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ABSTRACT

This paper describes the Learning IN Communities (LINC) integrated curriculum project implemented at the University of Central Florida. The report reviews two programs initiated in the fall of 1998, a Biology-English-Statistics class and a Calculus-English-Humanities class. The paper discusses the rationale for attempting this alternate teaching methodology, the approach to instruction, characteristics of the student body, classroom specifics, and the expected and realized benefits and shortcomings of the classes. The program achieved the goals of enhancing teaching and research experiences for the participating faculty and improving student learning. Prior experience across the nation as reported in journal articles indicated that other programs have had the same outcomes. Sections of the report provide an introduction; background information; discussion of anticipated benefits; development, delivery, and documentation of the project; cohort activity examples; and a discussion of outcomes and realized and unrealized benefits of the project. Appended are questions relating to one of the cited articles and a current lifestyle IQ test. (Contains 15 references.) (JM)

# DECONSTRUCTING THE WALLS BETWEEN SCIENCES AND HUMANITIES

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## ABSTRACT

This paper describes the Learning IN Communities (***LINC***) integrated curriculum project implemented at the University of Central Florida by focusing on two ***LINC***s which commenced in Fall, 1998. Those ***LINC***s were a Biology-English-Statistics class and a Calculus-English-Humanities class. We discuss the rationale for attempting this alternate teaching methodology, our approach to instruction, the student complexion, classroom specifics, the expected and realized benefits and shortcomings. Prior experience across the nation as reported in journal articles indicated that the following outcomes should be experienced: 1) enhanced teaching and research experiences for the participating faculty, 2) improved student learning and acclimation to college. For the most part our ***LINC***ed project achieved these goals.

## INTRODUCTION

One of the premises underlying this paper is the idea that the arts and sciences and humanities isolate themselves from one another. This premise is also one of the driving motivations for developing more curriculum-integrated courses at the University of Central Florida. The concept of walls brings to mind images of the Berlin Wall collapsing under a happy flood of people suddenly granted their freedom, or of imposing images of the Great Wall of China dividing a great unknown inside from the greater unknown on the outside. We know these were built to keep out intruders, to isolate and provide protection for a country's inhabitants. Academic walls offer a similar protection. Isn't life easier when we only have to deal with like-minded people, that is, when we do not need to defend our ideas to others who view life through a different interpretive glass than our own? Wouldn't it be difficult to interleave each others' ideas and build a common base upon which to uncover and discover further knowledge? Walls help us to clearly define who is "in" our group, and who is definitely "outside." Walls simplify. Walls protect our valued assumptions because they protect us from defending our ideas to others who may view the world from a completely different perspective as they peer over their own, possibly higher walls. Walls are comfortable, confining, and consolidating. Walls keep us together and they stand us apart. But when a few brave souls dare to conjure up scenarios of joint activities then some of us decide to try our hand at ripping down the walls brick-by-brick to see what might come of collaborative ventures. In particular, the University of Central Florida (UCF) committed itself to trying the concept of integrated curriculum classes, often referred to as cohort learning or a learning communities model. This project is referred to as ***LINC*** (***L***earning ***IN C***ommunities) at UCF. It is a fresh attempt to explore a new land without the academic walls that commonly separate students, teachers and disciplines. UCF is attempting to discover what new knowledge can be created by working together instead of working alone, in isolation. A simple, rather obvious idea, of course, but also one that has powerful ramifications both for what happens inside the classroom and what happens outside of it.

*LINCage RATIONALE*

Many faculty share the point of view that we each can be enhanced by viewing colleagues' teaching, by reviewing their research and by participating in interdisciplinary discussions. Dr. Hoffman feels quite strongly about this statement. She explains that from a statistician's point of view, it is imperative that she gets involved in interdisciplinary activities. Dr. Hoffman is aware that good things come from collaborations. This lesson was reinforced while working in industry for seven years. Since returning to academics in 1988, Dr. Hoffman has felt more secluded. Many reasons contribute to this isolation, reasons ranging from the fact that she has readily accessible statistician colleagues with whom she can interface and thus requires no fraternization outside the department, to the physical isolation of departments within colleges within the university as a whole. While this occurrence is detrimental to all types of departments, it is particularly onerous to statisticians whose knowledge and toolbase is so extensively invoked by so many other disciplines that statisticians perceive something of an identity crisis for statistics departments. Evidence enough is provided when one notes that statistics departments are found in Colleges of Arts and Sciences, in Business, in Agriculture, in Engineering and in Education (this 'schizophrenia' does not happen to English departments). This fact, while not intrinsically good or bad, is nonetheless problematic. In the August/September, 1997, Amstat News the current president of the American Statistical Association Dr. Jon Kettenring speaks to this issue. He talks about the surviving and thriving of statistics departments across the nation. "A new department was officially formed this year at University of Pittsburgh...the arduous start up process...emphasize(d) interdisciplinary collaborations and joint appointments. Multidisciplinary committees were established to develop undergraduate applied statistics courses." Dr. Kettenring goes on to quote other statisticians about what endeavors they are finding to be rewarding and fruitful at their own universities. Nancy Reid, of the University of Toronto and current IMS president...(says) "I think to be successful statistics departments have to have...extensive research contacts across the campus, through joint appointments, collaborative research, joint graduate programs, multidisciplinary research contacts, and so on." This ***LINC***ed course activity at the University of Central Florida fits into that 'and so on' list.

There is convincing evidence that ***LINC***ed classes are successful mechanisms for delivering college material. We will offer a brief overview from various sources about this integrated curriculum, team teaching methodology.

Matthews etal (1996) explain that "learning communities are conscious curricular structures that link two or more disciplines around the exploration of a common theme." They also note that these types of activities have seen a boom in the 1980s and 1990s but that cohort education dates back to the 1920s in American education. They cite Evergreen State College (a public college in Washington State) as having a continuously running program of this kind since 1970. A similar activity at SUNY Stony Brook (supported by the Exxon Educational Foundation and the U.S. Department of Education) began in the mid-1970s.

Matthews etal say that success of the cohort teaching is attributable to the "...unique approach to rethinking and connecting prevailing curriculum structures, (yielding) flexible, efficient, and imaginative response to challenges...Faculty...engage in fairly substantial planning to address the sequence and interconnections that can be made with the course material, experiential learning activities, class assignments, and group process." Also cited by Matthews etal is a paper by Gabelnick etal (1990) which claims that "learning communities rekindle the creative side of teaching and provide new challenges for well-established teachers...they turn everyone into a learner again."

Other research reviewed by Matthews etal includes a paper by Tinto (1987) indicating that the students who participate in cohort classes build a strong group identity which aids in their acclimation to the college environment. Matthews etal also report on a longitudinal study by Tinto, Love, and Russo (1994) which concludes that peer support is enhanced, students receive enriched educational experiences due to the variety of faculty perspectives, and a perceived overall improved quality of learning.

Therefore, engaging in this cohort instructional triad should be a suitable project for achieving the following goals: 1) on a local level this joint teaching effort addresses the recommendations of well-respected statisticians to pursue interdisciplinary activities, 2) on an individual level this project will afford opportunities for collaboration among colleagues from differing departments, and 3) for the students it appears that this type of educational innovation facilitates knowledge acquisition and

provides peer support that makes for a smooth transition to college life.

## UCF *LINC*age BACKGROUND

The primary purpose of the University of Central Florida's ***LINC***age project is to link several groups of two or three courses, which currently are offered in the general education program at UCF. One of the ***LINC***ages discussed in this paper consisted of Introduction to Statistics, Introduction to Biology and English Composition and was taught to 19 Honors students during Fall, 1998. The other was a year-long cohort/link arrangement of courses composed of a ***LINC***age between Humanities I & II (Greek philosophy/literature to early 20th Century Western philosophy/literature), Calculus I & II, and Basic Composition I & II mixed with introduction to Technical Communication. The students in this year-long cohort are mainly computer science and engineering majors enrolled from Fall, 1998 through Spring, 1999.

The current initiative for this program came from a university-wide committee formed in the 1996 - 1997 academic year to review the general education program (GEP). With the input from prior year committees and colleagues who were experienced with cohort education, this committee proffered a resolution which was adopted by the Faculty Senate to endorse the cohort model. The first ***LINC***ed courses were taught in the Fall, 1997. During the Spring, 1999, the University of Central Florida is offering nearly 40 ***LINC***ed courses to a subset of the nearly 5000 freshmen on campus.

The Biology-English-Statistics ***LINC*** was targeted toward in-coming freshman in certain majors such as pre-med and biology. As part of their first semester course load this group enrolled in Statistics 2023, Biology 2010, and English Composition 1101. A description of these courses from the 1997 - 1998 University of Central Florida catalog follows:

- STA2023: First methods course introducing probability and statistical inference, including estimation, hypothesis testing, binomial and normal distributions.
- BSC201: Basic principles, unifying concepts, and facts of modern biology. Introduction to quantitative biological experimentation.
- ENC1101: Expository writing with emphasis on effective communication and critical thinking. Emphasizing the writing process. Topics are based on selected readings and on student experience.

Initially, 20 Honors students were enrolled for the this ***LINC***ed course. One dropped out the first week. These are generally excellent students and thus the experience which we report on here may not exactly mirror experiences by other instructors. A brief description of the Honors program follows. The program had more than 600 students in the Fall, 1998 class. The description of this program from the 1997 - 1998 University of Central Florida catalog is:

The University Honors Program ...is designed to attract and challenge students who have demonstrated an ability to achieve academic excellence...classes are small, and course work crosses traditional discipline boundaries to encourage critical thinking...(the entrance) criteria is...

| High School GPA | SAT scores | ACT scores |
|---|---|---|
| 3.9 + | 1150 | 25 |
| 3.7 - 3.89 | 1250 | 28 |
| 3.5-3.69 | 1300 | 30 |

These students are admitted to UCF's Honors College based on these scholarly achievements, and they benefit from the feel of a small college atmosphere (embedded in a university of about 30,000 students) via small class sizes, extra symposiums, and special student lounges.

For the Biology-English-Statistics ***LINC*** A. Graeme Lindbeck volunteered from Biology, Bill Morton from English and Lorrie Hoffman from Statistics. Each of the instructors had taught these courses before and both Drs. Lindbeck and Hoffman have also taught honors sections in their respective disciplines.

The Calculus-English-Humanities year-long ***LINC*** was targeted toward in-coming freshman in computer science and computer engineering. The cohort design was to not only link the seemingly unrelated areas of mathematics, philosophy, literature and technical writing, but to also allow the cohort students to satisfy a large portion of the general education requirements all in one large, year-long combined instruction section. To provide a greater sense of unity for the course, the entire cohort was organized under the title: Charting the Geography of Reason -- Exploring the Borders of Calculus, Language and the Humanities. To find a similar link between all the sections, the entire cohort focused on underlying logic structures in the fall sections (mathematical proof, philosophical logic structures, and sentence and language logic/rhetorical structures in English).

For the fall semester the students enrolled in Calculus with Analytic Geometry I (MAC 2311H), Honors English Composition I (ENC1101H), and Honors Humanistic Tradition I (HUM2211H). For the spring semester the students enrolled in Calculus with Analytic Geometry II (MAC2312H), Honors English Composition II (ENC1102H) combined with Technical Writing Theory and Practice (ENC3211), and Honors Humanistic Tradition II (HUM 2230H). A description of these courses from the 1997-1998 University of Central Florida catalog follows:

- MAC2311H: Differential and integral calculus, emphasizing understanding basic concepts and their applications. Students will complete projects on their own. For honors students from all disciplines.
- MAC2312H: Continuation of MAC2311H.
- ENC1101H: Expository writing with emphasis on effective communication and critical thinking. Emphasizing the writing process. Writing topics are based on selected reading and on students experiences.
- ENC1102H: Focus on extensive research in analytical and argumentative writing based on a variety of readings from the humanities. Emphasis on developing critical thinking and diversity of perspective.
- ENC3211: Provides definition, history, scope, practices, and theoretical bases of technical writing and its relationship to general English studies.
- HUM 2211H: This course shares the interdisciplinary, multicultural focus on ancient civilizations and their cultural heritages. Honors-level content.
- HUM 2212H: This course share the interdisciplinary, multicultural focus on modern civilizations and their cultural contributions to the Global Village. Honors-level content.

Initially, 19 Honors students were enrolled for the this ***LINC***ed course. No one dropped the first semester, but six students dropped the cohort in spring, or were unable to continue due to failing grades in either the English, Calculus or Humanities section. The students were highly motivated and due to the daunting combination of intense honors-level calculus, philosophy, literature, composition and technical writing, the class composition tended toward students who welcome difficult academic challenges. The readings for each section were complex, detailed and required a great deal of outside work. A number of the students, as incoming freshmen from Florida's public school system, were simply unprepared for the time-consuming amount of study required for the course and quickly fell behind therefore failing sections of the cohort during the fall.

For the Calculus-English-Humanities ***LINC*** Robert Brigham volunteered from Math, David Gillette from English and Ed Shaw from Philosophy. Each of the instructors had taught their respective courses before, but none of the instructors had yet taught an honors section. Additionally, to make the ***LINC***age more cohesive, David Gillette, and Robert Brigham spent the year previous to offering the ***LINC***age discussing how they would link their courses, and alter the content of their courses to provide for a more intense, interlinked experience for the students. These discussions included another professor from Philosophy who had initially proposed the ***LINC***, but by the time the courses were offered in Fall, 1998, the philosophy professor had taken a job elsewhere and the cohort/link had to be quickly redesigned during the first few weeks of the fall, 1998 semester.

## ANTICIPATED *LINC* BENEFITS

From perusing the literature we anticipated these types of benefits: 1) faculty skills would be expanded since three instructors from very different disciplines needed to work closely together to integrate their diverse knowledge bases in order to present coordinated lectures, 2) this broadening of each participants'

understanding of information outside their own respective disciplines should lead to rich collaborative research and renewed teaching enthusiasm, and 3) the student would be exposed to the inter-relationship of the scientific procedure, data analytic efforts and communication skills required to excel in today's most demanding professions and would benefit from forming lasting friendships with their cohort group.

So, we expected immediate impact to three sets of constituents. The first set of affected persons will be the instructors themselves, the second set is the students and the third is a more nebulous group -- indirect recipients of the accomplishments of this teaching activity. This latter can range from the academic community who will read the papers published about our ***LINC***ed efforts to employers who will hire our (hopefully, better trained) ***LINC***-exposed graduates.

## DEVELOPING, DELIVERING AND DOCUMENTING THE *LINC*

### The Biology-English-Statistics *LINC*

Obviously, during the planning and preparation stage the joint activities comprised of the selection of examples, readings, in-class and homework projects took extensive interaction on our parts. Early commitments were necessary in order to plan for the scheduling of the courses and to obtain the necessary resources such as special classroom space, computer connectivity, and laboratory instrumentation. Several of us benefited from a one-week internally funded Institute conducted during the summer, 1998, where we were able to begin developing ideas for in-class collaboration. Dr. Hoffman uses many examples in her statistics classes which are gleaned from her seven years in the airline and computer design businesses. She welcomed introducing new examples which come from work in the biological sciences and those motivated by the Gould text The Mismeasure of Man which we chose for the assigned reading in the English course. We also expected to tie the course together by assigning a joint project which involved collecting insect samples, conducting a statistical analysis of that data, and requiring a write-up of the results. We expected the students to work in teams of four. Additionally, each of us planned a one-class activity related to the ideas expressed in Gould regarding the concept of intelligence and IQ testing.

During the delivery stage the team expected to more fully engage students in cross-curriculum knowledge acquisition. One of Dr. Hoffman's goals was to not hear the comment 'but where will I use this stuff?' We expected to remedy this reaction by conducting the statistical computations on just-collected biological laboratory data. One of Dr. Lindbeck's goals was to not hear 'these calculations take so long and make no sense' and we expected to remedy that reaction by being able to incorporate the power of statistical computing into the data analytic portion of biological laboratory reports. One of Mr. Morton's goals was to not hear 'what can I think of to write about?' which was to be remedied by having a built-in topic related to the lab experiments. One of the anticipated effects of integrating this Introductory Statistics course into the Biology and English curriculum was that the students who harbor an innate (or learned) distaste for the mathematical sciences would come away with a renewed sense of appreciation and adventure for the subject matter.

In the evaluative and reporting phase the third set of persons will see the benefits (and pitfalls) of this instructional triad. The greater community is comprised of all of our professional colleagues on the UCF campus and elsewhere. Moving further away from the core players, we can extrapolate the value of this activity to the university and to the community by noting that well-qualified students who are hired by employers who are then pleased with their educational background is of great concern to the president of University of Central Florida, who has emphasized that UCF is a "metropolitan university" here to serve the needs of Orlando and Central Florida. Additionally, he promotes as one of his five goals for the university the idea of "partnership" -- working closely with the business community here in Orlando. Our team believes that the integrated thinking, which is one goal of cohort learning will produce more well-rounded students who have a better understanding of the integration of knowledge -- from acquisition of data through analysis and professional presentation. We will apply a very scientific eye to these claims as we review our results. Our team exercises the usual scientific caution and collected quantifiable assessments along with commentary. Since each of the team has taught these courses before, we will be able to compare the semester-end evaluations from the ***LINC***ed courses back to those which were not executed under the cohort model. We even repeated some examination questions which

were given to the non-cohort students during earlier semesters and gave identical tests to the ***LINC***ed and to regular classes, thus enabling us to compare knowledge acquisition levels somewhat quantitatively.

The Calculus-English-Humanities Year-long ***LINC***-----

During the fall semester, 1997, Dr. Gillette (English), Dr. Brigham (Math) and Dr.White (Philosophy) were contacted by the director of the Honors College to create a new linked course combining a year-long study of Calculus, English composition and rhetorical analysis with an overview of formative Greek, Roman, European and English philosophical and literary texts. All three professors met bi-monthly for Fall, 1997, and Spring, 1998, semesters to design a combined course that looked at the development of scientific thought and logical reasoning in Western society. The team arranged their courses so in fall they would focus on the idea of logic structure and underlying design as the core of the ***LINC***. In the English section, students were to study the development and use of various grammars, starting with standard grammar and sentence diagramming and eventually moving onto discussions of transformational grammar. In the Humanities section, students would focus on the development of Greek logical reasoning to see how that lead to the first conception of scientific thought versus philosophical thought. In Calculus the emphasis would be on the establishment of proofs and discussion of applied Calculus. One of the primary texts for the combined course was to be Goodbye Descartes: The End of Logic, and the Search for a New Cosmology of the Mind by Keith Devlin. This book explored the development of Western scientific thought and the invention of the calculus while also examining the interaction of these concepts with literary narrative -- therefore an essential text for the ***LINC*** design. A second primary text was to be Aristotle's Rhetoric which would help form the foundation of many course discussions and give all the students a common language for their rhetorical and logical analysis. The English section would have students write about a variety of topics in correlation to the history and literature they were learning in the humanities section, as well as trying to develop their writing arguments along the logical and reasoning lines introduced in their philosophical readings, as well as putting to use the "ordered thinking" they were learning from the Calculus section.

The Calculus-English-Humanities team decided that all three instructors and all the cohort students would meet once a week for one combined discussion of convergent topics such as the nature of language, the definition of education and learning, or the various uses of metaphor. The weekly meetings were designed to run like graduate seminars with the topic being introduced by the instructor, but the discussion being primarily generated by the students themselves.

In mid-Spring, 1998, Dr. Gillette left for a 6-month research trip to Japan, and the meetings ceased until the start of the ***LINC*** in Fall, 1998. Some of the discussion continued through email exchange while Dr. Gillette was overseas, but then late Summer, 1998, Dr. White took a position with another university and the ***LINC*** had to be quickly re-established with a new instructor for the Humanities section. Because Dr. Shaw, the new Humanities instructor had completely different research and pedagogical interests than Dr. White, the ***LINC*** had to also substantially change in design and execution. Unfortunately, the first face-to-face Fall, 1998, meeting of all three members of The Calculus-English-Humanities team took place only a few days before the start of the semester. Therefore, many of the original goals of the Calculus-English-Humanities team were radically altered at the last minute, resulting in a fair degree of confusion for the first few weeks of the semester.

The Calculus-English-Humanities ***LINC*** instructors in contrast were still in the act of teaching their ***LINC*** while this paper was being composed, so their observations are more casual and simply based on observation conclusions based on comparing the current situation to years of past experience in the classroom.

Due to the last minute changes incurred by the Calculus-English-Humanities team, there was not enough coordination between past classes and the new link to provide for useful information gathering. Therefore the Calculus-English-Humanities team was only able to evaluate their experiences in the ***LINC*** through casual observation and intuitive analysis.

In summary, the ***LINC***ed instructor triads progressed through four phases: 1) Planning, where integrated

classroom work was selected, 2) Delivery, where the actual instruction took place, and 3) Evaluating, where objective quantitative comparisons along with student comments were reviewed in order to assemble this professional publication describing the ***LINC*** activity.

## COHORT ACTIVITY EXAMPLES

Biology-English-Statistics ***LINC***

One of three planned panel discussion/activities which were centered around ideas from Gould's book was directed by Dr. Hoffman. Gould views the manipulation of data, data collection methods and analytic techniques and deals with how these activities can affect the proper assessment of intelligence. Dr. Hoffman chose to look at a subset of this kind of problem by addressing the issue of gender differences in mathematics abilities. This involved the students completing preparatory subtasks: 1) answering questions on an article by Jeffrey E. Foss entitled "Is there a natural sexual inequity of intellect?" (see Appendix I), 2) administering and tallying a purposely biased survey called "The Current Lifestyle Quiz" (see Appendix II), and 3) writing a self-reflective assignment on personal math skills. These subtasks culminated in an in-class activity which required identification of a hypothesis and then of supporting evidence. The objective was to hone the student's critical analysis skills by making them collect information related to the question of whether men or women are better at mathematics and reviewing underlying arguments about gender differences in capabilities.

An example of the type of data presented to the class was an editorial by a woman reporter from the Orlando Sentinel newspaper. She quoted the U.S. Department of Education and the National Coalition of Girls' Schools: "By the time college rolls around, women are much less likely than men to major in engineering, physical sciences or computer science...girls and boys do learn in different ways...girls are put off by the image of a lonely scientist toiling away, focused on a problem to the exclusion of the outside world...this is a stereotype...scientists today use the team approach" (Marquez, 1998).

Dr. Hoffman displayed supporting figures to the ***LINC***ed class which were acquired from the National Science Foundation website (NSF, 1998). The percentage of B.S. degrees awarded in Engineering to UCF women in 1985 was 14.7% and in 1995 it was 18.1%. The class discussed the apparent improvement over time, but still were aghast at the low percentage. The reporter would have us believe that the trouble lies in the fact that boys and girls learn differently and that perhaps teachers are using the boy-learning model to communicate lessons and therefore not cultivating the girls' minds in the areas required to pursue a curriculum such as engineering.

This issue was addressed in a classroom lecture/activity involving the discussion of nature versus nurture in the realm of mathematical skills. We read an article by Jeffrey E. Foss (1996). He criticizes Doreen Kimura's "Sex Differences in the Brain" (1992). She peruses existing literature related to mathematics performance and concludes that mathematicians are born not made. She further proffers that the males of the human species are in an innately superior position when it comes to mathematical reasoning capabilities, due to hormones and brain hemispheric usage. Foss takes her to task on the interpretation of these experimental results. All of the rhetoric can be distilled into the query: does there exist a test which can determine whether nurture and environment and training or genetic predisposition factors uniquely without interaction dictate our mathematical capabilities.

Some of the best hard data which can be found to rebut Kimura's thesis is evidenced in the international mathematics proficiency scores of U.S. students (ETS, 1998). Comparing nine and 13-year-old boys' and girls' scores on these examinations (the only ages available on the report) over all available years: 1978, 1982, 1986, 1990, 1992, 1994, and 1996, one finds no statistically significant difference at any of the difficulty levels for any of the years when comparing boys and girls.

The class also discussed how encouragement and mentoring helps students excel. Sadly, women do run up against biases. The self-reflective assignment (preparatory task 3 mentioned above) was given to the 14 women and 5 men in the ***LINC***ed class. (This is not an unusual ratio of women to men in introductory math classes. The balance tilts the other way in more advanced courses.) The question I asked was "Think back on times in your life where you were in a math class, or in a situation where you

needed to use some math skills, or you were watching others use or learn mathematics. Briefly describe what you observed in terms of comments by others, or activities by you related to math competency." Many responses were innocuous but some related startlingly cruel experiences for girls. For example: "...fifth grade teacher...even when the boys were wrong, he praised them for attempting the problem. He never called on a single girl..." . Another girl wrote: "...one math teacher that I remember would call on the boys in the class 95% of the time...she stated 'that is because boys are better in math than girls'." Yet another girl lamented that a male teacher told her she was "... 'dumb and that I shouldn't worry about learning physics' ".

Another piece of data was gleaned from having the class tally and discuss the results of the "The Current Lifestyle Quiz" . Dr. Hoffman purposely wrote this to be a female-biased test. This led to discussions of biases in standardized exams.

Armed with this cross-section of information about men and women and their differences when it comes to mathematical coursework, the class was broken up into three teams. The three teams were given identical sets of sheets of paper with short synopses on each piece of data and each proposed hypothesis and instructed to tape their premise choice on the top of the wall with the supporting evidence below. One spokesperson then defended their chosen hypothesis. Generally, most chose to straddle the line and elect to use data from both sides of the issue to conclude that heredity and environment have equally influential roles in forming mathematicians.

The Calculus-English-Humanities ***LINC***-----

Due to the last-minute disorganization mentioned above, the Calculus-English- Humanities team was unable to realize many of the links they had first envisioned for their courses. However, a few weeks into the semester it became immediately apparent the English and Humanities sections could easily be linked by having many of the English writing assignments serve as reflections on the reading being discussed in the Humanities section. Therefore, one of the primary links for the course became the student-reporting of information from one section of the link into another section. The weekly meeting of all the students and instructors quickly became the center-piece of the course and a time when the connections between the courses could be solidified. One of the most productive discussions for these joint meetings revolved around the definition of the nature of language, and even how one would define "language."

A semester-long debate arose concerning the proposition that C++ or some similar computer programming language could actually be considered a language. This discussion lead to writing assignments involving definition as the primary activity to help the students understand how important the understanding and definition of terms is in any scientific or logical investigation. In the Humanities section, students learned to explicate the texts they were reading by doing an extensive definition review of terms, concepts and narratives. In the Calculus section, definition also became an operative metaphor for helping explain the exploration of new mathematical structures and processes.

A web site for the course was established, along with a web board discussion area where students were encouraged to continue their weekly discussions online. The language discussion evolved into a discussion of how we define human versus animal, man versus machine, and how we could or would define the soul. Additionally the Calculus-English-Humanities team arranged for movie nights every week when a film relating to the definition of language, thought or time were introduced. For example, the viewing of Slaughterhouse Five lead to discussions of time and our view of "reality." A viewing of the documentary, Fast, Cheap and Out of Control lead directly into our discussions of the nature of human versus machine, and programming versus the soul. The cross-disciplinary links, as they evolved in the course, were more informal than planned, but seemed to be more closely connected with the programming and engineering interests of the students. And even though the format was rather disorganized and certainly differed from the original plan, a number of the semester long discussion themes (the nature of language, logic, reasoning, learning, and the definition of the soul) did eventually tie the courses together.

**OUTCOMES AND REALIZED AND UNREALIZED BENEFITS OF *LINC***

Biology-English-Statistics ***LINC***

We did not accomplish all that we set out to do. Unfortunately, the insect collection project literally got washed away. Hurricane George came through Orlando in September and flooded out the collection trays. There was nothing to salvage and so that portion of the combined activities had to be abandoned, much to our chagrin. We had also planned to do some joint quizzing where there would be a statistics question on a biology examination. We were unable to find enough time to coordinate this kind of activity. Aside from these mishaps, we were able to accomplish much of what we planned.

Mr. Morton did finish most of the Gould text and had discussions on those concepts particularly relating to critical analysis and critical response. These types of essays are part of the required core assignments for ENC 1101. Dr. Hoffman used several examples from the Gould text including those involving correlation and confidence intervals. She also used data collected in several of the biology laboratory experiments; both as in-class examples and as data for quiz questions. The panel discussion which was assembled by Mr. Morton dealt with whether IQ tests should be administered and how they should be used. Different teams took issue sides and effectively argued their cases. And Dr. Hoffman conducted the mathematical gender differences activity.

The ultimate question is whether the goals set forth were accomplished. These are the summary of the goals as we have discussed them above: 1) Gabelnick etal say that a rekindling of the creative side of teaching will occur for the instructors, 2) instructors will discover ways to collaborate on research, 3) Tinto reports that students bond and thus are able to help each other adjust to the first year of college, and 4) Tinto, Love and Russo propose that the students' learning increases.

Did Mr. Morton, Dr. Hoffman and Dr. Lindbeck feel a revitalization from participating in this ***LINC***ed course? No, we just felt tired. I do expect that when we repeat this course in Fall, 1999, we will get the exhilaration which comes with enhanced accomplishment and the pleasure of finding new ways to present old ideas. Developing and presenting a course for the first time, whether it is a ***LINC***ed course or not is usually an extremely taxing undertaking. We really did gain knowledge about each others' course topics and an appreciation for the difficulties associated with teaching each discipline and benefited from watching each other teach.

As for collaborative research, this paper is a vehicle for the joint reporting of our results and thus we are accomplishing this portion of the stated goals. Mr. Morton was able to incorporate the data collection of student commentary by assigning that as a final paper. Dr. Hoffman developed several quizzes and examinations which were essentially identical to ones previously administered to non-***LINC***ed introductory statistics courses and thus can report on grade differentials. Dr. Lindbeck has done the same with his biology course. These insights and analyses appear below.

The student bonding was the most conspicuous and rewarding goal which was met. Here are some of the comments gleaned from students' final English papers: "I was able to form small study groups with just a few class members...without them, I never would have survived my first semester"; "...easy to make friends..."; " ...good way to make the transition from high school...made some real good friends who I study with, party with and talk to"; "...major factor in my successful transition from a high school student to a college scholar".

Interestingly, the student comments also covered some benefits and some shortcomings which we had not anticipated. One student pointed out that "...professors tend not to give two major tasks on the same day." And this was true. When we were doing our planning we instinctively avoided doubling up assignments, but it was nice that someone noticed and appreciated that aspect. On the downside, one student lamented "link courses limited what other courses you could take...could not drop one of the classes...unless I wanted to drop out...". And this is a problem. Drop out rates tend to be very high for statistics classes. But to drop statistics the student apparently must also withdraw from the English and biology class.

Lastly, we address the issue as to whether student learning has improved. There are numerous ways we

could conjecture to measure quality of the learning experience, but here we choose to compare grades on in-class tests for ***LINC***ed versus non-***LINC***ed students. Dr. Hoffman gives quizzes about every other week in the statistics class. Quiz 2 which covers means, standard deviations, and graphical techniques was almost identical (except for the dataset being analyzed). The Fall, 1997, non-***LINC***ed class averaged 99.1 while the Fall, 1998, ***LINC*** class scored an average of 97.1. Both of these classes contained 19 honors students. A statistician would warn about inferring to a large population from this sample, particularly since the ***LINC***ed class was largely comprised of biologists whereas the non-***LINC***ed class was a more diverse cross-section from UCF. But we certainly can make the statement that this non-***LINC***ed class did better early on in the course than the ***LINC***ed students. The final examination was almost identical, also. The Fall, 1997, non-***LINC***ed class averaged 84.0 while the Fall, 1998, ***LINC*** class scored an average of 88.9. In this case ***LINC***ed class scored better than did the non-***LINC***ed class. Perhaps the study groups which these linked students were able to assemble paid off for them. Dr. Lindbeck found similar results when comparing non-***LINC***ed and ***LINC***ed courses. He gave exactly the same examinations to a regular non-honors, non-***LINC***ed introductory biology class and to his honors ***LINC***ed class and found these averages. On Exam 1 the regular class averaged 61 while the ***LINC***ed class averaged 73. On Exam 2 the regular class averaged 61.5 while the ***LINC***ed class averaged 71. On Exam 3 the regular class averaged 60.5 while the ***LINC***ed class averaged 68. We can not be sure if the spread is due to the fact that these are honors students or to the fact that the ***LINC*** is benefiting the students or some combination of these (or other) factors. Again since this is not a controlled well-designed scientific experiment, we can only speculate that we have infused some improvement into the students' educational experience. If one is willing to interpret examination scores as a measure of learning then we have some evidence that the ***LINC***ed group is learning more than their counterparts.

The Calculus-English-Humanities ***LINC***-----

In many ways, the Calculus-English-Humanities team also did not accomplish all they set out to do. As stated above, the original, rather tightly-conceived plan for the ***LINC*** had to be radically readjusted at the last minute, leading to a fair degree of confusion in the ***LINC***. The primary lesson learned by the Calculus-English- Humanities team was that the essential element for any successful ***LINC*** was the active, continuous participation of all the ***LINC*** planners from the start to the end of the project. Like all good, useful acts of collaboration, the ***LINC*** rises and falls on the energy and interests of the instructors and students involved.

For the Calculus-English-Humanities team, the ***LINC*** was still underway at the time of this paper's composition, therefore the results are not in. But, certainly the sense of exhaustion is present as the requirements of interacting with each other's courses, and meeting jointly on a weekly basis involves a great deal of extra, time-consuming work. But Dr. Gillette and Dr. Brigham have both commented on the excitement they have encountered in the attempt to link Calculus and English in some meaningful way. Both Dr. Gillette and Dr. Brigham have talked about how the chance to learn more about the other's field of study and teaching methods have definitely improved their individual teaching and their approach to their own fields.

Dr. Gillette from the Calculus-English-Humanities team is currently trying to collect more information about the results of his ***LINC*** experiences in connection with other ***LINC***s from the English department. Additionally, during Fall, 1998 and Spring, 1999, Dr. Gillette managed to connect his ***LINC*** students, through the Web, with some of his Japanese

ESL students from writing and intercultural communication courses he taught in Summer, 1998 at the Nagoya University of Foreign Studies (NUFS). This collaborative project between UCF and NUFS in Japan is currently leading to more research exploring the linking of courses not only between subjects, but between different languages, cultures and countries.

**SUMMARY**

We declare ***LINC*** to be enough of a success at UCF to warrant a continuation. No one will dispute the fact that the ramp up effort is enormous. Effort expended is certainly as much if not more than preparing for any new course. The rewards are greater, though, than those for a regular new course preparation.

Students appreciate these three course combinations for three specific reasons: the reduction in scheduling conflicts for major assignments and the camaraderie afforded them via repeated contact with peers in the three classes rather than merely one class over the semester, plus the seemingly increased performance in their coursework (and, therefore, we extrapolate, an increase in learning and skillset acquisition).

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## APPENDIX I: Questions About the Foss Article

1. State Doreen Kimura's hypothesis about men versus women in professional fields.

2. Foss claims as Gould does that supporting evidence for the premise stated in question 1. is (circle all that apply): a)true b)false c)consciously faked, fudged, manipulated d)accidentally misinterpreted e)designed to support a pre-conceived notion.

3. What does Sells mean by a "mathematical filter"?

4. State the statistic given about men outnumbering women on the mathematical reasoning skill distribution.

5. How does Foss discount the claim of "Hormonal influence..on developing brains"?

6. Can you devise an infallible testing procedure to discern whether males or females are better at "targeting"? Describe the test or explain the reasons you can not devise such a test.

7. What makes Foss say that it would be best for society not to accept the premise of innate differences between the sexes for mathematical reasoning?

8. Androgen seems to alter what intellectual capability? States its impact for each sex.

9. Testosterone seems to alter what intellectual capability? State its impact.

10. What factors associated with the mathematical reasoning test environment might affect testosterone levels?

11. List problems associated with trying to link testosterone levels to mathematical reasoning skills.

## APPENDIX II: CURRENT LIFESTYLE IQ TEST

1. Describe a typical game played at a baby or wedding shower.

**SOLUTION:** 1. a tray is passed around with many items and you get to observe it for a few minutes and when it is hidden away you must write down from memory as many items as you can. The person with the most correct wins. 2. a quiz is given with questions about the bride and/or groom like 'what day of the week was she born on?' etc. The person with the most correct answers wins.

2. How many teaspoons in a tablespoon?

**SOLUTION:** 3

3. What percent of women in the United States are natural blondes?

a) under 20% b) 20 - 30 % c) 31 - 40 % d) over 40%

**SOLUTION:** a

**(REFERENCE:** *America By The Numbers*, Les Krantz, 1993, Houghton Mifflin, NY, pp. 31-32)

4. What is the approximate cost range of a bottle of fingernail polish at somewhere like K-Mart?

a) 0 - $2.49 b) $2.50 - $4.49 c) $4.50 and up

**SOLUTION:** b

5. How long will your cat live if typical?

a) under 8 years b) 8 - 10 years c) 11 - 13 years d) over 13 years

**SOLUTION:** d

**REFERENCE:** *Guinness Book of Records*, 1992, Bantam Books, NY, as quoted in *Astounding Averages*, DD. Dauphinais and K. Droste, 1995, Visible Ink Press, Detroit.

6. About how many calories are there in a typical chocolate candy bar (i.e. Almond Joy, Kit Kat etc.)?

a) less than 100 b) 100 - 200 c) 201 - 300 d) over 300

**SOLUTION:** c

7. In the movie "Titanic" the character Molly Brown is played by which actress:

a) Kate Winslet b) Kathy Bates c) Clare Danes d) Elsa Winfred

**SOLUTION:** b

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