate their knowledge and abilities and how important certain activities that promote learning and persistence were to them using a 9-point Likert scale that ranged from "very weak" to "strong" for knowledge and abilities questions and "not at all important" to "very important" for the activities that promote learning and persistence. In a separate section students were asked to estimate the time they expected to spend on activities related to school or work. Post-survey questions were similar and included additional sections asking students to rate their level of satisfaction with their learning environment. LLC students were asked additional questions about their satisfaction with the LLC and to rate their LLC experience overall.

3.3.4 Analysis

All analyses were performed using SPSS version 11. Frequencies were determined for all Likert scale questions. Several *t*-tests were run comparing LLC and comparison students on items that addressed activities promoting learning and persistence, satisfaction with learning environments, and student estimates and actual time spent on activities. Chi-square analysis was used to measure differences in students' responses to the planned persistence question "do you plan on staying in engineering?" Responses to the open ended questions were coded and those with the highest frequencies are reported.

Confirmatory factor analysis of the seven previously identified scales underlying the set of knowledge and ability items for the pre- and post-surveys were analyzed separately using a promax solution with pairwise deletion of missing data (as similarly performed by Iowa State University in the development of this instrument). Mirroring the steps of development by Iowa State University researchers, the same seven scales – knowledge, diversity, written communication, critical thinking, teamwork, oral communication, and time management – were extracted for computation. Reliability analysis for each scale was also performed.

For each scale a repeated measures analysis of variance was performed with data from the students who completed both pre- and post-surveys. Interactions using paired sample *t*-tests to determine significance at the 95% level were used to assess whether LLC students reported learning more during the semester than their non-participating peers.

3.4 Results

Entering engineering LLC participants were similar in many ways to their peers at the beginning of the semester. At the end of the semester, differences in their college experiences began to emerge as they spent less time at paid work and more time in study groups, interacted more with their advisors and instructors, and indicated their persistence in engineering at a much higher frequency (94%) than their non-participating peers (78%).

3.4.1 Pre-survey results

Both LLC students and peers starting the semester were looking forward to learning about their major and taking classes in their major, learning and increasing their knowledge, meeting new people, and experiencing college life. There was little difference in what the LLC participants were looking forward to in comparison to their non-participating peers. Both groups were worried about the same things: difficult classes, time management, grades, and workloads. Table 3-3 lists the most frequent responses to the open ended questions on the pre-survey.

Table 3-3. Most frequent responses to open-ended pre-survey questions

Question	LLC & Comparison Students	Difference
What are you most looking forward to this semester?	▪ learning about major/classes in major ▪ meeting/making friends/college life ▪ increasing knowledge/learning	
What worries you the most about your first semester?	▪ time management ▪ grades/doing well in classes ▪ difficult class/passing/math/chemistry ▪ workload ▪ failing/falling behind	Comparison students: wrong major/discipline

Students rated the importance of factors that promote learning and persistence on a Likert scale ranging from 1 (strongly agree) to 9 (strongly disagree). Table 3-4 lists the attributes associated with college success (Pascarella & Terenzini, 1991) that were significantly different between the LLC students and the comparison students when asked to rate their importance. Effect sizes, reported as *d* values, are by convention reported as .2 small, .5 medium, and .8 large (Green & Salkind, 2003).

Table 3-4. Significant college attribute ratings responses

LLC students thought it was more important to work collaboratively on class projects		LLC	Comparison
$t(117) = 3.081$	$p = .003$, $d = .49$	M = 7.71, SD = 1.08	M = 7.10, SD = 1.62
LLC students thought it was important to develop study groups with other students			
$t(128) = 4.665$	$p < .01$, $d = .75$	M = 7.69, SD = 1.12	M = 6.70, SD = 1.81
LLC students thought it was more important to interact with people from different cultural or ethnic backgrounds			
$t(108) = 2.834$	$p = .005$, $d = .45$	M = 7.37, SD = 1.38	6.67, SD = 1.91
Comparison students thought it was more important to receive prompt feedback			
$t(213) = -2.392$	$p = .018$, $d = .38$	M = 7.80, SD = 1.17	M = 8.19, SD = 0.95

Students were asked to predict how much time they expected to spend in various activities listing the number of hours for each of those activities. Significant differences in the amounts of time spent on activities are shown in Table 3-5.

Table 3-5. Pre-survey hours per week spent in college activities rated significantly different

Comparison students expected to spend more hours studying alone		LLC	Comparison
$t(212) = -2.53$	$p = .012$, $d = .41$	M = 7.71. SD = 4.50	M = 9.52, SD = 4.34
LLC students expected to spend more time studying in groups			
$t(212) = 4.792$	$p < .01$, $d = .77$	M = 6.37, SD = 3.42	M = 4.01, SD = 2.90
Comparison students expected to spend more time doing social activities			
$t(118) = -3.815$	$p < .01$, $d = .61$	M = 5.45, SD = 3.17	M = 7.68, SD = 4.72

When students were asked to rate their knowledge and abilities, there was one difference between LLC and comparison students. Comparison students had significantly higher estimates of their written communication abilities (M = 6.69, SD = 1.32) than LLC students (M = 5.25, SD = 1.41), $t(214) = -2.037$, $p = .043$ on a Likert scale of 1 (very weak) to 9 (very strong).

3.4.2 Post-survey results

By the end of the semester, differences emerged between the LLC students and their non-participating peers. Four open-ended response questions regarding academic successes and difficulties as well as what they liked and disliked about engineering were asked at the end of the survey. A considerably higher percentage of LLC students intended to continue in engineering studies (94% LLC students versus 78% non-LLC students). Table 3-6 details the perceived persistence results from the survey.

Table 3-6. Planned persistence

	Plan to stay in engineering	Do not plan to stay in engineering	Undecided
LLC	45 (93.8%)	1 (2.1%)	2 (4.2%)
Comparison	115 (77.7%)	17 (11.5%)	16 (10.8%)

Survey questions and their most frequent responses are listed in Table 3-7.

Table 3-7. Responses to open-ended post-survey questions

Question	Same	Differences	
	LLC & Compares	LLC	Comparison
What was your greatest difficulty or negative academic experience this semester?	▪ class/lab ▪ test/grades ▪ time management	▪ chemistry ▪ teaching/professor ▪ math	▪ time spent on homework/studying
What is it about the study of engineering that you like?	▪ applied real-world/science/math ▪ problem solving ▪ intellectually stimulating/interesting / technology/how things work ▪ building/constructing/ designing things	▪ creative	
What is it about the study of engineering that you dislike?	▪ difficult classes/hard to understand ▪ amount of time it takes/amount of work	▪ nothing	▪ math

LLC students were asked some additional open-ended questions on the survey about what they liked and disliked about their learning community. The most frequently cited response (>75%) to what they liked best about their LLC was studying together and being able to get help from their group members or facilitators. The students would have liked to have more of their LLC peers participating in the peer-facilitated study groups (since these groups were not mandatory) and at times wanted to study subjects that were not scheduled during the group meeting times. Their most frequent responses are listed in Table 3-8.

Table 3-8. Frequent responses from LLC students

Liked best about learning community	Least liked about learning community
▪ study together/help from group members/facilitators ▪ residential living with same majors	▪ nothing ▪ not everyone participated in study groups ▪ not getting help wanted in study groups/wanted to work on another subject in study group other than what was scheduled

Fully participating LLC students (those that attended five or more times during the semester) rated their overall LLC experience as 7.42 on a 1 (strongly dissatisfied) to 9 (strongly satisfied) Likert scale. Partially participating LLC students (attended less than five times) rated their overall experience at 6.86.

Comparison and LLC students were mixed when they reflected on the number of opportunities they had to participate in activities that promote learning and persistence such as being able to see connections among classes, being able to connect personal experience with class learning, and having better understanding of the nature of their anticipated major. Although only one significant difference was found, LLC students took advantage of these opportunities more often than their comparison counterparts. LLC students reported having more opportunities to interact with people from different backgrounds (M = 7.20, SD = 1.29) than their comparison counterparts (M = 6.53, SD = 1.69), $t(106) = 2.922$, $p = .004$, $d=.49$; on a 1 (strongly dissatisfied) to 9 (strongly satisfied) Likert scale.

Responding to questions about what students did during their non-class time, LLC students spent significantly more hours in study groups, consistent with the nature of learning communities. Comparison students spent more time at paid work. Results from the post-survey question regarding college activities are shown in Table 3-9.

Table 3-9. Post-survey hours per week spent in college activities rated significantly different

LLC students spent more time studying in groups		LLC	Comparison
$t(191) = 4.389$	$p < .01$, $d = .74$	M = 4.62, SD = 3.05	M = 2.53, SD = 2.77
Comparison students spent more time at paid work			
$t(143) = -2.506$	$P = .013$, $d = .42$	M = 0.56, SD = 2.63	M = 1.91, SD = 4.62

When asked to rate their knowledge and abilities, students responded similarly to their pre-survey responses. No significant differences between LLC and comparison students in their estimates of knowledge and abilities were found, although comparison students still rated their written communication abilities higher, (though not significantly as was found on the pre-survey), than the LLC students. Knowledge, diversity, teamwork, oral communication, and time management were all rated higher by LLC students than comparison students, although the results were not significantly different.

A repeated measures analysis was run on each scale to determine changes in the LLC and comparison groups and changes between the pre- and post-surveys. Significant differences were found in the groups taken as a whole between their pre- and post-survey responses for knowledge, written communication, and oral communication. However, there were no significant differences between the pre- and post-survey responses of the LLC group compared to the comparison group from the beginning of the semester to the end. Table 3-10 details the significance, mean, and standard deviation for the different scales.

Table 3-10. Repeated measures results

Scale	Time (pre vs. post)	Pre-survey		Post-survey	
		Mean	SD	Mean	SD
Knowledge	*t*(-6.506) $p < .01$, $d = .48$	5.41	1.51	6.15	1.32
Diversity	not significant				
Written Communication	*t*(-4.219) $p < .01$, $d = .31$	6.55	1.33	6.98	1.36
Critical Thinking	not significant				
Teamwork	not significant				
Oral Communication	*t*(3.722) $p < .01$, d = .28	6.63	1.14	6.92	1.11
Time Management	not significant				

3.4.3 Survey instrument

Cronbach's alpha was used for reliability analysis of the knowledge and abilities questions assessing internal consistency of the scales. A scale's reliability measures the consistency of questions relating to their particular scale. Reliability ranges between 0 and 1, where 1 most closely correlates to the scale and zero least correlates. Table 3-11 lists the scale, reliability, and associated questions.

Table 3-11. Scale reliability analysis

Scale	Reliability	Associated Survey Questions
Knowledge of university, discipline, and careers	.84	1, 2, 3, 4
Diversity	.79	5, 19, 20, 21
Written communication	.81	6, 7, 8
Critical thinking	.36	9, 10, 11
Teamwork	.83	12, 13, 14, 15
Oral communication/leadership	.90	16, 17, 18, 26, 27, 28
Time management	.91	22, 23, 24, 25

Reliability for six of the seven scales was high. Further refinement of the critical thinking scale is necessary for future use of this instrument. Reliability analysis for critical thinking increased from .36 to .82 if question 9 were left out. During confirmatory factor analysis, six factors, rather than seven as Iowa State University researchers found, emerged when analyzing scree plots. Scales for knowledge, diversity, written communication, oral communication, and time management were clear; however, questions about critical thinking and teamwork tended to load on other factors and question 9 loaded on a separate factor entirely. Additional refinement on teamwork question 14 is also warranted as it generally loaded on the oral communication factor. Redesigning some of these questions and subsequent testing will produce a more refined instrument useful for evaluating and benchmarking effects of engineering living-learning communities at this institution.

3.5 Discussion of Results and Implications

This study found LLC students more engaged in activities that promote learning and persistence and spending more time in those activities than their peers. Most compelling was the expected persistence in engineering, where 94% of the LLC students intended to continue their studies in engineering versus 78% of their non-participating peers. Non-significant results regarding critical thinking and teamwork indicate further work is needed with both the structure of the LLC and the survey instrument. However, initial indications of the success of the engineering LLC concept are encouraging.

During the engineering LLC pilot study, several aspects of the program were seen to be beneficial to the students. The vast majority of students were anxious to meet new friends but were worried about time management and grades. Many students in the LLC indicated they did meet new friends, did improve their grades, and improved time management and study skills. Students perceived the peer-facilitated groups to be a learning opportunity to work through concepts and problems they had with class work, which, in turn, improved their grades. Students also used the peer-facilitated groups as a method of time management by regularly using the time around the study groups for completing homework, again mitigating some of their concerns over their abilities to manage time. Students developed relationships with their upper-classmen facilitators often asking for advice and finding university resources through them, thus learning how to seek help and becoming more independent. Survey results confirm that the LLC students believed they had a better understanding of university resources, university policies and procedures, and knowledge about engineering by the end of the semester. LLC students were particularly satisfied living in the same residential hall with other engineering majors, allowing them to help each other and study together – the very essence of living-learning communities.

It is not surprising that learning communities work well for beginning engineering students because the practice of engineering usually occurs in a team setting with a great deal of interaction among team members. Additionally, engineers must be lifelong, self-directed, experimental learners to keep current in their field. Learning communities promote this type of behavior in the peer-facilitated study groups as students learn and construct concepts and ideas under guidance of their peer-facilitators. The premise of learning community theory posits that students learn from each other and learn to interact in ways that support each other both socially and academically. Living and learning in the same environment develops teamwork and critical thinking skills early in engineering students' academic career preparing them for a successful academic career and eventual entry into the engineering profession or graduate school.

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3.7 Appendix A: WSU Engineering Freshmen Survey 1

WSU ID _________________ Discipline (if known): _________________

Items 1-28. Listed below are a number of knowledge and ability domains related to your education at Washington State University. Please rate your current level of skill functioning in each domain using the scale below.

Very Weak 1 2 3 4 5 6 7 8 9 **Very Strong**

1. Knowledge of university policies and procedures relevant to undergraduate students	1 2 3 4 5 6 7 8 9
2. Knowledge of university resources for undergraduate students (e.g. writing lab, student counseling center, etc.)	1 2 3 4 5 6 7 8 9
3. Knowledge in your anticipated discipline or field of study	1 2 3 4 5 6 7 8 9
4. Knowledge of career choices and options in your anticipated discipline or field of study.	1 2 3 4 5 6 7 8 9
5. Knowledge of other cultures and/or ethnic groups.	1 2 3 4 5 6 7 8 9
6. Ability to produce well-written term papers that would receive a grade of “B+” or better.	1 2 3 4 5 6 7 8 9
7. Ability to write the types of technical, critical, review, or creative papers typical for your discipline with a grade of “B+” or better.	1 2 3 4 5 6 7 8 9
8. Ability to edit a document or paper for correct grammar, punctuation, and spelling.	1 2 3 4 5 6 7 8 9
9. Ability to analyze and evaluate ideas systematically and critically from different perspectives.	1 2 3 4 5 6 7 8 9
10. Ability to apply academic knowledge and reason to current problems.	1 2 3 4 5 6 7 8 9
11. Ability to think of different ways to solve problems.	1 2 3 4 5 6 7 8 9
12. Ability to work cooperatively and productively with others.	1 2 3 4 5 6 7 8 9
13. Ability to effectively listen to others enabling you to clearly understand what is being said and reflect that understanding back to the speaker.	1 2 3 4 5 6 7 8 9
14. Ability to interact with others and contribute to group discussions.	1 2 3 4 5 6 7 8 9
15. Ability to put team goals above your own personal goals.	1 2 3 4 5 6 7 8 9
16. Ability to make formal class presentations.	1 2 3 4 5 6 7 8 9
17. Ability to argue a point of view assertively.	1 2 3 4 5 6 7 8 9
18. Ability to persuade others to follow your lead.	1 2 3 4 5 6 7 8 9
19. Ability to effectively and comfortably interact with people from other cultures or ethnic groups.	1 2 3 4 5 6 7 8 9
20. Ability to speak up when you see bigotry.	1 2 3 4 5 6 7 8 9
21. Ability to accept religious differences.	1 2 3 4 5 6 7 8 9
22. Ability to manage your time effectively.	1 2 3 4 5 6 7 8 9
23. Ability to prioritize tasks to be performed for a project.	1 2 3 4 5 6 7 8 9
24. Ability to coordinate multiple concurrent tasks or projects.	1 2 3 4 5 6 7 8 9
25. Ability to study effectively.	1 2 3 4 5 6 7 8 9

26. Ability to inspire others through your leadership.	1 2 3 4 5 6 7 8 9
27. Ability to bring people with different viewpoints together to cooperate on a project.	1 2 3 4 5 6 7 8 9
28. Ability to facilitate group interactions.	1 2 3 4 5 6 7 8 9

Items 29-43. How important is it to you that each of the following be part of your college experience?

Not at all Important 1 2 3 4 5 6 7 8 9 **Very Important**

29. Interact closely with faculty members.	1 2 3 4 5 6 7 8 9
30. Receive individual support, encouragement of advice from faculty members.	1 2 3 4 5 6 7 8 9
31. Participate in a department club, residence government, or other organization.	1 2 3 4 5 6 7 8 9
32. Work collaboratively with other students on class projects.	1 2 3 4 5 6 7 8 9
33. Develop study groups with other students.	1 2 3 4 5 6 7 8 9
34. Apply learning to real world problems.	1 2 3 4 5 6 7 8 9
35. See connections among classes (e.g., learning in one class supports or augments learning in another class).	1 2 3 4 5 6 7 8 9
36. See connections between personal experiences and class learning.	1 2 3 4 5 6 7 8 9
37. Interact with people from different cultural or ethnic backgrounds.	1 2 3 4 5 6 7 8 9
38. Earn high grades in classes.	1 2 3 4 5 6 7 8 9
39. Take courses from professors who have high expectations for you.	1 2 3 4 5 6 7 8 9
40. Have experiences that help you understand the nature of your anticipated major.	1 2 3 4 5 6 7 8 9
41. Have experiences that "fit together" in helping you reach your goals as a student.	1 2 3 4 5 6 7 8 9
42. Have opportunities to practice the skills you are learning or have learned.	1 2 3 4 5 6 7 8 9
43. Receive prompt feedback about your progress.	1 2 3 4 5 6 7 8 9

Items 44-53. How many hours per week do you expect to spend on the following activities? Respond using the following scale.

0= 0 hours	7=7 to 8 hours	15= 15 to 16 hours
1=1 to 2 hours	9= 9 to 10 hours	17= 17 or more hours
3= 3 to 4 hours	11= 11 to 12 hours	
5= 5 to 6 hours	13= 13 to 14 hours	

44. Classes and labs.	
45. Studying alone.	
46. Studying in groups.	
47. Talking with your advisor.	
48. Talking with instructors outside of class.	

49. Community service/volunteer work.	
50. Social activities.	
51. Recreational activities.	
52. Leadership activities.	
53. Paid work.	

Please record your comments for the following questions.

A. What are you most looking forward to this semester?

B. What worries you about your first semester?

3.8 Appendix B: WSU Engineering Freshmen Survey II

Record the information requested below in the spaces provided.

WSU ID # ________________________ Discipline (if known): _________________

Items 1-28. Listed below are a number of knowledge and ability domains related to your education at Washington State University. Please rate your current level of skill functioning in each domain using the scale below.

Very Weak 1 2 3 4 5 6 7 8 9 **Very Strong**

1. Knowledge of university policies and procedures relevant to undergraduate students	1 2 3 4 5 6 7 8 9
2. Knowledge of university resources for undergraduate students (e.g. writing lab, student counseling center, etc.)	1 2 3 4 5 6 7 8 9
3. Knowledge in your anticipated discipline or field of study	1 2 3 4 5 6 7 8 9
4. Knowledge of career choices and options in your anticipated discipline or field of study.	1 2 3 4 5 6 7 8 9
5. Knowledge of other cultures and/or ethnic groups.	1 2 3 4 5 6 7 8 9
6. Ability to produce well-written term papers that would receive a grade of "B+" or better.	1 2 3 4 5 6 7 8 9
7. Ability to write the types of technical, critical, review, or creative papers typical for your discipline with a grade of "B+" or better.	1 2 3 4 5 6 7 8 9
8. Ability to edit a document or paper for correct grammar, punctuation, and spelling.	1 2 3 4 5 6 7 8 9
9. Ability to analyze and evaluate ideas systematically and critically from different perspectives.	1 2 3 4 5 6 7 8 9
10. Ability to apply academic knowledge and reason to current problems.	1 2 3 4 5 6 7 8 9
11. Ability to think of different ways to solve problems.	1 2 3 4 5 6 7 8 9
12. Ability to work cooperatively and productively with others.	1 2 3 4 5 6 7 8 9
13. Ability to effectively listen to others enabling you to clearly understand what is being said and reflect that understanding back to the speaker.	1 2 3 4 5 6 7 8 9
14. Ability to interact with others and contribute to group discussions.	1 2 3 4 5 6 7 8 9
15. Ability to put team goals above your own personal goals.	1 2 3 4 5 6 7 8 9
16. Ability to make formal class presentations.	1 2 3 4 5 6 7 8 9
17. Ability to argue a point of view assertively.	1 2 3 4 5 6 7 8 9
18. Ability to persuade others to follow your lead.	1 2 3 4 5 6 7 8 9
19. Ability to effectively and comfortably interact with people from other cultures or ethnic groups.	1 2 3 4 5 6 7 8 9
20. Ability to speak up when you see bigotry.	1 2 3 4 5 6 7 8 9
21. Ability to accept religious differences.	1 2 3 4 5 6 7 8 9
22. Ability to manage your time effectively.	1 2 3 4 5 6 7 8 9
23. Ability to prioritize tasks to be performed for a project.	1 2 3 4 5 6 7 8 9

24. Ability to coordinate multiple concurrent tasks or projects.	1 2 3 4 5 6 7 8 9
25. Ability to study effectively.	1 2 3 4 5 6 7 8 9
26. Ability to inspire others through your leadership.	1 2 3 4 5 6 7 8 9
27. Ability to bring people with different viewpoints together to cooperate on a project.	1 2 3 4 5 6 7 8 9
28. Ability to facilitate group interactions.	1 2 3 4 5 6 7 8 9

Items 29-35. Please indicate your level of agreement with each of the following statements by using the following rating scale.

Strongly Disagree 1 2 3 4 5 6 7 8 9 **Strongly Agree**

29. I was able to see connections among my classes (e.g., learning in one class supported or augmented learning in another class).	1 2 3 4 5 6 7 8 9
30. I was able to see connections between personal experiences and class learning.	1 2 3 4 5 6 7 8 9
31. I was able to earn high grades in classes.	1 2 3 4 5 6 7 8 9
32. My professors had high expectations for me.	1 2 3 4 5 6 7 8 9
33. I better understand the nature of my anticipated major.	1 2 3 4 5 6 7 8 9
34. I have had experiences this semester that "fit together" in helping me meet my goals as a student.	1 2 3 4 5 6 7 8 9
35. I have received prompt feedback about my progress in classes.	1 2 3 4 5 6 7 8 9

Items 36 – 49. Please indicate your degree of satisfaction this semester on each of the following dimensions.

Strongly Dissatisfied 1 2 3 4 5 6 7 8 9 **Strongly Satisfied**

36. Opportunities to interact closely with faculty.	1 2 3 4 5 6 7 8 9
37. Level of individual support, encouragement, or advice from faculty members.	1 2 3 4 5 6 7 8 9
38. Opportunities to interact with people from different cultural backgrounds.	1 2 3 4 5 6 7 8 9
39. Opportunities to participate in a department club, residence government, or other organization.	1 2 3 4 5 6 7 8 9
40. Opportunities to work collaboratively with other students on class projects.	1 2 3 4 5 6 7 8 9
41. Opportunities to develop or participate in study groups.	1 2 3 4 5 6 7 8 9
42. Opportunities to apply learning to real world problems.	1 2 3 4 5 6 7 8 9
43. Opportunities to practice the skills you are learning or have learned.	1 2 3 4 5 6 7 8 9
44. Overall quality of instruction that you received this semester.	1 2 3 4 5 6 7 8 9
45. Overall quality of your classmates.	1 2 3 4 5 6 7 8 9
46. Availability of your academic advisor.	1 2 3 4 5 6 7 8 9

47. Helpfulness of your academic advisor.	1 2 3 4 5 6 7 8 9
48. Overall experiences at WSU.	1 2 3 4 5 6 7 8 9

Items 50-59. During the fall semester, how many hours per week did you spend on the following activities?

0= 0 hours	7 = 7 to 8 hours	15 = 15 to 16 hours
1 = 1 to 2 hours	9 = 9 to 10 hours	17 = 17 or more hours
3 = 3 to 4 hours	11 = 11 to 12 hours	
5 = 5 to 6 hours	13 = 13 to 14 hours	

50. Classes and labs.	
51. Studying alone.	
52. Studying in groups.	
53. Talking with your advisor.	
54. Talking with instructors outside of class.	
55. Community service/volunteer work.	
56. Social activities.	
57. Recreational activities.	
58. Leadership activities.	
59. Paid work.	

Please record your comments for the following questions.

A. What was your greatest success or positive academic experience this semester?

B. What was your greatest difficulty or negative academic experience this semester?

C. Do you plan to continue in Engineering? Please circle one: Yes No Undecided

D. What is it about the study of Engineering that you:

Like:

Dislike:

If you are an Engineering Teniwe Student please complete the following questions:

Strongly Dissatisfied	1	2	3	4	5	6	7	8	9	**Strongly Satisfied**

Please rate your overall Engineering Teniwe experience	1	2	3	4	5	6	7	8	9

C. What was the most satisfying aspect of Engineering Teniwe?

D. What was the most disappointing aspect of Engineering Teniwe?

4.0 CASE STUDY DEVELOPING AND EVALUATING A FRESHMEN LIVING-LEARNING COMMUNITY PROGRAM FOR ENGINEERING AND SCIENCE MAJORS

4.1 Abstract

A living-learning community (LLC) program was developed with the objective of increasing retention of freshmen engineering and science students, improving academic abilities, and increasing college engagement. Common residence, up to three common classes, and a seminar class were the three components of the program. Using a mixed-method approach to program evaluation, this case study found significant increases for retention of engineering students in their major but not for science students when compared to control peers. There was no difference between living-learning students and control peers for retention in college. LLC students had higher grade averages in the common classes (although only significant increases in one class) compared to control peers and lower incoming preparedness (as measured by the institution's academic index number a ratio of high school GPA and SAT or ACT scores). LLC students self-reported more engagement in college activities and interacted more with each other although indicated lower institution loyalty compared to non-participating peers. Higher engagement levels of program participants were confirmed by triangulating with national survey comparisons, observations, focus groups, and student essays.

4.2 Introduction

In an effort to improve the engagement, academic abilities, and retention of engineering and science students, researchers at Washington State University developed a novel LLC for entering freshmen encompassing both residential and academic life. The program, called "Teniwe" (meaning "to talk" in the Native American language of the Nez Perce), was a voluntary, self-selected program that housed students with a common major (engineering and biotech) and pre-registered them in a common block of classes during the Fall 2004 semester. Additionally, a seminar class provided the basis for facilitating community building, familiarization with university resources, and academic improvement through study skills and content help with common-linked classes.

The first Teniwe program was started the previous year with 55 engineering students. A similar structure was employed with the exception of the seminar class. The first year of the engineering LLC the seminars were weekly two-hour peer-facilitated group meetings. The group meetings were not credit bearing and were used to work on activities developed by linked class faculty to increase course contents knowledge and for homework. Several changes were made to the LLC including expanding the program to include biotech majors (chemistry, math, biology, biotechnology, molecular biosciences, pre-veterinary, zoology), incorporating a credit-bearing seminar class with more emphasis on college transition skills and a research component in addition to content knowledge, and additional assessment measures for engagement and study skills.

The objective of this case study is to evaluate the effectiveness of the Fall 2004 living-learning community (LLC) on students' academic performance, engagement, and retention. Furthermore a mixed method approach to program assessment was used to gain insight into those aspects of the program that students perceived were more beneficial and to understand why.

Traditional evaluation of learning community programs encompassing various facets of a student's life during the first year are often limited to statistical analyses of grades, retention, and responses to surveys – indicating *what* happened but not *why* it happened. What these measures fail to address are the cumulative effects of social and academic experiences. They also fail to address temporal changes that freshmen go through during their first year and how such programs affect these changes.

While retention, grades, and engagement are measurable, the impacts of this LLC may be more subtle. Using both quantitative and qualitative data provides an opportunity for triangulating results and provides supporting evidence and possible explanations for the retention, grades, and engagement results. Additionally, through qualitative data insight is gained from the students' perspectives providing a basis for determining if the program was received by the students as it was intended.

4.2.1 Limitations

This project was undertaken with the intent of developing and evaluating a living-learning community geared to a specific population for specific reasons at Washington State University. It is foremost a case study, an assessment, rather than a research study. Erwin (1991) outlined two important contrasts: 1) "Assessment guides good practice, whereas research guides theory and tests concepts." and 2) "Assessment typically has implications for a single institution, whereas research typically has broader implications for higher education." This holds for this case study, where administrators and researchers were faced with resource and time limitations, organizational contexts, and design limitations.

4.3 Literature Review

To understand this evaluation process, it is necessary to understand the type of learning community that was developed and why this method may be useful for engineering students and science students. Also, a review of evaluation methodology for other learning communities offers different ways of conducting an evaluation for this type of LLC.

4.3.1 Learning communities

Although learning communities vary, in practice they all have the following components. MacGregor & Smith (2005) defined learning communities as those with common intentions to "rearrange the curricular time and space of both students and teachers in order to foster community, coherence, and connections among courses and more sustained intellectual interaction among students and teachers…" Shapiro and Levine (1999) identify four major types of learning communities: 1) paired or clustered courses; 2) cohorts in large courses or first-year interest groups; 3) team-taught courses; and 4) residential learning communities. Most learning communities fall within these categories or are combinations of these primary types. The learning community for this evaluation is a combination of three of these general types: clustered courses, first-year interest groups, and residential.

4.3.2 Learning communities and retention

Of the students who eventually drop out or transfer from college, approximately half leave during their first year of attendance. Some things that appear to help students integrate and persist in their new environments are (1) comprehensive, on-going orientation throughout the freshman year (Tinto, 1987; Noel, 1985), (2) a caring attitude of faculty and staff and contact outside class (Pascarella & Terenzini, 1977), (3) academic support (Tinto, 2005), (4) student-faculty discussions about social and intellectual issues unrelated to coursework (Pascarella & Terenzini, 1977), (5) involvement in campus activities (Bean, 2005; Tinto, 1997), and (6) living on campus (Astin, 1979). Astin (1984) suggested that who are engaged and integrated into their institutions are more likely to persist (Astin, 1984). Learning communities promote retention through engagement with peers, faculty, and staff.

4.3.3 Learning community components

Several studies suggest that adding an academic component to a residential learning community structure can improve the college experience and increase retention and academic understanding. (Rowe, 1998; Nicklus, 1991; Pike, Schroeder, & Berry, 1997). Blimling & Hample (1979) found that academic achievement increased from 0.05 to 0.2 points per quarter when residential environments were restructured around common academic themes. Other research suggests that students in residential programs without an academic component are not as likely to show differences in academic achievement and retention as their non-participating peers (Ware & Miller, 1997; Pike et. al., 1997). Furthermore, research on learning communities suggests that co-curricular classes can help academic achievement, but do not necessarily improve student attitudes and engagement when these students are compared to their peers (Rice & Lightsey, 2001).

4.3.4 Teniwe: a LLC model

Learning communities hold promise because they appear to mitigate many of the reasons students leave college and why they leave engineering and science. Living-learning communities for science and engineering students are predicted to be most beneficial when all three parts are combined: the residential component coupled with common classes and a coordinated seminar. Combining residence and academics appears best suited to improve retention, academic abilities, and increase college engagement (Blimling & Hample,1979; Blimling, 1993; Minor, 1997; Nicklus, 1991). Adding the third component, the small group, peer-facilitated seminars, is predicted to increase the collaborative learning between peers and provide an opportunity for upperclassmen peers to model problem solving skills and serve as mentors to LLC participants.

4.3.5 Evaluation methodology literature review

Methods for evaluating learning communities have been proposed by Moore (1995) Tinto, Love, & Russo (1995), The Living-Learning Program Report (Inkelas, Brower, Crawford, Hummerl, Pope, & Zeller, 2000), and Wilkie (1995).

Moore used Perry's (Perry, 1970) theory of intellectual development as a basis for measuring the effects of learning communities. A survey instrument, the Measure of Intellectual Development (MID), an essay-writing test derived from Perry's work, was used to determine impacts from the learning community. The MID was given to learning community participants and also to peers who were then scored on a 1.0 to 5.0 system relating to where they stand in Perry's intellectual development scheme. Intellectual development was then compared between the two groups. Results from this study found that learning community participants showed further developmental gains than their non-participating counterparts.

Love, Tinto, & Russo (1995) approached evaluation by first assuming learning communities were effective ways to respond to the academic and social needs of students. Further, they were "casting our nets widely in an effort to be open to unexpected phenomena." The researchers suggested that by doing this, subjective value judgments were eliminated and instead an understanding developed about how each program met the needs of students at each institution and how it shaped student learning and persistence.

The National Living-Learning Communities Report (Inkelas, Brower, Crawford, Hummel, Pope, & Zeller, 2000) undertook a multi-institutional study to compare types of living-learning communities (the type of learning communities that would fall under the "residential learning communities" based on the Shapiro and Levine categories listed previously) with each other and among institutions. This study is unique, as it developed a typology and a standard method of inquiry. Using Astin's (1993) Inputs-Environment-Outcomes (I-E-O) theoretical framework, the study provides useful data for benchmarking residential learning communities. The I-E-O theory is one where "*outcomes* (student characteristics after exposure to college) are thought to be influenced by both *inputs* (pre-college characteristics) and *environments* (the various programs, policies, relationships with faculty and peers, and other educational experiences that impact students)." A survey instrument was developed to identify inputs, the environment, and outcomes, and was administered to over 23,000 respondents in 34 colleges and universities. Researchers sought to reduce bias and internal validity threats by identifying and accounting for differences in "inputs" and assert that this study provides an assessment methodology for multi-institutional and like-program comparison (Inkelas, et. al., 2000).

Wilke (1995) proposed a more "institutional" method by responding to a series of questions divided into three categories: student performance, student retention, and student development. Measures were mixed using both quantitative (grades, retention, course completion, credits completed) and qualitative (students' responses to questions about their learning communities, students' perceptions of themselves as learners, and difficulties encountered by students in learning communities) methods. Wilke asserts the inclusion of quantitative data despite arguments against the appropriateness of such measures (grades might not be reflective of actual learning, students may not be retained due to non-academic reasons) because there is value in building a case directed toward administrators using more straightforward measures of grades and retention for funding learning communities.

The evaluation method for this case study is most closely related to both Inkelas et. al. (2000) and Wilke's (1995) approach using both quantitative and qualitative data to assess living-learning communities through both quantitative and qualitative measures to further understand the impacts of the different aspects of this program.

4.4 Research context

The Teniwe program was a living-learning community for biotech and engineering freshmen developed to address retention problems and designed to increase academic achievement and engagement during the fall semester of 2004. Students enrolled in the program when requesting housing. A block of rooms was reserved in one dormitory on two hall floors, one an all male hall and the other a mixed-gender hall.

Students were pre-registered for a block of classes. Engineering students were registered for math, chemistry, introduction to engineering, and freshmen seminar. Biotech students were registered for math, chemistry, biology, and freshmen seminar. Depending upon their abilities and scores on a math placement exam, students were placed in either pre-calculus, calculus for engineering, calculus for life science majors, or higher math classes.

4.4.1 Math

Teniwe students were preferentially placed in one of the four-credit sections of either pre-calculus (Math 107) or calculus for engineering (Math171). In each of those sections, Teniwe students accounted for a little less than half of the 75 or so students in that section. Of the 81 Teniwe students, 30 placed in Math 107 and 33 placed in Math 171. Six students placed in higher math classes and five choose calculus for life sciences (Math 140). The remaining seven students either dropped their math in the first two weeks or took a lower-level math course. There were no designated Teniwe sections for any of the other math sections – students were placed as their schedules allowed.

4.4.2 Chemistry

The majority of students were enrolled in a special section of general chemistry (Chemistry 105) rather than the larger (200 plus students) traditional lecture classes. The "Teniwe" section was taught by a senior faculty member and had 77 students. Although the curriculum for the class was similar in course credit and content to the traditional concurrent four-credit Chemistry 105 classes, it was taught from an inductive perspective relating concepts to everyday occurrences and correspondingly related to the professor's research.

4.4.3 Freshmen seminar

The freshmen seminar class was a small, two-credit seminar class that met for two hours twice a week. The seminar was designed to connect the linked co-curricular classes and to help transition students to college life. The seminar curriculum included reviews of linked course content, time for completing homework for common classes, activities to develop skills necessary for college (oral, written, presentation, research, technology), an introduction to campus resources, and opportunities to build community with peers, upperclassmen, and faculty.

The seminar classes were divided into four engineering and two biotech seminars. Membership in a particular seminar was based on their major (engineering or biotech) and secondly on their math class. The seminar classes ranged from 9 to 16 students, although in one seminar there were 21 students. Typically, the seminars used the first hour for developing study skills or working on the faculty-developed activities and the second hour for homework or completing seminar activities.

Several activities were developed by faculty from the common classes to increase understanding of concepts in the linked classes and were scheduled in seminar class to coincide with coverage of the content in the linked class. Freshmen Seminar program administrators and researchers developed activities to improve study skills using the content in the linked classes for context.

Leveraging Washington State University's research resources, a research component was added to the seminar class to introduce the research process to living-learning community (LLC) students. Student groups were paired with graduate students currently performing research providing an opportunity to see the research process from a personal perspective and role models for continued studies. Students met with their graduate researchers several times to learn about their research topic and tour their labs, used the library to collect additional information about the research topic under the guidance of the graduate researcher, and then created a professional poster on the research topic based on information from the graduate researcher and the additional research by the students. The research project culminated in a research symposium where students presented their research to interested students, faculty, and administrators.

All the seminars were facilitated by a pair of upperclassmen peers who were in turn guided by graduate facilitators (graduate students hired by the freshmen seminar program to oversee and guide peer facilitators) who were the official instructors of record. Peer-facilitators met once a week with their graduate facilitator to finalize the weekly activities and discuss any problems or issues they might be having with their groups.

The peer facilitators for each of the freshmen seminar groups were trained prior to the beginning of the semester in mentoring, successful study strategies, and student learning and development theory and application. Training developed by researchers and freshmen seminar administrators addressed common issues when upperclassmen students work with freshmen. Upperclassmen may be inclined to "teach" the freshmen as they understand teaching by telling students the answers or the steps to solving a problem in a more instructor-centered way rather than facilitating problem-solving in a more student-centered approach. Allowing the freshmen students to talk through their steps and discuss why they are doing and providing models for problem solving based on collaborative learning theories and a student-centered approach were practiced and discussed during the training.

Throughout the semester peer facilitators met with researchers and linked class faculty in addition to regularly meeting with their graduate facilitators in regularly scheduled meetings discussing linked class content and practicing the activities they would present to their classes. For example, when peer-facilitators were going to work with the students using technology, they first met with researchers and freshmen seminar administrators to practice and refine the Excel, PowerPoint, and webpage development activities that were linked to either the research project or linked class content.

4.5 Methodology

Holistically evaluating a program with such a variety of components necessitates a variety of assessment measures. Consequently, a mixed method approach, one that encompasses both quantitative and qualitative assessments was used. Table 4-1 lists the different assessments used for the Teniwe program evaluation. The "category" column in the table corresponds to the goals of the Teniwe program. Although some of the qualitative data overlap in two or more categories, the predominant category is listed (e.g. focus groups are listed under engagement but results provide additional insight for understanding retention and grades in addition to engagement).

Table 4-1. Program evaluation measures

Category	Sub-Category	Instrument	Analysis
Engagement	Student surveys	Course evaluation	• Aggregate responses to *learning environment* and *critical engagement* sections to gauge overall satisfaction with class • Benchmark responses pertaining to engagement questions • Analyze open-ended responses to questions for student suggestions for class improvement (Freshmen Seminar and chemistry class only)
		NSSE survey (collected in Feb)	Compare NSSE results to engineering students locally and nationally using t-test, frequencies, and effect size, Cohen's *d* (Cohen, 1988 p. 44) where .2 is small, .5 medium, and .8 is large.
	Interviews	Focus Groups	Identify students' perceptions of Teniwe program; program strengths, weaknesses, improvement
	Student essays	Reflective essays	Content analysis of reflective essays for common themes regarding engagement, program evaluation, and students' development level
	Observation	Observations during common classes	Observations of social behavior of Teniwe students compared to peers
Academic Achievement	Grades in common classes	Data collected through institutional database	*t*-tests, effect size *d* (Green & Salkind, 2002 p. 153) where .2 is small, .3 medium, and .8 large.
	Student Preparedness (AIN)		
	Study skills assessment	LASSI	comparison to national norms

Retention	Retention in college	Data collected through institutional database	Pearson's χ^2, effect size Cramer's V (Green & Salkind, 2002 p. 353) where.10 is small, .30 medium, and .50 large.
	Retention in engineering or science		

4.5.1 Study Participants

Eighty-six students self-selected by signing up for the Teniwe program. Five dropped during the first week of school leaving a total of 81 students. Fifty-nine of the Teniwe students were majoring in engineering and 22 declared in a biotech major. Biotech majors included biology, chemistry, mathematics, pre-veterinary, or zoology. Engineering majors included electrical, mechanical, civil, material science, biomedical, or computer science engineering. All students were first-time entering freshmen having completed high school in May 2004.

There were 202 engineering peer comparison students and 201 biotech comparison students. Control students graduated in May 2004, lived on campus in one of the residence halls, were freshmen starting college for the first time, and listed one of the biotech majors (biology, chemistry, mathematics, pre-veterinary, or zoology) or engineering as their major and were 18-19 years old. Gender, ethnicity, and incoming preparedness as measured by the AIN are detailed in Figures 4-1, 4-2, and 4-3, respectively.

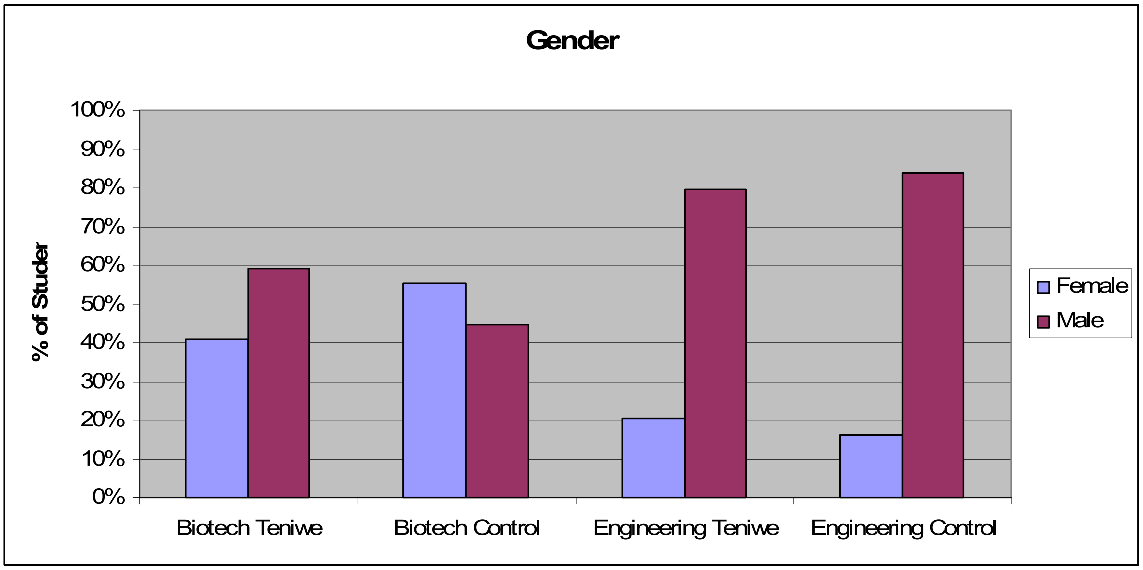

Figure 4-1. Gender.

The majority of students were Caucasian, followed by Asian, Native Hawaiian, or Pacific Islander, then Hispanic, Latino/a, or Spanish origin. Figure 4-2 outlines the number and ethnicity of the Teniwe and control students.

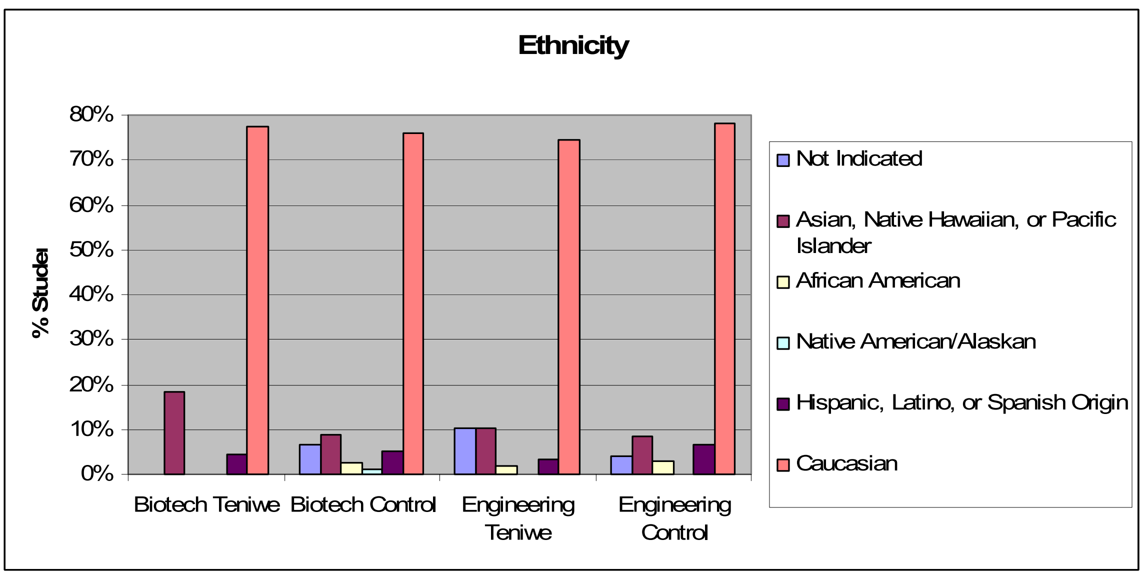

Figure 4-2. Ethnicity.

Boxplots of the AIN (a Washington state formula that combines high school GPA and SAT scores to predict preparedness for college) for Tenwie and control students are depicted in

Figure 4-3. AIN can range from zero (student was home schooled and therefore does not have an AIN) to 100, the highest AIN a student can have. Heavy black lines in the boxes represent the average AIN, and the upper and lower parts of the box represent one standard deviation above and below. The whiskers represent the second standard deviation values.

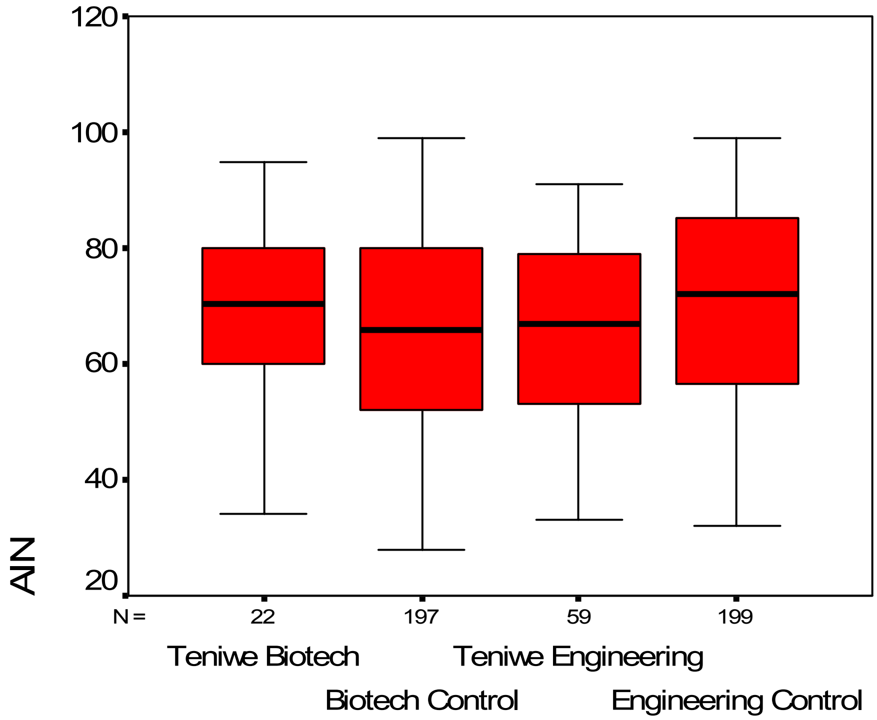

Figure 4-3. AIN boxplot.

4.5.2 Course Evaluations

Online course evaluations for all of the linked classes (biology, chemistry, math 107, 140, and 171, freshmen seminar) were completed during the 15th week of a 16-week semester in addition to standard departmental evaluations (which were not part of this holistic evaluation process). Of the 81 LLC participants, the 76 students enrolled in the freshmen seminar classes were asked to voluntarily complete the online course evaluations.

The evaluations were voluntary and no administrators or researchers were present when students completed the online evaluations. Students had the opportunity to complete surveys at any time during the 15th week through any internet connection. Course evaluation questions were divided into four main categories: skill development, evaluation of student learning, learning environment evaluation, critical engagement, and student demographics. There were also open-ended questions where students typed in responses, although the majority of questions were Likert-type with a choice of "strong agreement," "agreement," "unsure," "disagree," "strongly disagree," and "does not apply." When students accessed the surveys via a web address they were required to enter their network identification numbers ensuring one survey per student. Only those students registered for the class were able to access the surveys. Responses were compiled in a database that was downloaded to an Excel program for automatic summary calculation and report generation.

No course evaluations were returned for Math 140 (calculus for life scientists) where three students were enrolled, and no evaluations for Math 172 (calculus II) were available. Table 4-2 details the number of course evaluations and the return rate.

Table 4-2. Course evaluation response rates

Course	Course Evaluations Returned	Number of Students Completing Class	Return Rate
Biology 106	18	23	78%
Chemistry 105	53	78	68%
Engineering 120	41	59	69%
GenEd 105 (Freshmen Seminar)	52	76	68%
Math 107	19	34	56%
Math 171	14	36	39%

Two items were of interest to researchers with respect to the course evaluations: 1) were LLC students satisfied with the linked courses and what feedback from open-ended questions could be used to improve the linked classes; and 2) were the LLC students building community building as evidenced by their answers from two specific questions on the course evaluations.

Questions from the learning environment and critical engagement sections of the course evaluations were aggregated, normalized, and then graphed to qualitatively determine relative student satisfaction. The number of responses from each response category (i.e. "strongly agree," "agree," "etc.) were counted, then were normalized by adding the sections together and dividing by the total responses possible, i.e. for Biology 106 the number of SA (strongly agree) responses for critical engagement was added to the number of SA responses for learning environment then divided by the total possible responses for each section. Critical engagement and learning environment questions are listed in Table 4-3.

Table 4-3. Critical engagement and learning environment questions

Critical engagement section questions	Hands-on activities helped me understand the course concepts
	I was encouraged to answer my own questions
	Approaches used in this course helped me to relate course materials to the real world
	Completing course requirements helped me better understand the course concepts
	This course helped me realize connections between areas of knowledge that I hadn't appreciated before
	In this course I learned to consider contrasting points of view
	I improved at collaborating with peers
	This course pushed me to think
	The time I spent on course activities was conducive to my overall learning
	I worked harder than I thought I could to meet the instructor's standards or expectations
Learning environment section questions	The instructor…
	provided timely and frequent feedback
	explained material clearly and concisely
	was available during office hours or scheduled appointments to discuss my problems and progress during office hours
	clearly and consistently communicated expectations for students in the course
	was responsive to students' concerns
	graded assignments and exams fairly
	valued my contributions to the course
	treated students with respect

Of importance for the community-building aspect of engagement are two questions from the course evaluation: 1) I spent time discussing what I learned in this course with other people (such as students, friends, family); and 2) When I had questions about the content I referred to other students in the course. The responses were again answered using a Likert scale where responses ranged from strongly agree to strongly disagree.

4.5.3 NSSE

The National Survey of Student Engagement (NSSE) annually assesses the extent to which undergraduate students are involved in educational practices empirically linked to high levels of learning and development (Kuh, 2001). These levels of learning and development are clustered into the following categories: 1) level of academic challenge, 2) active and collaborative learning, 3) student-faculty interactions, 4) enriching educational experiences, and 5) supportive campus environment.

WSU participates in the NSSE national surveys once every two years in February; the most recent being February 2004. Teniwe students completed the 2005 NSSE survey March 2005, although national comparison data came from 2004 survey respondents. Questions on the surveys did not change and were compared with the 2004 results.

A special analysis for engineering students was performed by NSSE for the institution based on data collected in 2003. The comparisons for this component of engagement used this special analysis; thus, the institutional and national results presented in the findings represent responses from only engineering students, not the general student population. Although there were some Teniwe science majors (~15% of the respondents) that completed the surveys, the majority were engineering students. It was deemed more appropriate to compare the Teniwe responses to those from the special analysis results (those containing only responses from engineering students) with than those of the general student population.

Surveys were completed during the second-semester Teniwe chemistry 106 class on March 11, 2005. Students were all members of the Teniwe LLC 2004 class. Twenty-seven surveys were completed and analyzed and were compared to previous (Fall 2003) Teniwe participants, WSU fall 2003 freshmen engineering students, national peer institution freshmen engineers, and NSSE institution freshmen engineering students. Six surveys (20%) were selected using a random number generator and rechecked for accuracy in transcribing responses. Two transcription errors were found so six more surveys were randomly picked (not including the surveys already reviewed) and rechecked. No additional errors were found so no further inventories were rechecked.

NSSE comparison data of mean and standard deviations was available for comparison; however, the entire NSSE data set was not. Effect size is frequently used in meta-analysis studies that summarize findings when raw data is not available using Cohen's *d*. Cohen's *d* is calculated as a standardized difference between two means using the mean and variance of the independent groups with the following formula (Cohen, 1988 p.44):

$$d = \frac{M_1 - M_2}{\sigma_{pooled}}$$

Where:

$$\sigma_{pooled} = \sqrt{\frac{{\sigma_1}^2 + {\sigma_2}^2}{2}}$$

Effect size measures the magnitude of a treatment effect and is independent of sample size. Effect size in this context measures the relative magnitude differences among groups. Effect sizes that are negative move in the opposite; for example, the question, "working for pay off campus" has a negative effect size when compared with all groups meaning LLC students more often did *not* work off campus. Effect sizes were both positive and negative and are considered "small," 0.5-0.79 "medium," and 0.8 and higher were listed as "large" as suggested by Cohen (1988, p. 24).

4.5.4 Focus Groups

Focus groups for each of the freshmen seminar classes were conducted by educational and engineering researchers not associated with the Teniwe project during the first week of December 2004, one week prior to the end of the semester. Questions developed by researchers looked for insight from students regarding which components of the LLC were beneficial (residence, common classes, seminar) and how the program affected their retention, academics, and engagement. Focus groups met in their freshmen seminar classrooms at their regular meeting times. No peer facilitators, researchers, or administrators associated with the program were present. Seventy-four students participated in one of six focus groups.

A list of questions was prepared by the program administrator for the focus groups. Questions were asked about the Teniwe program, living arrangements, classes, and students' day-to-day activities. Appendix A lists the questions used in the focus groups. Focus group leaders were free to pursue discussions and probe to further understand phenomena. Each focus group was recorded; however, the tape was only used for reference by the facilitator while completing the reports. Focus group facilitators summarized responses to questions in a final report to program administrators.

4.5.5 Content Analysis of mid- and end-term reflective essays

Of interest to researchers was how students perceived the Teniwe program, their college goals and expectations, study habits, engagement activities, and their developmental level according to the Perry scheme (Perry, 1970). Forty-five mid-term and 74 end-term essays were analyzed constituting a 90% sampling rate. Essays were grouped by their freshmen seminar class; thus, there were two biotech seminar classes and four engineering seminar classes.

Students in the freshmen seminar class were required to write two essays reflecting on their goals, growth, and experiences; the first during midterms and the second at the end of the semester. A series of questions was available to the students to guide their essays, although the students were not required to specifically answer each of those questions. Only final essays from two groups were analyzed as the mid-term essays were not available. Both mid-term and final sets of essays were available for the other four seminar classes.

Each reflective essay was read through once for common themes then re-read noting responses to common questions posed by the freshmen seminar peer-leader and particularly interesting comments or insights. They were then read a third time extracting comments specific to the themes which developed. Themes centered on the students': (1) view of their academic abilities, strategies, and goals; (2) perceptions of differences between college and high school; (3) perceptions of the freshmen seminar and the Teniwe LLC program; and 5) development according to Perry (1970).

Open coding on essays was performed in their entirety rather than line by line or paragraph by paragraph. Themes were categorized by questions as listed above, defining properties of that category, and identifying the timing (mid- or end-term) of the comment (Strauss & Corbin, 1990, p73). The essays were read and coded in a continuous block of time.

Results were expressed by coded segment rather than by student, since some students made duplicate comments. The most common comments for each coding category (goals, problems, benefits, and freshman seminar comments) were included in the results, as well as some outliers of interest.

Theoretical sensitivity (Strauss & Corbin,1990) was increased by the researcher's grounding and familiarization of research in learning communities, collaborative learning, and student development; the researcher's personal experience developing the Teniwe program and working with freshmen by teaching and interacting in freshmen seminar and the introductory engineering class; and through analytic process having and continuing to work with previous year's living-learning program, data, focus group responses, seminar responses, and survey responses.

To verify the validity of the coding categories and counts, a second researcher coded all essays once. This researcher has over five years' experience coding and analyzing undergraduates' discourse and writing for learning studies, including the qualitative analysis of essays. To eliminate the bias of the first researcher, the second coder conducted final counts and summarized results. Due to the qualitative nature of the data and the large scope of the case study, a Kappa reliability analysis was not run. Additionally, results are expressed in general terms, citing the most common comments, occasionally comparing them with the total number of segments.

Codes in agreement were required to occur in the same sentence, and the number of differences between coders was noted in contrast with the total coded segments. Coder agreement on all essays averaged 89%, ranging between 81% and 95% for each freshman seminar group.

4.5.6 Observations

Two observations each of chemistry, math, and freshmen seminar were conducted at intervals at least a week apart. Observations of environmental conditions, students, and the instructor were recorded in a bound lab notebook. Observations were reviewed for indications of engagement (number of times students interacted with the teacher and each other) and students' attitudes (how they were sitting, where they were looking, and obvious body language).

Observations were also recorded of the spatial arrangements and condition and temperature of the room. Of particular interest was if Teniwe students were sitting together and how they were interacting as compared with the rest of the class. The observer was familiar with Teniwe students and was able to identify them in the common classes being observed.

4.5.7 Grade comparison analysis

Final class grades were used to determine academic gains between the Teniwe students and control peers. Common class grades (math, chemistry, biology, and engineering) were collected and analyzed by class for differences in means using the *t*-test independent samples test and effect size *d* (Green & Salkind, 2002 p. 153) where .2 is small, .3 medium, and .8 large. Institutional grade data was used by querying students using their college identification number and membership in the class. The grade was then converted to a number as shown in Table 4-4.

Table 4-4. Letter grade number conversion

Letter grade	Points
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D+	1.3

D	1.0
D-	0.7
F	0
Withdraw	9
Incomplete	99

Students in Math 172 (calculus II) and Math 140 (calculus for life scientists) were not included in the analysis due to their small numbers. Only six students were in Math 172 and three students were in Math 140.

4.5.8 Student preparedness analysis

Academic Index Number (AIN) was used as a measure of student preparedness and collected from the institution's official database. AIN is a formula derived by the Sate of Washington that combines a student's high school GPA and SAT scores in an approximate one-third/two-third ratio, respectively. Independent-samples *t*-test was performed including Levene's test for equality-of-variance to determine differences between Teniwe students and control peers for each of the individual common classes analyzed.

4.5.9 LASSI

The Learning and Study Strategies Inventory (LASSI) is a 10-scale 80-item assessment of students' awareness about and use of learning and study strategies related to skill, will, and self-regulation components of strategic learning (Weinstein & Palmer, 2002). The LASSI was used to assess study skills and strategies of Teniwe participants near the end of their first semester of college. This assessment was used to measure one of the goals of the freshmen seminar component, improving study skills. The results are compared to national norms provided by the inventory authors. The LASSI is a nationally normed valid and reliable instrument used throughout the United States. More information on the history of the LASSI development, results of pilot and field testing, scale statistics, norms, and the processes used in scale construction can be found in the LASSI 2nd edition user's manual (Weinstein & Palmer, 2002).

The inventory was administered by peer-facilitators to each of the freshmen seminar classes during the last week of November and the first week of December 2004. Students were not required to take the inventory and were asked not to put their names on their responses. A total of 58 students completed the inventories although two contained questionable data and were not counted. An inventory was deemed questionable when the same response number was recorded on more than 9 sequential questions. The researcher transcribed and numbered the responses from the inventories into an Excel spreadsheet and calculated the scores according to the instructions. Twelve surveys (20%) were selected using a random number generator and rechecked for accuracy in transcribing responses. No errors were found; consequently no additional inventories were rechecked.

4.5.10 Retention analysis

Semester retention (fall 2004 to spring 2005) and year retention (fall 2004 to fall 2005) between Teniwe and control students was analyzed using the Crosstabs procedure in SPSS (version 11.0) which applies a Pearson χ^2 for a 2x2 (Teniwe/control x enrolled/not enrolled) contingency table analysis with an additional layer: "biotech" and "engineering." Institutional data for enrollment status was collected on the tenth day of the semester which is the date administrators use to indicate official enrollment.

Additional analysis compared the frequency of Teniwe students who switched from engineering or biotech majors to a different major and their control peers using the same Crosstabs methodology. Students who were not retained in the institution were not included in the "switching" analysis. A student's major was determined using the interest code from the institution's database collected each year and used for assigning an advisor in the student's major. In addition to Pearson χ^2 analysis, effect size for significant results was determined using Cramer's V as calculated by SPSS where .10 is small, .30 medium, and .50 large (Green & Salkind, 2002 p.253).

4.6 Findings

Results from the different assessments and their relation to the Teniwe goals are summarized in Table 4-5. Details for each of the measures and related findings follow.

Table 4-5. Measure or instrument and results

Category	Instrument or Measurement	Results
Engagement	Course Evaluation	• developed community with other students; • mostly satisfied with math, biology, and chemistry; • mostly dissatisfied with freshmen seminar and introductory engineering; • suggested improvements to freshmen seminar and chemistry as described in course evaluation section below.
	NSSE survey	• overall higher engagement reported by LLC students compared to peers particularly in time spent working in groups, quality of relationships, time usage, and positive institutional environment; • LLC students were not as satisfied with their overall educational experience or satisfaction with their college.
	Focus Groups	• liked common living/classes; • asked for class content help from each other; • studied together; • believed LLC Teniwe program was "worth it" overall but not freshmen seminar class.
	Content analysis from reflective reports	• worked with peers in study groups and projects; • made friends; • perceived Teniwe as helping them make the transition to college primarily through friends and ready-made study groups; • majority of students in dualistic phase as

		categorized by Perry development scheme; • believed they developed independence and social skills during semester; • identified problems with study habits but did not always mitigate those problems; • liked common living/classes; • used campus resources - primarily the recreation center.
	Observation	• had to be "forced" into sitting together in freshmen seminar class groups during first two weeks. After that students routinely sat together in freshmen seminar and in other classes; • no difference between Teniwe students and peers interacting more or less with teacher.
Academic Achievement	Grades in common classes	• LLC students had significantly higher average grades in chemistry class; • LLC students had higher grade averages in math, biology, and engineering but not significantly; • lower AIN scores in all analyzed classes.
	AIN in common classes	
	LASSI (study skills assessment)	• Teniwe students had weak study skills mostly in lower 50th percentile compared to national norms.
Retention	Retention in college (10th day) Retention in major	• no difference in semester retention; • no difference in annual retention; • significant difference for engineering control students who "switched" out of engineering more than Teniwe engineering students; • no difference in "switching" majors for biotech students and control peers.

4.6.1 Course evaluations

Student course evaluations were used in this study to determine engagement from responses on two specific evaluation questions, to gauge student satisfaction with the linked classes, and to solicit feedback for linked class improvement, specifically feedback from the freshmen seminar and chemistry class.

The majority of students agreed that they had; (1) spent time discussing what they learned with other people; and (2) asked other students when they had questions indicating they were building community with their peers as the program intended. The exception to this was the freshmen seminar class where a larger number of students did not discuss with each other outside of class nor did they ask questions of each other nearly as often as they did with other classes. These unexpected results suggest either some issues with the class itself or all the discussions went on in class and nothing from the class affected the students outside class. It is the former that is suspected due to dissatisfaction students voiced with the freshmen seminar (GenEd 105) course through course evaluations, focus groups, and reflective essays.

Results of the two questions are shown in Figures 4-4 and 4-5 by class. The reluctance to discuss what was learned in the freshmen seminar class outside class is a striking difference from the other classes. It is also interesting to note that the chemistry class had high numbers of students who "strongly agreed" and "agreed" versus the other classes. This may be due to the smaller size of the class and the emphasis on contextualizing new knowledge where discussion and interaction with other students and the instructor was facilitated.

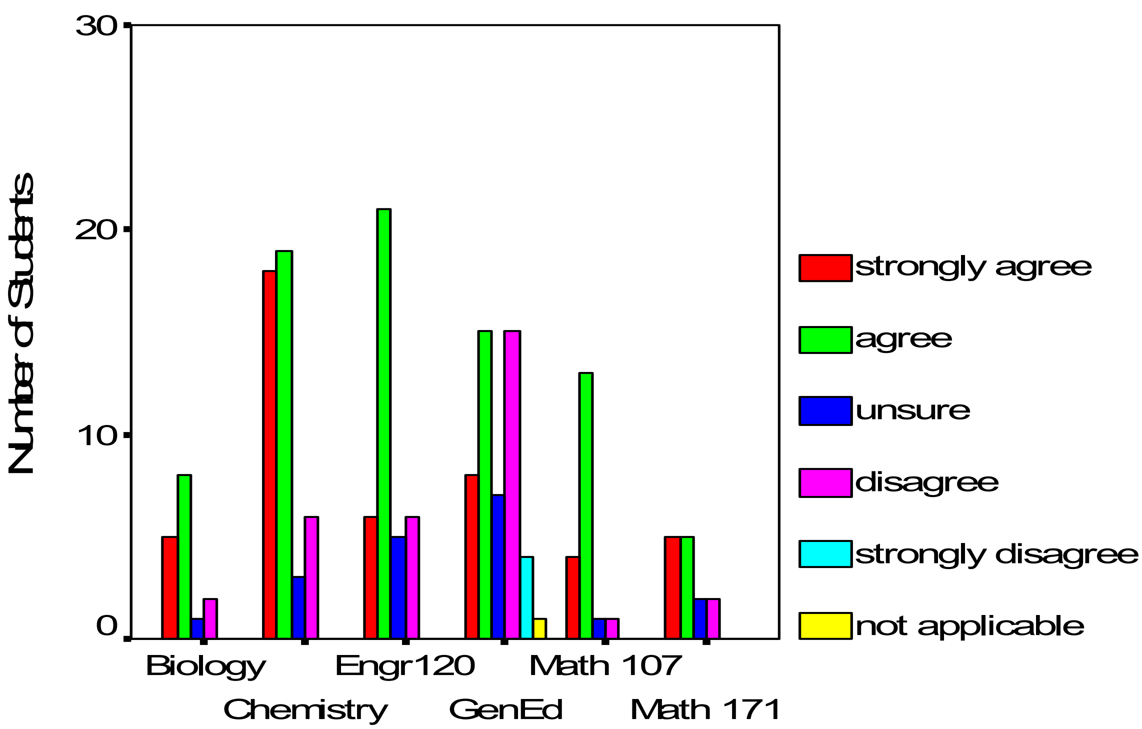

Figure 4-4. Response to the question, " I spent time discussing what I learned in this course with other people (such as students, friends, family)."

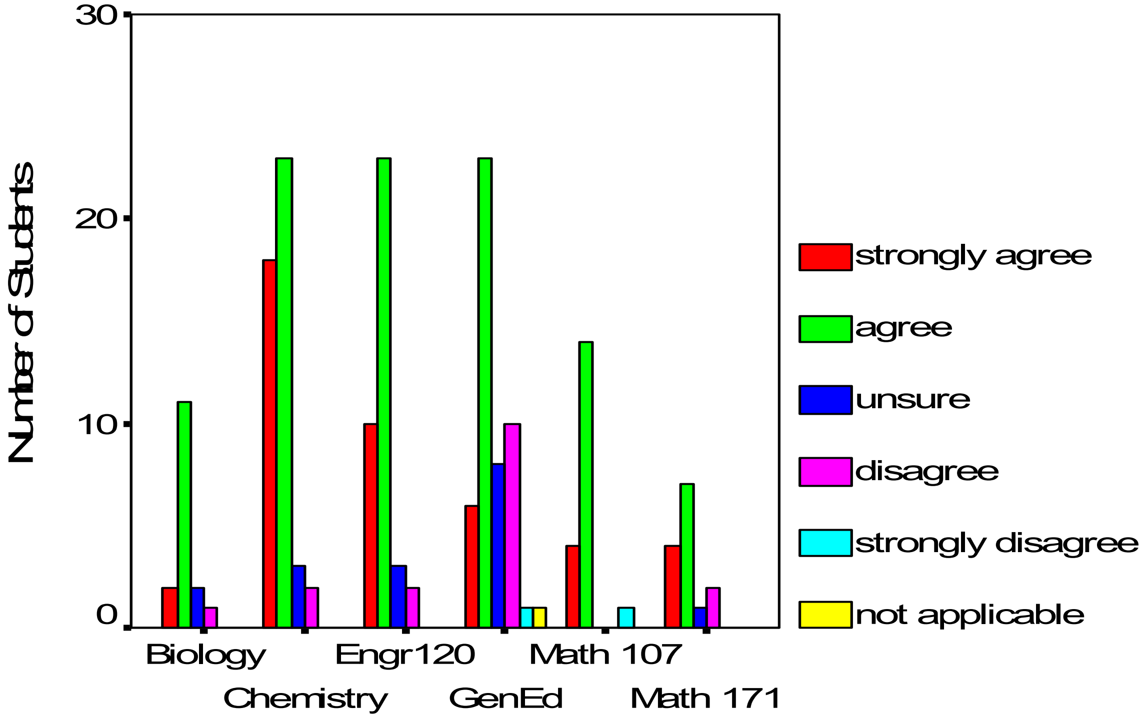

Figure 4-5. Responses to the question, "When I had questions about the content I referred to other students in the course."

A graph of the distributions for responses from the two sections of the course evaluation, learning environment and critical engagement, was used to qualitatively determine student satisfaction with each course. The two sections contained questions (listed earlier in Table 4-3) that can be generalized, for the most part, as attributes of the course rather than attributes of the student. The number of responses was summarized by course and section and further aggregated by adding the numbers from the individual sections by class. A table showing the number of responses and total responses possible is shown below in Table 4-6 where SA = strongly agree, A = agree, U = unsure, D = disagree, SD = strongly disagree, and NA = not applicable.

Table 4-6. Summarized responses to sections in course evaluations

	Total responses possible	Course	SA	A	U	D	SD	NA
Critical engagement section	180	Biology 106	26	87	27	19	6	4
	530	Chemistry 105	141	199	70	63	13	6
	410	Engineering 120	41	157	103	67	19	2

questions	520	Freshmen Seminar	25	175	119	140	35	2
	190	Math 107	44	104	30	7	0	0
	140	Math 171	30	58	17	14	0	21
Learning environment section questions	144	Biology 106	32	67	20	9	0	8
	424	Chemistry 105	112	178	48	40	25	5
	328	Engineering 120	12	82	101	58	53	6
	416	Freshmen Seminar	185	166	30	16	2	1
	152	Math 107	69	72	10	1	0	0
	112	Math 171	49	40	10	1	2	10

Responses were further summarized then normalized by adding the sections together and dividing by the total responses possible, i.e. for Biology 106 the number of SA responses for critical engagement (26) was added to the number for learning environment SA (32) then divided by the total possible responses for each section (180 + 144), effectively:

$$\frac{26+32}{180+144} = \frac{58}{324} = 0.1790 \; or \; 17.9\%$$

The summarized results are shown in Figure 4-6 below. High bars on the left side of each grouping indicate higher satisfaction. Based on the shapes of the distributions, it appears students were more satisfied overall with math, chemistry, biology, Freshmen Seminar and least satisfied with Engineering 120.

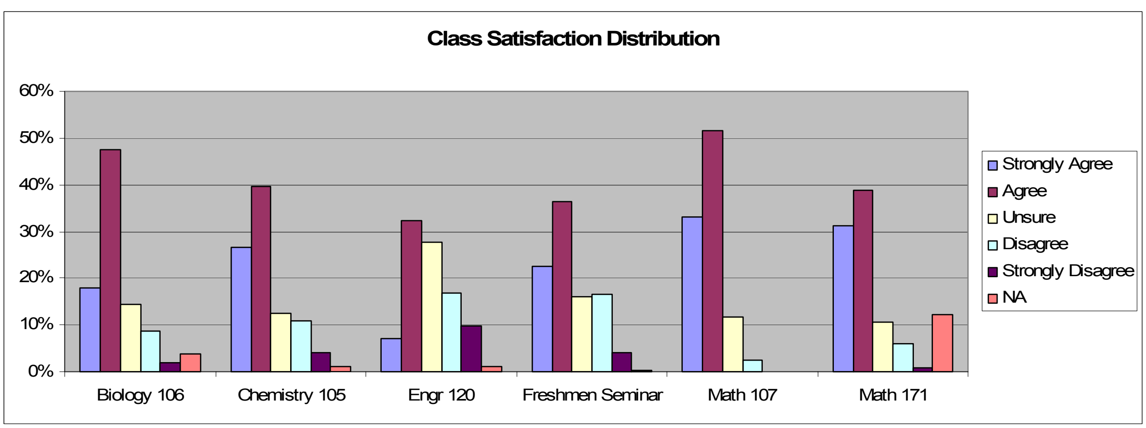

Figure 4-6. Linked course satisfaction.

Feedback from the freshmen seminar and chemistry classes was qualitatively analyzed by coding and counting responses to what students liked best, least, and suggestions for improvement. Only the freshmen seminar and chemistry classes were analyzed as those classes were designed specifically for this program. The freshmen seminar class was developed to foster community, improve study skills, improve content knowledge in linked classes, and familiarize students with available resources from the college as well as provide an introduction to current research at the institution. The chemistry class was designed to increase content knowledge, foster community, and develop team skills. Most frequent responses to each of the questions are listed in Tables 4-7 and 4-8.

Table 4-7. Questions and frequent responses for freshmen seminar

	Number of respondents	Number of comments	Number of times comment was listed	Most frequent responses
What did you like best about the course?	36	41	15	Facilitators
			9	Meeting people
			4	Building community/discussions
			3	Course content
			3	Group work/projects
What did you like least?	34	39	11	Busy work
			5	Length of class
			4	No learning
			4	Projects
			3	Content not aligned with classes/no relevance
			3	Took time away from other studies
What suggestions or changes, if any, would you make to improve this course?	28	32	8	Change content of class
			6	Change projects
			5	Length
			4	Make it an optional class
			2	Keep the research project
			2	No changes

Table 4-8. Questions and frequent responses from chemistry

	Number of respondents	Number of comments	Number of times comment was listed	Most frequent responses
What did you like best about the course?	41	47	14	Labs
			8	Lecture
			6	Presentations/teamwork
			4	Instructor
			4	Tutorial/help sessions
			3	TA
What did you like least?	40	43	12	Issues with lecture (alignment w/ text, organization, hard to follow, etc.)
			6	Labs
			4	Instructor assumed higher knowledge level of students
			4	Homework/exams/quizzes
			3	Subject content difficult/confusing/not enough explanation
What suggestions or changes, if any, would you make to improve this course?	33	39	10	Teaching level too high
			10	Lectures
			5	Textbook
			2	New labs
			2	More help sessions

4.6.2 NSSE

A convenience sample subset of Teniwe students (32%) completed NSSE surveys during their second semester at the institution. Because only summary and not raw data was available from NSSE, Cohen's *d* (Cohen, 1988) was used to determine effect size. Effect size in this context measures the relative magnitude differences among groups. When the effective size is negative, it denotes an opposite direction. Selected questions with medium and large effects sizes (< .5) that are especially relevant to this study are shown in Table 4-9. Results from all NSSE questions can be found in Appendix B.

Table 4-9. Selected Teniwe responses compared to other groups

	2004 Teniwe compared with:				
NSSE Question	2003 Teniwe	2003 WSU Eng	2003 Peers Eng	203 NSSE Eng	Comments
Worked with classmates outside of class to prepare class assignments	.58	.83	.56	.59	Expected large effect size
Number of problem sets that take you more than an hour to complete	1.30	1.10	.96	.96	Interesting results
Participated in activities to enhance your spirituality (worship, meditation, prayer, etc.)	-.35	-.58	-.63	-.52	Interesting results despite several comments on reflective essays about spirituality
Working for pay off campus	-.21	-.34	-.52	-.64	Most students do not have jobs and could potentially devote more time to studies
Worked harder than you thought you could to meet an instructor's standards or expectations	0.52	0.58	.38	0.30	Interesting results
Relationships with other students	-0.23	0.20	0.12	0.21	Unexpected negative effect size compared to previous Teniwe albeit very small
Preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other activities related to your academic program)	-0.01	0.24	0.23	0.28	Although higher effect sizes with compares, would have expected higher (other than 2003 Teniwe)
How would you evaluate your entire educational experience at this institution?	-.61	-.40	-.48	-.38	Would expect small effect sizes when compared to previous Teniwe group
If you could start over again, would you go to the *same institution* you are now attending?	-.67	-.29	-.40	-.15	Would expect small effect sizes when compared to previous Teniwe group

4.6.3 Focus groups

Seventy-four students participated in one of six focus groups. Students in general felt that the LLC (living-learning community) program was beneficial to them in making new friendships and creating a support system of students they could ask for help with their classes. The LLC of students with common classes was the essential part of this program in their opinion. These findings would appear to support the hypothesis that this type of LLC does indeed create an environment where peers will build community with each other. Summaries from all six focus groups detailed below mirror students' essays in their assessment of the LLC Teniwe program and the freshmen seminar class.

4.6.3.1 Engineering focus group results

Engineering students overwhelmingly believed the common classes combined with a common residence were the most important aspects. Students believe this enhanced interaction promoted closer relationships and aided their transition to college life.

The Teniwe section of the general chemistry class was perceived as harder than the regular general chemistry sections. Several students believed the teaching style, in their words, "wasn't handed to us on a plate, instead we had to use the internet, other textbooks, the library or do whatever it took to look things up" increased their learning.

The freshmen seminar class was faulted because the activities and work assigned did not make sense to the students and the peer facilitators could not always explain the purpose of assignments; however, students overwhelmingly personally liked their peer facilitators. Activities in the freshmen seminar class were described as "busy work." Several students suggested that aligning the assignments with their linked classes would have helped. Although this was the intention of the seminar and the activities were designed to link with common classes, this, in the students' view, was not apparent suggesting a different or a more overt approach to linking assignments might be viewd as more aligned. Students perceived the two credits for the freshmen seminar "put them behind" in their studies because those credits did not count toward their engineering degree program. This was striking difference from the previous years LLC participants who believed that the work they did in the non-credit bearing group meetings was worthy of receiving credit. One focus group found the orientation to the campus and the introduction of various professors' research projects helpful and interesting. Several focus groups said two hours per week for the freshmen seminar class was too long.

The majority of students indicated that the study skills activities in the freshmen seminar class were remedial as they had already learned them in high school. It is interesting to note that student scores on the LASSI suggested a lack of successful study strategies and potential difficulties academically due to study skills.

4.6.3.2 Biotech focus group results

In general, students from the biotech focus groups stated that the Teniwe program was beneficial for a variety of reasons. They believed that the program helped them in getting to know the physical environment, adapting to college life, having common courses, making friends, having preset study groups, and bouncing ideas off each other.

Students in the biotech focus groups believed the chemistry class associated with the program was more in depth and more advanced than the regular chemistry class and were concerned that their class did not cover general material to the degree that the regular chemistry class did. Because of this, some students felt they were behind non-Teniwe students in general chemistry information but further ahead in specific chemistry material. Most students stated that because of the extra demands placed on them in the chemistry course they thought that they would have done better academically if they had not been in the program.

Biotech focus group students suggested organizing assignments between classes so all courses did not have due dates in the same time frame and letting the peer facilitators know the purpose of each assignment and how all assignments combined to meet the objectives of the class.

Again, as with the engineering focus groups, students described the freshmen seminar activities as “busy work,” although one group said that basically, all the “busywork” gets at the underlying concepts from the class [referring to classes in general], which lays the groundwork for future classes. This may imply students view most homework and class activities as busy work and may explain the low rankings in study skills and strategies as measured by the LASSI. However, one biotech focus group believed the study skills and time management activities and handouts helped them. As with the engineering focus groups, biotech students liked their peer facilitators and felt they were easier to relate to than professors primarily because of the age difference and that they learned from their peer facilitators.

4.6.4 Content analysis on mid- and end-term reflective essays

The reflective essays provided a rich source of qualitative data. Summaries for each of the groups are provided below. Further analysis was categorized into the several themes that developed in the analysis: student development, identifying psychological processes and attitudes, differences among the Teniwe students themselves, and a program evaluation from the students’ perspective. The summaries for each seminar class and the analysis categorized by theme follow.

Understanding student expectations and their reactions in college can be contextualized if some idea of their development level and psychological processes and attitudes is known. Using Perry's (1970) stages of student intellectual development, we can make sense of student course evaluations, focus group comments, their behavior, and to some extent their grades. Bean (2005) identified psychological processes (self-efficacy, approach/avoidance behavior, and locus of control) that facilitate a student's decision to stay in college or leave, many of which are reflected in these essays. Additionally, some differences were noted between the LLC Teniwe students themselves and appeared to be aligned by their major. Finally, the essays were mined for information regarding the students' perceptions of the LLC program and in essence provided a "student evaluation" for the program. It is important to note that although students mentioned many ways that they had grown and improved over the course of the semester, most did not specifically attribute this growth to the LLC program itself. However, several attributed some gains to freshman seminar or their college experience in general, which is indivisible from the LLC program.

Although these gains may be attributed to the LLC program, it is impossible to say for certain, since some gains may be the result of time, maturation, and increasing familiarity with the college environment. It would be interesting to compare the LLC students' intellectual and social growth with non-LLC students at the same institution.

It is also important to note that some of the self-regulation issues that students chose to improve may have been suggested by freshman seminar facilitators as common obstacles to student success, such as improving study skills, time management, and adjusting expectations, since they were mentioned so often with the same terms.

4.6.4.1 Seminar group 1 summary

Students' goals for the year included making friends and getting good grades. Many students felt they had benefited from common living arrangements and campus resources. Some other common benefits included meeting people, forming study groups, gaining study skills, and building community. The biggest problem students faced was time management. No mid-term reflective essays were available for analysis for this group so only final essays were analyzed.

4.6.4.2 Seminar group 2 summary

The most common student goals included getting good grades and making friends. The most common benefits of the program noted were time management and study skills, as well as a sense of community. The biggest problems facing students by far were procrastination and time management.

Although a few students felt that freshman seminar helped them, for instance in gaining communication skills, many students did not end up liking the course by the end of the semester. Some felt that the course was a review of skills already learned in high school, and several were disappointed that it wasn't a study hall. It may be necessary for administrators to clarify that freshman seminar is not simply a study hall and will require course work.

It is interesting to note that many students felt that good grades correlate directly with effort, although two found that this attitude didn't always work.

4.6.4.3 Seminar group 3 summary

The most common goal noted was getting good grades, followed by improving study skills and making friends. The most common comments on program benefits included making friends and accessing campus resources. Other benefits included improving study skills, having common living arrangements and common classes, and stopping procrastination. This improvement in procrastination is important since procrastination was by far the most common problem that students admitted to having. Other common problems included lack of preparation for college in high school and lack of motivation for "boring" subjects.

Many students commented that freshman seminar was not useful to them academically because it was a review, and some felt patronized by this. However, many students benefited from the support given by the peer facilitators, and some enjoyed the research project. One student noted that she felt constricted by the strong social ties of the LLC Teniwe program, wanting to meet more people outside of the program. No mid-term reflective essays were available for this seminar group, consequently only final essays were analyzed.

4.6.4.4 Seminar group 4 summary

The most common goal noted by students was to get good grades, followed by making friends. Nearly half of the students felt that good grades were a direct result of effort. However, several changed their minds about this by the end of the term when they found that either they got good grades without much effort or tried hard and did not receive good grades.

Major benefits of the program noted by the students included common living and learning communities, gaining study skills, making friends, and improving time management skills. As with most of the other groups, procrastination was the most common problem noted by students, followed by a lack of preparation in high school for college work, and time management issues.

As for the freshman seminar class itself, students' most common comment was that they enjoyed getting to know their peers and peer facilitators. Many students felt that freshman seminar was a review of skills they already had and required a lot of busy work that wasn't useful. Many students felt that freshman seminar required too much time for too few credits, and they had been told in the initial advising program that freshman seminar would be a study hall. These students were quite disappointed because of this expectation.

Interestingly, several students noted that they are not motivated to change their habits regarding procrastination because they feel that they work well under pressure. Two students had the perception that the LLC program was geared to serious students only.

4.6.4.5 Seminar group 5 summary

The most common goals students had at the midterm point were obtaining good grades, improving study skills, and improving time management. They felt that their biggest obstacles to these goals were procrastination and unrealistic expectations of the college experience. Even at the midterm point, the biggest benefit of the LLC program that students mentioned were that it helped them improve their study skills, make friends, and learn to manage their time.

By the time of the final essay, the most common goals that students felt they had reached were that they had made friends, gotten help from friends, formed study groups and improved their time management skills. A few students mentioned that although freshman seminar helped them with social skills and networking, they did not feel that it helped them academically.

4.6.4.6 Seminar group 6 summary

The most common student goals were to make friends, improve study skills, and improve grades. Students' most common struggle was with procrastination. Several students mentioned that their study skills had already improved by the midterm point, that they felt more part of a community, and that they had formed study groups. By the time of the final essay, many students felt that they made friends and built community, as well as learning to manage their time and improve study skills. A few mentioned that the program helped them set goals and reflect on their progress, which motivated them.

4.6.4.7 Student intellectual development

Analysis of the reflective essays using Perry's (1970) scheme of student intellectual development indicated LLC students appeared to be predominately in the "dualist" stage where knowledge is truth – factual information, correct theories, and right answers (Perry, 1970). They view professors as authorities with the "right" answer. "Teaching" entails explaining to them and they repeat it back on a test. This thinking was reflected in students' essays in comments like, "*the teach [sic] are very informative and they tell you what you need to know and try to explain it in a way that I will remember…..*" Students expect to receive important information and become anxious if not complete or ambiguous. Comments such as "*Chem teacher rambles on multiple topics some of which have no relevance to what we are learning so I'm left to gather information from the book* " reflect this. When a student doesn't understand the topic or material covered, it is thought to be the professor's fault. Several student comments were similar to this one, "*"…for lack of understanding due to the professor's teaching style.*." or *"my hope is that next semester a new teacher might be able to grasp my interests more…"*

One counter to dualism development found in the present analysis is the positive attitude students had toward study groups and group projects. Where a dualism developmental state would suggest students would be uncomfortable learning from their peers (only the professor knows the right answer, how could a peer know) the students in this study readily adapted to study groups and responded positively that they liked the fact that they could "…*just run down the hall and get help or an answer to a question*." It is important to note student development for a couple of reasons: first, moving students through developmental stages, particularly dualistic and multiplicity stages are often met with resistance and blame on others – the teacher, TAs, school, etc. and second, understanding students' developmental stages helps put some of their comments into perspective. It is also important to note that students often will not necessarily appreciate their movement to higher developmental levels until after the fact. At the time, students may feel they are being asked to do things with which they are not comfortable or familiar. Students are likely more comfortable with multiple-choice questions, passive learning, and believing that there is a "right" answer. Consequently, when these beliefs are tested or they are asked to actively participate in their learning, it feels uncomfortable and students complain, but after reflecting, students can often see that learning did occur despite their original beliefs.

The chemistry class presented an interesting opportunity to analyze because it was taught "differently," and almost all the students commented on the chemistry class. Students recognized it was different from high school, and the techniques they used in high school were not working in the chemistry class. Several students discovered that they were learning concepts rather than memorizing. Four students were frustrated and stated that they just couldn't memorize the information from the chemistry class and thought the professor "rambled." About 20 students said that the quizzes, text, and tests were disconnected. A couple of students realized they had to adapt their learning and read the text prior to the lectures and started enjoying the class. About three-fourths of the students reported liking the instructor and TAs from the class and often asked them for help and attended the review sessions.

4.6.4.8 Psychological processes

Many of the essays provided insight to the student's psychological processes and attitudes. Bean (2000) suggested three psychological processes influenced a student's decision to continue in college: (1) self-efficacy; (2) approach/avoidance behavior theory; and (3) locus of control. Evidence of these processes could be identified in the students' essays. Self-efficacy is the belief that the student can perform in a way to achieve grades that leads to increased self confidence and likelihood of persistence in college. This sentiment was echoed in a majority of the essays through statements such as, "*If I just work hard enough I can get a good grade"* although there did appear to be a decline toward the end of the semester in their self-efficacy with statements, *"but I believe with good study habits that I don't have currently but might obtain….. [realizes things have to change but will do it later when" forced" by harder classes]* and *"…I learned that I'm not always going to get the A in class, but as long as I tried my best that's all I can expect. At least I know I earned my grade."*

Approach and avoidance are ways of coping in the environment to reduce the stress that environment creates. Positive adaptations lead to increased likelihood of persistence. Few students mentioned this aspect and those that did usually indicated they either went to the recreation center and worked out or relaxed with friends to relieve stress.

A majority of the students appeared to have a more internal locus of control. Students with an internal locus of control believe, for example, that their good grades are a result of effective studying. There were numerous comments suggesting "hard work" would result in good grades, *"…I do think that with more effort I could have done much better….."* Students with an external locus of control believe they "got lucky" with their grade or that there is an ability that they do not control. About 10% of the students indicated an external locus of control suggesting they did not do well or they did do well because of "natural" inclinations saying, *"I know that I am a smart person but there are just some areas that I fall short in. mostly [sic], these areas are what would come naturally to other people…"*

4.6.4.9 Differences between biotech and engineering LLC students

Interestingly, the biotech LLC students appeared to be more satisfied with the entire LLC program than the engineering students. Where both groups were more satisfied at mid-term, the engineering students became increasingly dissatisfied as the semester progressed. Engineering students expressed satisfaction with the common class and residential arrangements but were almost offended by the freshmen seminar class and felt they had been "duped" and forced into taking a class that was "beneath" them. This general dislike toward the freshmen seminar class appeared to influence their outlook on the program and appeared to affect only the engineering LLC group and not the biotech students. This difference in attitude toward the freshmen seminar class may underscore the strong influence of peers in learning communities.

The engineering students believed the freshmen seminar class put them "behind" in their programs, that the study skills were remedial, and that the activities were "busy work." In several engineering essays there was an indication of the effect of peer pressure *"although many people seemed to not get much out of freshmen seminar, I thought it was a lot of fun. I was never at any point in the semester not eager to go to seminar because I knew it was a class that was more laid back than all the rest."* This may provide a basis for recognizing a pattern to their behavior noting that academics are tightly intertwined around social networks.

4.6.4.10 Student program evaluation

In general, students had positive comments and experiences with the common classes and common residence. Students believed they had ready-made study groups and peers they readily took advantage of. The freshmen seminar class appeared to be the source of most of the students' dissatisfaction with the program. Students believed they understood the objective of the freshmen seminar class to help them academically with their linked class content but felt that it was not implemented well. When the class consisted of activities to improve their study skills in a generic format – not specific to their linked classes – the students rebelled and perceived it as a remedial class, one that was beneath them.

Students believed the class was a type of "study hall" where they would receive help similar to that of tutoring and were disappointed when they did not have time to work on homework in class due to other class activities. Not a surprising reaction when many students indicated that in high school they did most of their homework at school. The majority of the students liked the freshmen seminar research activity and commented that it gave them some ideas of what they could study and how research worked at the university. A minority of students liked the freshmen seminar study skills activities and used them. The majority of students liked learning about campus resources and some indicated they had already used them.

4.6.4.11 Limitations

It is important to note that students did not usually identify what they believed to be the cause of these benefits. Few attributed gains directly to the LLC program itself, but several attributed them to freshmen seminar or their college experience. A few students felt that freshmen seminar had only helped them with social skills, not academic ones, and that the increased socializing had actually detracted from the time they devoted to academic work. It is also important to note that some of the self-regulation issues that students chose to improve may have been suggested by freshmen seminar facilitators as common obstacles to student success, such as improving study skills, time management, and adjusting expectations, since they were mentioned so often with the same terms.

Although these gains may be attributed to the Teniwe program, it is impossible to say this for certain, since some gains may be the expected result of time, maturation, and increasing familiarity with college requirements. Comparing these results with studies conducted on students at the same institution who aren't involved in such programs would provide a clearer picture of how the LLC program affected students' achievements.

4.6.5 Observations

Periodic observations were made in all the classes except the biology class during the semester. Table 4-10 outlines the class and date of recorded observations of the linked classes. A weekly check of the freshmen seminar classes on a rotating schedule was performed by the researcher to note student interaction and provide support for the peer facilitators.

Table 4-10. Class observation dates

Class	Date of Observation
Chemistry 105	11/5/04, 11/10/04
Math 107	11/3/04
Engr 120	11/3/04
Math 171	11/10/04

All classes except the freshmen seminar were held in traditional lecture halls in secured seats in rows facing the front of the room. As the semester progressed, more LLC students were sitting together; in the chemistry and math classes both LLC and non-LLC students asked questions although there appeared to be no difference in the number of questions asked between LLC and control students. LLC students did not appear to behave any differently than control peers in classes. The freshmen seminar classes had the most peer-to-peer and peer-to-instructor interaction, followed by chemistry, then the math classes.

4.6.6 Grades

In only one class, chemistry, LLC students had significantly higher grade averages. LLC students had higher grade averages in all the common classes yet lower AIN (academic index number – an incoming preparedness measure) scores. Historically, the state of Washington has relied on AIN scores to predict success in college. This analysis appears to contradict that common assertion.

Biology 106

There were no significant grade differences between the LLC students and their peers in the biology class (*t* (25.5) = 1.152, p=26, *d*=.383, equal variances not assumed); however, the AIN of the LLC students was lower (*t* (89) = -1.202, p=.23) despite having higher mean grades. Table 4-11 details the number, mean, and standard deviation for the LLC students and their control peers.

Table 4-11. Descriptive statistics for biology 106

		N	Mean grade	Std. deviation
GRADE	Teniwe	21	2.69	1.524
	Control	63	2.28	0.964
AIN	Teniwe	22	63.2	18.30
	Control	69	68.5	17.89

Grade distribution comparisons between Teniwe and control student frequencies are listed in Table 4-12 and by percentages in Figure 4-7.

Table 4-12. Biology grade frequencies

	A	A-	B+	B	C+	C	C-	D+	D	F	W
Teniwe	0	1	0	3	2	7	3	0	2	3	0
Control	1	5	7	7	7	10	5	10	8	3	6

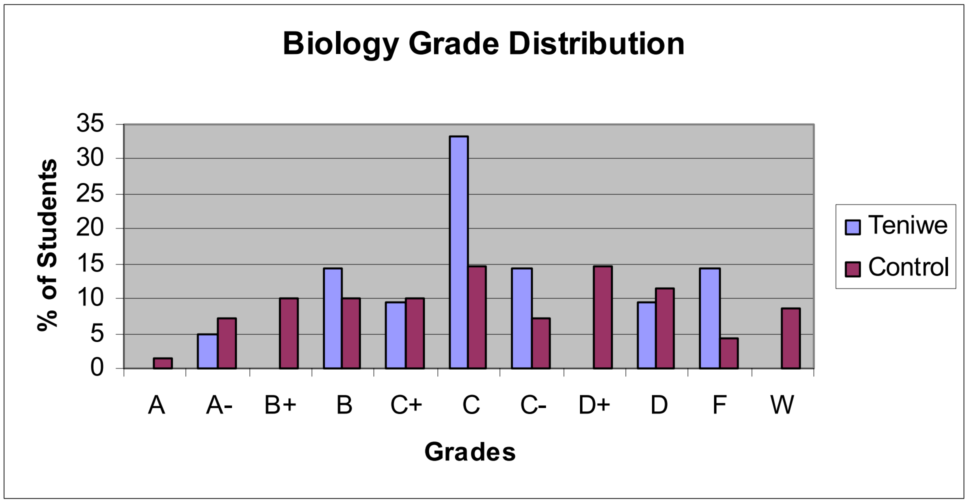

Figure 4-7. Biology grade distribution.

Chemistry 105

LLC students had significantly higher grades than their control peers, *t* (195.37) = 2.781, p=.006 (equal variances not assumed). LLC students had lower AIN scores than their peers although not significantly, *t* (292) = -1.763, p=.079. Table 4-13 outlines the chemistry class grade means, standard deviation, and number of students.

Table 4-13. Chemistry class grade descriptive statistics

		N	Mean grade	Std. deviation
GRADE	Teniwe	73	2.96	0.676
	Control	189	2.66	1.016
AIN	Teniwe	77	66.4	15.91
	Control	217	70.2	16.02

Grade distributions are listed in Table 4-14 and percentages shown in Figure 4-8 for chemistry LLC and control students.

Table 4-14. Grade frequencies

	A	A-	B+	B	B-	C+	C	C-	D+	D	W
Teniwe	9	8	12	11	17	7	5	3	1	0	0
Control	13	13	4	10	8	12	10	4	7	2	3

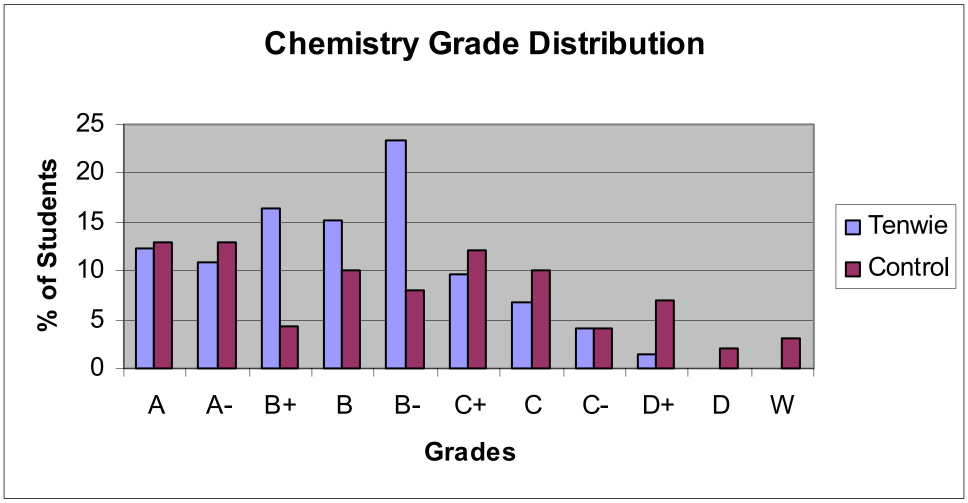

Figure 4-8. Chemistry grade distribution.

Engineering 120

LLC students had a higher grade average than the control students although the difference was not significant, t (153.6) = 1.896, p=.060 (equal variances not assumed). There was also no difference in AIN t(154) = -.922, p=.358 but again, the LLC students had a lower AIN average. Descriptive statistics for the engineering class are found in Table 4-15.

Table 4-15. Engineering class descriptive statistics

		N	Mean grade	Std. deviation
GRADE	Teniwe	57	3.705	.33
	Control	101	3.555	.66
AIN	Teniwe	57	66.81	15.25
	Control	99	69.37	17.53

There was only one control student who withdrew from the class. No LLC or control students received D's or F's. Grade frequencies are listed in Table 4-16 and percentages are shown in Figure 4-9.

Table 4-16. Grade frequencies.

	A	A-	B+	B	B-	C+	C	D+	D	F	W
Teniwe	25	17	11	4	0	0	0	0	0	0	0
Control	53	15	9	12	3	6	2	0	0	0	1

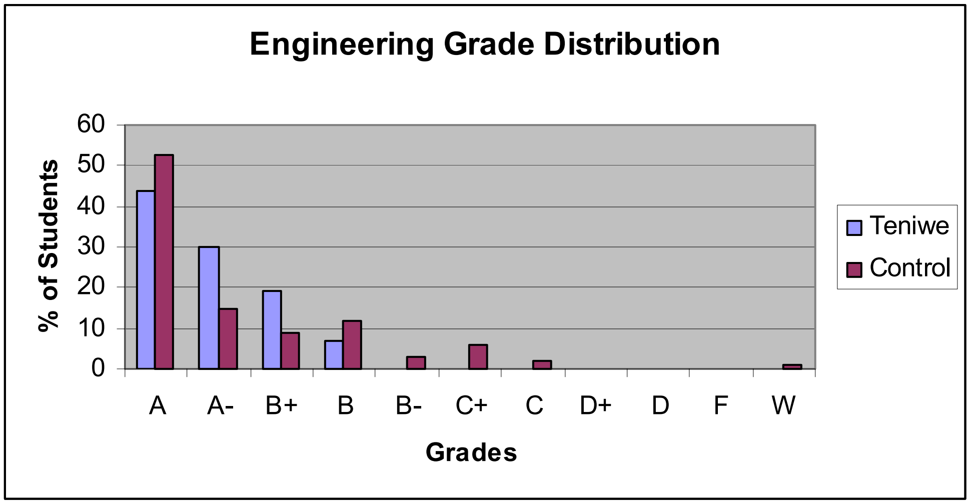

Figure 4-9. Engineering grade distribution.

Math 107

There were no differences in grades between the LLC students and their control peers, *t* (57.56) = .316, p=.753 (equal variances not assumed) although the LLC students had a higher grade average. There was also no difference in AIN *t* (165) = -.468, p=.641 and again, the LLC students had a lower AIN. Descriptive statistics for the Math 107 class are found in Table 4-17.

Table 4-17. Math 107 class descriptive statistics

		N	Mean grade	Std. deviation
GRADE	Teniwe	30	2.647	.94
	Control	128	2.581	1.29
AIN	Teniwe	32	62.06	15.36
	Control	135	63.52	15.94

Grade distributions for LLC and control students are listed in Table 4-18 and shown in Figure 4-10.

Table 4-18. Grade distributions

	A	A-	B+	B	B-	C+	C	C-	D+	D	F	W
Teniwe	2	5	2	5	3	5	3	2	1	1	1	0
Control	19	25	8	17	12	4	10	4	7	7	15	8

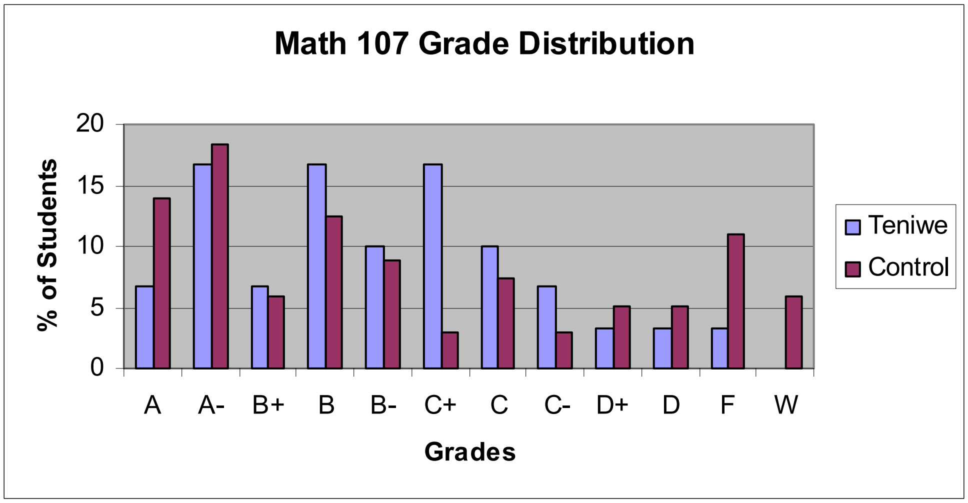

Figure 4-10. Math 107 grade distribution.

Math 171

LLC students had higher grade averages although not significantly, t (68.76) = .971, p=.335 (equal variances not assumed). LLC students had lower AIN scores although, again, not significantly, t (141) = -.981, p=.328. Descriptive statistics for the Math 171 class are found in Table 4-19.

Table 4-19. Math 171 class descriptive statistics

		N	Mean grade	Std. Deviation
GRADE	Teniwe	33	2.679	.9949
	Control	99	2.471	1.2571
AIN	Teniwe	34	68.32	15.665
	Control	109	71.18	14.582

Grade distributions are listed for Teniwe and control students in Table 4-20 and percentages are shown in Figure 4-11.

Table 4-20. Grade distributions

	A	A-	B+	B	B-	C+	C	D+	D	F	W
Teniwe	5	1	7	5	1	2	8	1	2	1	0
Control	21	2	5	26	2	2	13	5	4	9	10

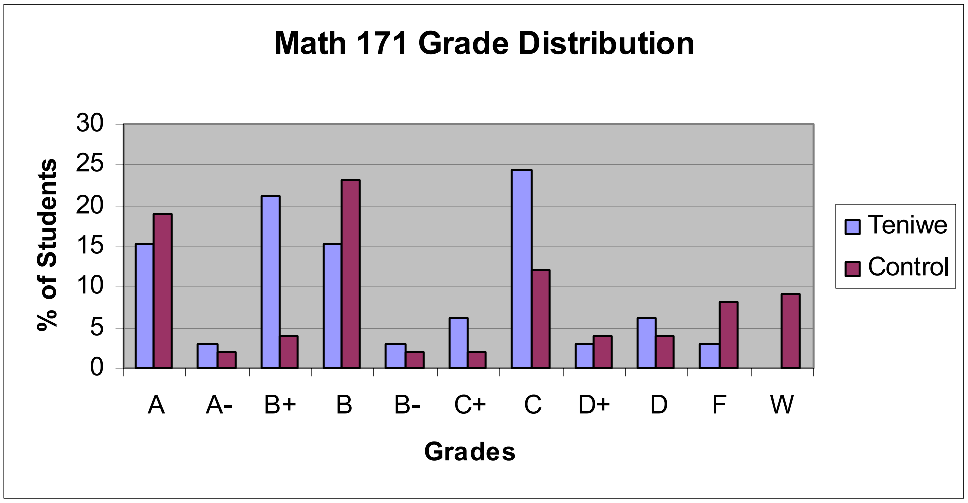

Figure 4-11. Math 171 Grade distribution.

4.6.7 LASSI

LLC responses to LASSI surveys on three of ten study strategy categories (information processing, self-testing, and study aids) were in the 50th to 75th percentiles. The other seven strategy categories were at or below the national normed 50th percentile level indicates an area of relative weakness. Scores at or below the 50th percentile suggest current study strategies are not sufficient to help the student succeed in college (Weinstein & Palmer, 2002). Anxiety, attitude, concentration, motivation, selecting main ideas, time management, and test strategies were below the 50th percentile. Of these, attitude, motivation, and test strategies were the lowest. Results are shown in Table 4-21.

Table 4-21. LASSI student results

	N	% students above 75 percentile	% students below 50th percentile	Student average score	50th percentile score
Anxiety	56	11%	66%	24	26
Attitude	56	0%	98%	25	34
Concentration	56	4%	75%	25	28
Information processing	56	27%	45%	27	27
Motivation	56	4%	84%	25	32
self testing	56	43%	32%	27	25
selecting main ideas	56	5%	80%	26	29
study aids	56	54%	30%	28	26
time management	56	11%	68%	25	27
test strategies	56	0%	89%	24	30

Following the LASSI conceptual theory of three components, skill, will, and self-regulation predicting academic success, average scores from the LLC students suggest failure in college. The LASSI was administered near the end of the semester and likely reflects lower attitudes as found in the reflective essays. This may also help explain why LLC students, despite having a higher grade average, did not do significantly better academically (with the exception of the chemistry class where grades were significantly higher than control counterparts). If academic achievement and study skills are goals for the LLC and freshmen seminar, then it appears present practices need to change.

4.6.8 Retention

Both LLC Teniwe and control students were retained at about the same rate between the fall 2004 semester and the following spring 2005 semester. Two LLC students (2%) did not return; one left to serve in the Iraq war; and the other left for non-academic reasons. In the biotech control group 11 did not return (5%) and in the engineering control group four (2%) did not return.

Seven LLC students did not return the following year (including the two who did not return after the first semester). Year-to-year retention statistics from fall 2004 to fall 2005 are shown in Table 4-22. There was no significant difference in the retention of Teniwe students compared to peers using Pearson χ^2 tests.

Table 4-22. Year-to-year retention statistics for Teniwe and control students

		Not Retained	Retained	% Retained	Total
biotech	Teniwe	3	19	84.6	22
	Control	39	162	85.6	201
engineering	Teniwe	4	55	93.2	59
	Control	26	176	87.1	202

Retention in students' chosen major was determined by querying the institution's database and comparing the academic interest code. Academic interest is updated every time a student registers for classes and is used to assign advisors. Comparing the academic interest code from fall 2004 to fall 2005 using 2x2 Pearson χ^2 tests show significant differences in switching among LLC engineering students who did not switch as much as their control peers, χ^2 (2, N=232)=8.67, *p*=013, V=.193. There was no difference in switching between biotech LLC students and their control peers. Table 4-23 shows the switching statistics for LLC students and control peers.

Table 4-23. Switching analysis

		No Switch	Switched	% Retained in Major	Total	Significance
Biotech	Teniwe	14	5	73.7	19	ns
	Control	125	37	77.2	162	
Engineering	Teniwe	47	8	85.5	55	.013
	Control	122	54	69.3	176	

4.7 Program Implications

4.7.1 Engagement

LLC students appeared to be more engaged in college activities than their control peers. LLC students met more people, studied in groups more, and asked each other for help more often. Engagement measures from course evaluations, NSSE surveys, focus groups, reflective essays, and observations confirm these findings. There were, however, some interesting contrasts.

Students perceive the LLC program as advantageous to their academic abilities due to the living arrangements and the common classes but said in focus groups they were not sure if it was a direct result. Several suggested they would still make friends, just not as quickly. Others suggested they probably would not have studied in groups if not for the "ready-made" study groups. Students complained about the freshmen seminar class and activities but still gained some benefits socially as it provided a space for getting together with other students, opportunity for acquiring new study skills, and community-building discussions that "helped me get a good idea of what my peers were going through at the time, letting me know that I wasn't the only person facing certain circumstances." (from GenEd 105 course evaluation, "what did you like best….." question.)

4.7.2 Course evaluations

The majority of Teniwe students were satisfied with their chemistry course although about 10% of the students were unsure or not satisfied. There were noticeably fewer D's, F's, and withdrawals from LLC students, and they performed significantly better, grade-wise, than their control peers. Some explanation for course dissatisfaction despite higher grades may be because the chemistry course was specifically designed for the LLCe program and was smaller

(81 verses ~ 200) and was taught from an inductive approach; i.e. the same concepts were covered as other chemistry 105 courses except there was a different context for the concepts rather than a deductive approach as has traditionally been done. Students noticed this difference and reported it with comments like, "*at times this course really stressed thinking and a deep understanding of the material*" and "*there was a very high work load for this course, but the payoff in understanding of the material was worth the effor*t."

It also appeared the course facilitated group work and group study that was reinforced through class assignments and encouragement from faculty and TAs based on comments such as "*I had plenty of students who I knew and with who I could collaborate or get help from*" and "*I liked the team work and cooperation; it got us together working on projects.*"

Because the instructor for the course was working directly with researchers and program administrators, student groups were purposefully assigned to align with students' freshmen seminar groups. In freshmen seminar, students worked on chemistry group projects, and facilitators helped students with both course content and project completion. For example, one project required students to present information about a particular chemistry concept. In freshmen seminar facilitators helped students find resources to gather more information, create Powerpoint slides, organize their presentations, and they even held practice presentations to prepare them for their chemistry class presentations.

Students appeared to appreciate the LLC connection of freshmen seminar and chemistry as evidenced by comments from course evaluations about really liking that they were working in the same groups for both classes. Simply having instructors purposefully group students into pre-existing groups from other courses appears to greatly enhance the social and teamwork abilities and increase their engagement in other college activities.

4.7.3 NSSE

It is interesting to note that the largest effect size differences for all comparisons were from two questions: "Worked with classmates outside of class to prepare class assignments;" and "Number of problem sets that take you more than an hour to complete." A larger positive effect size for "worked with classmates outside of class…." confirms students were interacting more likely due to the LLC program and its emphasis on facilitating engagement through common classes, purposeful assignments in chemistry and freshmen seminar, and living arrangements. The larger effect size difference held when compared to former LLC students indicating that changes to the LLC program improved interaction with fellow classmates.

LLC students appeared to work longer on assignments than peers or at least perceived they were working longer. One explanation may be due to the attributes of the survey takers and the difficulty level of their classes. Additionally, because LLC students placed in the 50th percentile or lower for study skills, developing more effective study strategies might help students study more efficiently.

LLC students appeared to be more engaged in college activities overall yet were not as satisfied with their educational experience overall nor were they as satisfied with their college compared to Teniwe students from the previous year. Confounding factors may contribute to this apparent contradiction because survey takers were a convenience sample subset 32% (26 of 81 students) of the LLC participants (those that continued on to chemistry 106 with the same instructor as chemistry 105) as were the previous LLC students a subset accounting for 33% (18 of 55) of the previous LLC group.

4.7.4 Focus groups

Focus group results confirmed LLC students' satisfaction with the living and class arrangements but not necessarily with the freshmen seminar component. Overall, students said that the Teniwe program was "worth the money" but without the freshmen seminar class. One of the implications from the assessment of this program is that it appears social and academic benefits come from having common living arrangements *and* common classes.

The freshmen seminar class presented several challenges to both administrators and students. The reaction from students to the credits offered from the freshmen seminar was interesting. As one veteran administrator suggested, "credits are a double-edged sword." In the previous LLC program, no credit was offered for a weekly group meeting similar to a stripped-down version of freshmen seminar. Students overwhelmingly voiced concern that the work they were doing was akin to taking a class and they should receive credit for participating. Interestingly, when credit was offered this year, students believed they were behind in their program because they took the two-credit freshmen seminar class instead of possibly taking an additional class that would count toward their engineering degree rather than an elective. In the future, having optional credit for a similar class or tying the credits to the student's program may alleviate some of these student concerns.

Students felt that they did not learn any new study skills from the class but already knew them or figured them out themselves. This appears to contrast with responses in the essays and is possibly a peer pressure effect or the result of not asking specific enough questions on the essays. Students in the focus groups may have felt pressure to agree with more vocal members but on their essays were free to write as they pleased. In the essays students were asked "what worked for your learning" which does not specify *where* they learned these skills although in the focus groups students suggested they had already learned them in high school.

It appears that students do need to improve study skills and strategies (as evidenced from the LASSI scores) but how that is implemented may be the biggest hurdle. One idea is to have the peer facilitators lead study skill activities related to other class coursework (i.e. not bringing in any more homework) and have the students practice doing them with their assignments. Another idea is to have instructors in common classes emphasize study skills that are useful with the coursework in their classes and have students practice a variety of techniques with class assignments.

4.7.5 Reflective Essays

The reflective essays were a rich source of information about the LLC program from the student's perspective. Although the essays were written for an assignment in the freshmen seminar class, a lot of information about the LLC program, linked classes, and the social and academic development was mined from the essays.

Students wrote two essays, one mid-term in the semester and one at the end of the semester. The essays revealed students perceived college academics to be similar to high school academics and employed the same study skills. Mid-term predictions for academic success were rosy but became less optimistic by the end of the semester. Many students recognized behaviors that were not conducive to academic success but did not appear motivated or did not know how to make changes.

Based on what students wrote, it appeared many were in the dualistic developmental stage as described by Perry (1970 p.9) where:

> *"The student sees the world in polar terms of we-right-good vs. other-wrong-bad. Right Answers for everything exist in the Absolute, known to Authority whose role is to mediate (teach) them. Knowledge and goodness are perceived as quantitative accretions of discrete rightness to be collected by hard work and obedience."*

Overwhelmingly students suggested that effort was directly proportional to grades. A few suggested that academic success was something innate, something that comes natural that you are born with. It was to note that several students mentioned the belief that improved grades were directly related to increased effort in the class. Although what they meant by effort was not specified, it is interesting that some students might think that increasing their time "studying" will increase their grades rather than learning new study skills or changing strategies.

Students often blamed their lack of success on other things such as extra work in other classes and unfair grading. Because most students are in a dualistic developmental stage, many of the traditional methods of college life, independence, developing self-regulation, accurately assessing what is known and not known, and utilizing peers are difficult to master. When the methods are not mastered, they are perceived as personal rebukes on a student's own person rather than an assessment of their learned knowledge.

Another assessment measure that provided insight to student development was the course evaluation question "What are your views on the learning responsibilities between you and your professor (or T/A, lab assistant, facilitator, etc.)?" Analysis of this question indicated students were primarily in the dualistic stage.

Implications for future programs point to the way students learn techniques for academic improvement. The prime complaint with the freshmen seminar class was that it was "busy work." Students also appeared to perceive homework as busy work too (from focus group results); consequently, how students are taught new study skills, how they integrate them into their coursework, and if instructors place emphasis on these skills can affect how the students interpret and use the information. Overtly connecting study skills activities to student learning aligned with course assignments could improve the academic achievement aspect of similar programs.

Student reflective essays mirrored responses to focus group questions, course evaluations, and NSSE survey results in that they were meeting and making new friends, they were studying in groups, they often asked questions of each other, and thought the common living arrangements coupled with common classes were beneficial to them socially and academically.

4.7.6 Observations

One of the most interesting observations was how LLC students sat in the freshmen seminar classes. All freshmen seminar classrooms had movable chairs and tables or desks. During the first two weeks, students sat by themselves (for the most part) spaced away from each other. It was only after the third week when facilitators started asking the students to sit together for activities that they started to do this on their own. This observation suggests that even housing students in close proximity, having the same classes, and completing activities with the same 11-15 people for two weeks does not create community or facilitate student engagement; it takes an additional step, someone or something forcing them to interact on a regular basis. Observing linked classes during the third month of the semester, many non-LLC students were still sitting apart while LLC students often were sitting together. The implication for this is that direct facilitation of student group interactions is necessary.

4.7.7 Academic achievement

The premise for improving academically is based on a presumed increase in student-to-student interaction facilitated by the LLC program. Students self-reported on the NSSE survey that they worked with classmates outside of class to prepare class assignments and a number of problem sets that take a student more than an hour to complete. In their essays and in the focus groups they said they often studied together and asked each other questions routinely. Although additional time-on-task is not explicit, it would appear that elements of the LLC program facilitated easy and routine student-student interaction that would increase students' time-on-task leading to increased grade averages. Although only grades in the chemistry class were significantly higher, Teniwe students' average grades were higher than their control peers in each of the linked classes analyzed.

One possible explanation may be found in the results of the LASSI. Teniwe students, when compared to national norms, were on average below the 50^{th} percentile in study skills and strategies. This may explain why grades were not significantly higher suggesting that different learning strategies may improve their grades. Also interesting was the lowest study strategy category was attitude. The attitude construct measures the general attitudes toward school and motivation for succeeding in school.

Interestingly and unexpectedly AIN scores (a measure of incoming students' preparedness) were lower in all analyzed common classes; however, average grades were higher in those same classes. This may indicate a potential benefit from participation in the Teniwe program by rapidly improving preparedness.

Study skills should be incorporated into classes or through seminars to improve academic achievement for programs such as this one. Other academic improvement techniques such as peer-led team learning (Lyle & Robinson, 2003) or collaborative-type learning labs (Blanc, Debuhr, & Martin, 1983) associated with specific "hurdle" classes would also likely lead to academic gains. Again, as mentioned in the reflective essays section above, how study skills are introduced and practiced must be carefully facilitated to prevent "remedial class" perceptions.

4.7.8 Retention

Students participating in this program were expected to be retained in college and in their majors at greater numbers than their peers due to the social and academic support developed through the program. Because there was essentially no difference in retention in college between LLC students and control peers but there was a difference in retention in their chosen major, this type of program appears suited to a more narrowly defined group of students (i.e. engineering majors, math majors, education majors, etc.). An argument may be made that because students self-selected into the program, they may be more motivated to remain in their chose major. This view might be justified if both biotech and engineering students were retained in their initial chosen majors; but only the engineering students were retained in significantly higher numbers. Consequently, self-selection may not necessarily be a confounding variable.

Living-learning community programs such as this may hold promise for increasing retention in specific majors rather than retention in college. Tailoring classes within a context of the particular major, creating connections to the major and academics, and developing the social and academic networks of participating students will likely achieve increased retention in that major.

4.7.9 Changes to the LLC program

Programs such as this LLC (living-learning community) must be continually evolving based on assessments and evaluations, institutional culture, and finances among other things.

Based on the experience of administrating and evaluating this program, some changes as listed below are recommended.

- Reduce the number of common classes to two.
- Redesign the freshmen seminar course to a recitation-type class preferably following the common class.
- Continue to use peer facilitators but have respective departments sponsor facilitators (i.e., if one of the common classes is math, have an upperclassmen math major as the peer facilitator).
- Do not offer credit for the redesigned recitation-type class but append to common classes
- Train peer facilitators in content and study skills techniques especially geared toward students in the dualistic development stage; incorporate into assignments from common classes.
- Have faculty teaching common classes participate sporadically in recitation-type classes to increase student-instructor interactions.
- Have faculty teaching common classes coordinate tests so they are not on the same day.
- Use LASSI either as a pre-post evaluation for academic achievement or benchmark.
- Use grades to measure academic improvement comparison with control peers (this is more difficult as control peers must be identified).
- Use Moore's survey instrument (Moore, 1995), the Measure of Intellectual Development (MID) an essay-writing test to determine movement in Perry's developmental scheme (Perry, 1970) from participation in the living-learning community rather than relying solely on grades.
- Use NSSE or similar survey to measure engagement and for benchmarking program progress.
- Retention in major: survey students' decisions about their major in the beginning and end of program. Include open-ended questions as to why or why not they switched majors.

4.7.10 A Model Program

A model program would have several elements:

- A living-learning component with two classes
- Opportunity to learn and practice study and college transition skills
- Exposure to faculty and upperclassmen
- Familiarization and practice using campus resources
- Qualitative and quantitative assessments

This model program would have a living-learning component with two common classes, preferably both being a "hurdle" class. In each of those classes, a second hour once a week would be scheduled for concept understanding, study skills, and study sessions that would facilitate community development between students and upper classmen and professors. These extra hour classes could be billed as "recitation," but would not be graded classes. These recitation classes would be voluntary, although they would be more effective if teachers offered minimal extra credit for 80 percent attendance. If the two classes were in different colleges, say chemistry and introduction to engineering, then upper classmen and graduate students from each of those departments would be recruited as mentors. Using a ratio of about 4 mentors to 60 students it would take about 13 mentors for a class of 200. The mentors would have to be paid and trained in teaching study skills and getting the students to practice those skills without appearing remedial. Additionally they would need training in facilitation of study groups, modeling, and teaching problem-solving strategies for their area (in this example, chemistry) as well as refamiliarizing themselves with the specific content of the class.

Because the LLC model program is both a social and academic acclimation/improvement program, several assessment measures are needed to evaluate the different components.

Determining movement in Perry's developmental scheme, which should be facilitated by this type of program, can be done using Moore's Measure of Intellectual Development (Moore, 1995) to ascertain movement through developmental stages resulting from participation in this living-learning community although movement from year-to-year may be more appropriate than semester-to-semester.

Academic achievement is improved through effective study skills and habits so measuring these using the LASSI will benchmark study skills/strategies developed as a result of this program in addition to grade collections and comparison with control peers. Retention in a major can be measured using surveys at the beginning of the program and again at the end. Asking about changes in a student's major will help to further understand why students choose a particular major as well as measuring the number of students that are retained in that major. Survey student engagement using the NSSE instrument. Comparison to same major peers at same institution and peer institutions can be used as a benchmark for engagement and program improvement.

4.8 Conclusion

4.8.1 Academic achievement

Students perceived the program as advantageous to their academic achievement via quick and accessible peer support as well as through ready-made study groups. Many students recognized the advantage of study groups, both academically and motivationally.

It was expected that students who participated in this LLC (living-learning community) would perform better in their common classes (as evidenced by higher grades in the common classes) because of additional social learning, the increased time-on-task due to the regular seminar meetings, ready-made study group partners, and close residential proximity to other students taking the same classes. Indeed, LLC students had higher average grades in analyzed classes although significantly higher in only one class, chemistry. Reflective essays, focus groups, and NSSE surveys results confirmed students were participating in these activities.

Another factor possibly affecting students' grades was student preparedness. To reduce this internal threat to validity, AIN (a formula consisting of a student's high school GPA and SAT scores) was measured and tested for differences with control peers. Interestingly living-learning community participants had lower average AIN scores than control peers in all the analyzed classes. Contrary to what was expected, living-learning community students scored below national norms (on the whole) in learning strategies. This suggests a program area needing improvement or a population requiring more local norms; both of which are suggested. However, it is also possible that many students are not adequately prepared for the rigor of college study (Hart, 2005), so it may be worthwhile to redesign this aspect of the living-learning community program by incorporating study skills into the common classes and reinforcing the practice through a recitation-type meeting.

4.8.2 Retention

Students appeared to be building community by referring to fellow LLC students as "friends," even admitting to feeling peer pressure to study. Community building has been shown to increase retention; therefore, it was expected these students would be retained in significantly higher numbers than their control counterparts. This was not the case; LLC students were retained *in college* in equal numbers compared to control peers.

Where living-learning community students were significantly retained was in engineering. LLC engineering students remained *in engineering majors* significantly more than control peers. This was not seen in the biotech LLC students where they were retained in comparable numbers as their peers. Self-selection into the program did not appear to bias retention because no difference was found in retention of LLC biotech science majors (although this is a small sample size of 22 students) compared to peers but was found in LLC majors compared to peers suggesting incoming motivation (self-selecting into the program) may not have affected retention.

4.8.3 Engagement

Many LLC students believed that without the program they would have studied alone more and not made as much effort to meet other students or participate in campus activities. Over half of the students mentioned they had used university resources and had or were considering joining clubs. Almost all LLC students indicated that their social lives were full and that they met more people through the program. It was expected LLC students would be more engaged due to time spent studying in groups, discussing ideas with others outside class, and participation in co-curricular activities. Triangulation with reflective essays, focus groups, and course evaluations, and observations repeatedly confirmed this expectation.

Students completing the NSSE engagement surveys were more engaged overall in college than were previous LLC classes, other freshmen engineering peers at the same institution, freshmen engineering students at peer institutions and freshmen engineering students at all NSSE surveyed institutions. The interesting exception to this was the LLC students' responses to their overall educational experience and satisfaction with the college questions. Teniwe students indicated they were not as satisfied with either having a -.61 and -.67, respectively (a negative medium effect size) when compared with previous LLC students' responses. Future studies that examine this phenomenon would help elucidate this apparent contradiction.

4.8.4 Summary

Students' goals and first-year experiences have not changed dramatically in the past 20 years. Erickson & Strommer (1991) echoed similar observations about freshmen in the 1980's and 1990's as was found in this study. Freshmen goals for college were making friends, getting good grades, and becoming independent.

Most students in this study were primarily in the dualistic developmental stage. This study found freshmen characteristics consistent with dualistic definitions (Perry, 1970). An interesting observation and apparent contradiction to the dualistic development stage was how readily accepted group work and group projects were and how quick students were to ask one another for help. It appears that developing community through a LLC does provide an advantage to the students academically and developmentally by aiding those developmental transitions.

The results of this study suggest that increasing retention in specific majors, engagement in college activities, and academic achievement comes from positive social and academic experiences. The factors that are important in a dualistic developmental stage, such as grades, perceived fairness, fitting in with peers, and receiving constructive feedback are not always found in freshmen-level classes. Meeting these needs and transitioning students through a holistic experience, one that encompasses both social and academic worlds through a LLC, can turn a potentially negative experience into a positive and fondly remembered time.

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4.10 Appendix A: Focus group questions for engineering students

Focus group questions for biotech students were the same with the exception of substitution "engineering" for "science."

11) Do you feel you are benefiting from the Teniwe Program?
    a. In what ways are you benefiting?
    b. What do you like best about the program?
    c. What would you change about the program?
    d. How do you feel about the residential arrangements?
    e. How do you feel about the common classes?
    f. How do you feel about the Freshmen Seminar class?
        i. What is your perception of your peer facilitators
        ii. Are you learning from your facilitators?
        iii. Has Teniwe helped you with time management?
        iv. Are activities in your Teniwe group busy work or beneficial?
        v. Has the program helped you with your classes and exams? How?

12) Do you think you have done better academically than you would have without the program?
    a. How have you benefited as compared to non-participating students?
    b. Has Teniwe helped you with your grades?

13) Have you made new friends through the program?

14) Describe how you worked with your peers on group projects.
    a. Has the way you worked as a group changed from the beginning of the semester to the end?

15) What are you perceptions of the Freshmen Seminar class?

16) Do you have a better understanding of engineering and the type of engineering work you would be interested in doing?
    a. Have you decided on a major/engineering discipline?

17) Do you plan on continuing in engineering? Why or why not?

18) Do you plan on staying at WSU? Why or why not?

19) Is there anything in particular you would like program administrators to hear that we have not talked about? Praises or criticisms?

20) Summary of satisfaction with program: is the Teniwe program "worth the money?"

4.11 Appendix B: NSSE effect size questions and results

NSSE Question	2004 Teniwe compared with: 2003 Teniwe	WSU eng	peers eng	NSSE eng
Asked questions in class or contributed to class discussions	-0.08	-0.35	-0.17	-0.56
Made a class presentation	0.53	0.53	0.60	0.09
Prepared two or more drafts of a paper or assignment before turning it in	-0.34	-0.56	-0.14	-0.25
Worked on a paper or project that required integrating ideas or information from various sources	0.39	0.39	0.47	0.35
Included diverse perspectives (different races, religions, genders, political beliefs, etc.) in class discussions or writing assignments	-0.48	-0.59	-0.28	-0.38
Come to class without completing readings or assignments	0.45	0.12	-0.03	0.22
Worked with other students on projects during class	-0.21	-0.17	-0.39	-0.44
Worked with classmates outside of class to prepare class assignments	0.58	0.83	0.56	0.59
Put together ideas or concepts from different courses when completing assignments or during class discussions	-0.50	-0.25	-0.48	-0.46
Tutored or taught other students (paid or voluntary)	-0.71	-0.51	-0.44	-0.38
Participated in a community-based project as part of a regular course	-0.26	-0.04	0.00	-0.13
Used an electronic medium (list-serv, chat group, Internet, etc.) to discuss or complete an assignment	0.26	-0.04	-0.22	-0.13
Used e-mail to communicate with an instructor	-0.04	-0.47	-0.74	-0.73
Discussed grades or assignments with an instructor	0.62	0.07	-0.02	-0.13
Talked about career plans with a faculty member or advisor	-0.41	0.05	-0.11	-0.21
Discussed ideas from your readings or classes with faculty members outside of class	0.38	0.05	0.26	0.02
Received prompt feedback from faculty on your academic performance (written or oral)	0.48	-0.08	0.00	-0.12
Worked harder than you thought you could to meet an instructor's standards or expectations	0.52	0.58	0.38	0.30
Worked with faculty members on activities other than coursework (committees, orientation, student life activities, etc.)	-0.18	0.19	0.33	0.04
Discussed ideas from your readings or classes with others outside of class (students, family members, coworkers, etc.)	0.33	0.19	0.03	0.13
Had serious conversations with students of a different race or ethnicity than your own	0.26	0.15	0.11	0.14
Had serious conversations with students who are very different from you in terms of their religious beliefs, political opinions, or personal values	0.40	0.15	0.14	0.15
Memorizing facts, ideas, or methods from your courses and readings so you can repeat them in pretty much the same form	-0.23	0.25	0.10	0.16

Analyzing the basic elements of an idea, experience, or theory, such as examining a particular case or situation in depth and considering its components	0.96	0.47	0.26	0.24
Synthesizing and organizing ideas, information, or experiences into new, more complex interpretations and relationships	0.62	0.31	0.35	0.22
Making judgments about the value of information, arguments, or methods, such as examining how others gathered and interpreted data and assessing the soundness of their conclusions	0.17	-0.27	-0.10	-0.18
Applying theories or concepts to practical problems or in new situations	0.44	0.06	-0.35	-0.28
To what extent have your examinations during the current school year challenged you to do your best work?	-0.44	0.16	-0.29	-0.19
Number of assigned textbooks, books, or book-length packs of course readings	-0.02	-0.20	0.12	0.13
Number of books read on your own (not assigned) for personal enjoyment or academic enrichment	-0.05	-0.32	-0.01	0.01
Number of written papers or reports of **20 pages or more**	0.09	0.02	0.43	0.32
Number of written papers or reports **between 5 and 19 pages**	0.08	0.14	0.67	0.39
Number of written papers or reports of **fewer than 5 pages**	-0.22	0.04	0.40	0.11
Number of *problem sets* that take you more than an hour to complete	1.30	1.10	0.96	0.96
Number of *problem sets* that take you less than an hour to complete	0.12	0.00	0.06	0.02
Attended an art exhibit, gallery, play, dance, or other theatre performance	-0.55	-0.27	-0.50	-0.60
Exercised or participated in physical fitness activities	-0.16	0.20	0.22	0.29
Participated in activities to enhance your spirituality (worship, meditation, prayer, etc.)	-0.35	-0.58	-0.63	-0.52
Relationships with other students	-0.23	0.20	0.12	0.21
Relationships with faculty members	0.64	0.35	0.46	0.14
Relationships with administrative personnel and offices	-0.11	0.05	-0.05	-0.08
Preparing for class (studying, reading, writing, doing homework or lab work, analyzing data, rehearsing, and other activities related to your academic program)	-0.01	0.24	0.23	0.28
Working for pay **on campus**	0.33	0.00	0.00	-0.06
Working for pay **off campus**	-0.21	-0.34	-0.52	-0.64
Participating in co-curricular activities (organizations, campus publications, student government, social fraternity or sorority, intercollegiate or intramural sports, etc.)	0.34	0.17	0.14	0.11
Relaxing and socializing (watching TV, partying, exercising, etc.)	0.10	-0.59	-0.11	0.08
Providing care for dependents living with you (parents, children, spouse, etc.)	-0.10	-0.10	-0.14	-0.33
Commuting to class (driving, walking, etc.)	0.00	-0.12	-0.17	-0.09
Spending significant amounts of time studying and on academic work	0.21	0.23	-0.10	-0.16
Providing the support you need to help you succeed academically	0.07	0.13	-0.01	-0.26

Encouraging contact among students from different economic, social, and racial or ethnic backgrounds	0.40	0.26	0.31	0.31
Helping you cope with your non-academic responsibilities (work, family, etc.)	0.04	0.23	0.38	0.22
Providing the support you need to thrive socially	0.23	0.28	0.19	0.28
Attending campus events and activities (special speakers, cultural performances, athletic events, etc.)	-0.34	-0.08	-0.29	-0.13
Using computers in academic work	0.38	0.08	-0.49	-0.37
Acquiring a broad general education	-0.24	-0.01	-0.16	-0.11
Acquiring job or work-related knowledge and skills	-0.37	-0.11	-0.41	-0.56
Writing clearly and effectively	-0.45	-0.13	0.08	-0.11
Speaking clearly and effectively	0.11	0.01	0.13	-0.06
Thinking critically and analytically	0.15	0.12	-0.25	-0.18
Analyzing quantitative problems	0.21	0.05	-0.34	-0.19
Using computing and information technology	-0.28	-0.07	-0.56	-0.52
Working effectively with others	-0.36	-0.12	-0.22	-0.26
Voting in local, state, or national elections	0.31	0.21	0.27	0.41
Learning effectively on your own	-0.48	-0.23	-0.51	-0.35
Understanding yourself	-0.34	-0.32	-0.25	-0.23
Understanding people of other racial and ethnic backgrounds	-0.43	-0.21	-0.19	-0.15
Solving complex real-world problems	-0.38	-0.39	-0.42	-0.45
Developing a personal code of values and ethics	-0.30	-0.28	-0.27	-0.29
Contributing to the welfare of your community	-0.27	-0.17	-0.07	-0.10
Developing a deepened sense of spirituality	-0.15	0.07	0.15	0.06
Overall, how would you evaluate the quality of academic advising you have received at your institution?	-0.19	0.11	-0.36	-0.38
How would you evaluate your entire educational experience at this institution?	-0.61	-0.40	-0.48	-0.38
If you could start over again, would you go to the *same institution* you are now attending?	-0.67	-0.29	-0.40	-0.15

5.0 CONCLUSION

The LLC's (living-learning communities) appeared to increase engagement, slightly increase academic achievement, and increase retention in the engineering program but not in science programs. Eighty-two percent of the students participating in the fall 2003 Teniwe LLC were retained in engineering versus their non-participating peers where only 70% were retained. This translates to approximately 54 more students a year remaining in engineering (based on an average incoming freshmen class of 450). The second year 86% of the engineering Teniwe living-learning participants were retained versus a 70% retention rate for peers. Translation to student numbers suggests that 72 more students would be retained in engineering (again based on an incoming class of 450). However, retention in biotech majors was nearly identical for LLC students (85%) compared to their peers (86%).

Although it is difficult to draw direct causality to participation in the LLC program and retention in engineering, both living-learning community groups (fall 2003 and 2004 groups) showed an increase in retention consistent with the learning community literature (Taylor, 2003). It could be argued that because the LLC participants self-selected into the learning community because they have an increased commitment for their major; however, the biotech living-learning community participants did not have higher retention in their major so self-selection bias may not influence outcomes. Further research into why this particular structure of LLC appeared to work well for engineering students but not with biotech science students would be useful in refining the model and identifying situations where this type of learning community would be most appropriate. The argument for increased retention due to the LLC living-learning program is strengthened with the use of mixed-method assessment data indicating participation in the LLC program was beneficial to both engineering and science students through increased social networks, additional time on academic tasks, and integration into college. Apparently, though, those benefits appear to more directly serve engineering students with respect to staying in engineering majors.

All results, both quantitative and qualitative, indicate a LLC is a viable program for increasing retention, academic achievement, and engagement for engineering students and to a certain extent biotech studetns. Most surprising, however, was the lack of significant academic gains as evidenced by grades despite the increased time on academic tasks. Additional measures during the second year 2004 LLC program sought to gain insight by administering the Learning and Study Strategies Inventory (LASSI) measuring student study skill strategies. Unexpectedly, LLC students did not use many of the proven study strategies and scored low when compared to national norms. This may explain some of the discrepancies in academic achievement; students may be studying more but not as effectively.

Living-learning community programs such as this one do require resources for coordinators, peer facilitators, faculty time to coordinate curriculum and develop activities, and assessment instruments. Any institution is concerned with maximizing resources and strive for the most efficient and cost-effective mode of operation. Thus, researchers were interested in examining the different components of this living-learning community to see if some were more important than others. Results from both studies (2003 Teniwe group and 2004 Teniwe group) suggest that all three, common residence, common classes, and some type of connecting class/workshop/or seminar, are necessary for an effective program. The common residence increases student collaboration and motivation to study by developing relationships with peers, so when one student is having difficulties, there is almost always someone nearby with whom they can quickly consult. The group meeting/seminar provides the vehicle for developing social and academic skills, and the common classes provide the medium and common context. The program developed here had three common classes; based on the experience from this study it is believed that the same advantages can be had with just two common classes and would be much easier to administratively arrange. Based on focus group results and open-ended questions, having common classes appears to develop student self-regulation by providing opportunities to gauge their own time management and understanding with that of their peers.

A common concern of participating students both years was the perception that the weekly seminar (or in the case of the second year the freshmen seminar class) required them to participate in activities that they believed were "busy work." Although the activities were developed by faculty from the common classes and researchers, the majority of activities did not have any direct effect on the student's grade in the connected class nor did the students make connections between activities and classes possibly explaining why students believed the activities it to be "busy work.".

Although students expressed the most concerns about the weekly meetings/freshmen seminar class, this class time was crucial. Researcher observations of interactions among the students in the seminar classes and their linked classes indicated they did not naturally form groups – even when they live with and take the same classes with their peers. An additional mechanism was required that essentially "forced" the students together. That force was the weekly group meetings/freshmen seminar class.

5.1 *Changes from the 2003 LLC to the 2004 LLC*

5.1.1 Credit for weekly meetings

Teniwe 2003 participating students believed that the work they were doing in the weekly meeting should be worth some credit. They believed that in addition to recognizing the added work they were doing credit would provide extra motivation for peers who did not attend regularly. Student comments in focus group and mid-term assessments indicated students recognized the benefit of having other students attend these weekly meetings but were not able to motivate those other students to consistently attend; consequently, they believed offering credit would provide added incentive for participation in the weekly meetings. This was arranged for the following year by piggy-backing on an existing program, freshmen seminar, offered through the Student Affairs office. The results of this change were not as successful as hoped; primarily because engineering students were concerned that the two-credit freshmen seminar course had actually set them behind in their program as they would have taken another class that counted toward their program (freshmen seminar did not count toward the engineering degree program but was considered an elective). The credit class did, however, increase participation as part of the grade was based on participation.

5.1.2 Increase weekly meeting time

2003 LLC students also suggested additional time for the weekly meetings. They often used the time to complete homework and arranged their homework time around the meetings. Meeting only one hour per week did not provide enough time as many of them were not able to finish their work and did not have an opportunity to meet throughout the week as they learned and were assigned new topics in their linked classes. Additional time was accommodated the following year through the freshmen seminar class where students met twice a week as suggested by previous participants for two hours at a time. The second hour of the class was originally intended to be a time for homework because the 2003 LLC participants said this was very useful to them. As it turned out, the seminar class took on a life of its own and did not consistently provide time for working on homework. The content of the seminar class was constrained due to institutional requirements for freshmen seminar as well as goals from the living-learning community developers which at times conflicted with the homework time in class.

5.1.3 Extend program to include biotech students

Researchers, interested in applying this model to other majors, extended the program the following year to include science students. Hoping to increase the number of majors in biotech-type sciences, a "biotech" LLC was developed using the same administrative structure as the existing engineering LLC. The primary difference was biotech students took Biology 105 instead of Engineering 120. The remaining classes, Math 107, 171, or 140 and chemistry were the same. However, retention in the major results for biotech students were not as successful as they were for the engineering students.

5.2 Recommendations for future similar LLC programs

5.2.1 Reduce the number of common classes

Scheduling would be greatly simplified if one or two, rather than three, classes were linked. Preferably at least one of the classes should be a "hurdle" class, a class students often have difficulty with and those that have high repeat students. Having two classes still meets the needs of having context for developing effective study skills as well as more concentrated content-specific help.

5.2.2 Redesign the freshmen seminar course

A recitation-type class preferably following the common class would likely appear more aligned in the students' perspective and would allow faculty to address issues that emerge throughout the course in a more intimate forum. Overtly connecting study skills activities to student learning aligned with course assignments could provide the "big picture" students said they could not see. Students in both the 2003 and 2004 living-learning communities responded positively to the peer facilitators. Using peer facilitators in the linked-course seminar class will still provide the benefits from the apprenticeship model (Vygotsky, 1978) but will have the added benefit of greater content-specific help if the peer facilitators have been successful in the particular aligned co-curricular class (i.e., if it is a chemistry class, the peer facilitators are either chemistry majors or they have had more extensive chemistry classes). Additionally, if respective departments sponsor facilitators (i.e., if one of the common classes is math, have an upperclassmen math major as the peer facilitator) the faculty will likely have an easier time working directly with the facilitators, and the facilitators can provide feedback to the instructors about the students and their learning progress.

5.2.3 Train peer facilitators in content and study skills techniques

Having facilitators model different problem solving and study techniques rather than simply giving an answer will help to develop problem solving and study skills in the students. Facilitators trained in facilitating rather than the traditional tutoring helps transition students to more advanced intellectual development as they become more proficient at collaborative and active learning. Additional content training will improve the self-confidence of the peer facilitators which in turn, builds their facilitation skills.

5.2.4 Faculty involvement

Involving the linked class instructors, even sporadically, in the recitation-type classes increases student-instructor interactions. This could help alleviate disconnect students may have between different classes and promotes additional student-instructor interaction shown to improve students' engagement in college (Pascarella & Terenzini, 1977).

5.2.5 Coordinate test dates

Have faculty teaching common classes coordinate tests so they are not on the same day. This is likely one of the easiest and most useful things that can be done to alleviate student exam anxieties and is useful in scheduling activities for the linked seminar meetings.

5.2.6 Benchmark study skills and motivation

Use the Learning and Study Strategies Inventory (LASSI) (Weinstein & Palmer, 2002) or similar reliable and valid instrument either as a pre- or post-evaluation for academic achievement or benchmarking. The surprising results from the second year living-learning community suggests there is room for improvement in study skills strategies. The LASSI can be used as a benchmark or diagnostic tool and can form the basis for study skills activities in the linked seminar meetings. Continue to use grades as an additional measure to see if study skills improvement will have an effect on the grades in the class.

5.2.7 Measure intellectual development

Use Moore's survey instrument (Moore, 1995), the Measure of Intellectual Development (MID), an essay-writing test, to determine movement in Perry's developmental scheme (Perry, 1970) from participation in the living-learning community. Many of the students in the living-learning community appeared to be in the dualistic stage (Perry, 1970) consistent with other findings (Erickson & Strommer, 1991). This recommendation came about after analyzing reflective essays from the second-year living-learning students. The essays provided a great deal of insight into the students' experiences.

5.2.8 Measure engagement

Use NSSE or similar survey to measure engagement and for benchmarking program progress. Engagement can more effectively be measured using a national instrument that is reliable and valid and based extensive research. This tool can be used both for benchmarking and for determining improvement relative to peers in the institution and nationally. Additional analysis specific for particular majors from NSSE is recommend as it provides a more comparable measure, i.e., measuring engineering students to other engineering students locally and nationally.

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