AC 2011-242: WRITING CHALLENGES FOR GRADUATE STUDENTS IN ENGINEERING AND TECHNOLOGY

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Writing Challenges for Graduate Students In Engineering and Technology

Abstract

Graduate education for most students is the move to deeper exploration of knowledge through personal involvement, primarily through research and writing. By thesis or directed project, many graduate programs in engineering and technology incorporate substantial written research-based projects into the master's level curriculum to prepare graduates for professional careers or for further study at the doctoral level. Students in the engineering and technology fields face several challenges in moving to written projects of substantial length and complexity, whether through more limited experience with written projects or a personal dislike of the act of writing. The authors, who have experience in teaching research and writing to master's level students, touch on several issues for further research and explore techniques for helping students develop as writers. Several common issues are addressed, along with some practical techniques for graduate level educators in technology and engineering.

Introduction

One of the major challenges students in engineering and technology face is proficient research and writing at the graduate level. Graduate education is designed to prepare students for academic study at the doctoral level, or for advanced positions in their discipline. It is unusual to find a program which does not require competent (if not excellent) written and oral communication skills as a goal or learning outcome for the graduates of that program. However, students come to the graduate level with varying degrees of competence in their ability to express themselves through written communication. For purposes of this paper, the type of writing which will be discussed will be the scholarly type of academic writing. Even though academic writing encompasses all forms of study assignments, lab reports, short research papers, etc., the focus of this paper will be more on the lengthy research-based writing that is typical of scholarly writing (e.g., directed projects, thesis, dissertation, journal articles).

Background—Factors Contributing to the Problems

There are a number of factors involved in why students come to their graduate education with inadequate writing skills. In addition to scholarly writing being a totally different skill than many students have practiced, students have also had varying levels of quality in their feedback from their undergraduate instructors on written work, especially on scholarly writing. Obviously, there are a variety of reasons for writing deficiencies in students but many can be attributed to how the students were taught as undergraduate students. Additionally, the difference between scholarly writing and technical writing; the deficiencies in undergraduate writing experience; and faculty workload and the demands of teaching writing, with the related issue of rigor can influence student writing at the graduate level.

Technical Writing versus Scholarly Writing

Generally, engineering and technology undergraduates come to graduate education with experience primarily in technical writing skills. Although not everyone will agree with this definition, technical writing has been described as a marriage of the task of effective communication with the task of technical communication.[1] The mechanics of writing (i.e., format, structure, grammar and syntax), and the technical substance (i.e., analysis and interpretation) are both important, so that the results of scientific inquiry are communicated in such a way that the audience understands and can draw useful conclusions.[2] However, technical writing is usually not the same as scholarly writing, and scholarly writing is required in most research-based writing projects, such as theses and directed projects. As opposed to being concise, to the point, or having the data speak for themselves, scholarly writing relies on analysis, synthesis, and logical construction of a proposition with appropriate support.[3] Technical writing is generally designed primarily to transmit specific information, while scholarly writing is designed to underpin the creation of new knowledge. A student who is competent in technical writing may not be fully competent in scholarly writing (although certain problems are common to student writing in either style). Thusly, one area for future research may be how to narrow the gap between technical writing and scholarly writing.

Deficiencies and Lack of Writing Experience at the Undergraduate Level

From these educators' perspective, and in the opinion of many colleagues, a significant number of graduate students are performing at a level less than appropriate for written graduate work. The fact is that many graduate students do not know what good writing skills are supposed to be, nor do they understand that writing standards apply to every academic or scholarly submission.[4]

The problem of undergraduate writing has been the subject of much discussion recently with the release of *Academically Adrift* by Arum, Roksa and Cho, and the related article Improving Undergraduate Learning: Findings and Policy Recommendations from the SSRC-CLA Longitudinal Project.[5] Whatever one thinks of the method of research or the import of the results, the quality of undergraduate writing has certainly been raised as an issue in need of a solution. Arum, Roksa and Cho note in their findings that:

- Large numbers of students report that they enroll in courses that do not require either substantial writing or reading assignments;
- Fifty percent did not take a single course in which they wrote more than 20 pages over the course of the semester;
- Over the course of four years, 50% report they had taken five or fewer courses that required over 20 pages of writing.[6]

These findings are bolstered by the recent investigative article in The Chronicle of Higher Education, looking at writing assignments in two majors at Texas colleges.[7] The Chronicle analyzed ten public four-year institutions in Texas, looking at business and education majors. The conclusion was that business and education majors are exposed to only a handful of writing-intensive courses over the course of their 40-course studies. In addition, the report noted that education majors are exposed to fewer than eight such courses, and business majors are exposed

to fewer than five. While criticism has been leveled that page count is too simplistic a measure, it does tend to indicate that graduate students, when faced with a scholarly writing assignment of 50-80 pages, would be expected to have serious difficulties because they have not been exposed to many if any extensive writing projects.

As a result of this lack of preparation, many graduate students are simply not able to perform scholarly writing at the graduate level because their training has either been poorly handled or non-existent. In the case of students for whom English is a second language, and who may have studied outside the United States, their academic backgrounds may not have included much in the way of comprehensive English writing training. This would especially true in areas outside their own quantitative fields, so the struggle to write well is combined with the struggle to write well in English for those students.

Faculty Workload and Writing Feedback

Another issue which may bear upon the quality of writing seen at the graduate level involves the faculty workload at the undergraduate level. Properly grading written assignments and giving feedback requires an immense amount of time to perform well. Many undergraduate faculty do not have the time (or perhaps the inclination or skills) to grade the medium as well as the message. If the student's work is understandable, many faculty do not feel that it is their place to provide extensive feedback on writing. Graduate advisors, who are responsible for mentoring graduate students and guiding their research, also have workload constraints, and may not have the time or the background to provide the kind of writing guidance some students' poor skills may demand.[8]

College professors in various disciplines who assign written projects have different approaches to how written student work is graded and the type of feedback provided on written assignments. Many professors will not provide feedback on writing skills beyond certain basics, and only focus on content or subject matter when grading written work. Some faculty seem to do it out of concern for their teaching evaluations, and some do it as a time management technique (i.e., "I don't have time to teach my discipline and writing"). When it comes to written assignments, students generally expect that the grading or feedback an instructor gives will be on the content, not on the mechanics of the assignment (writing skills).

Often the preparation and training given to undergraduate students in courses requiring written assignments do not rigorously demand precision, creativity, and adherence to specific standards. The requirements of many courses, regardless of the discipline, do not require undergraduate students to conform to strict writing standards when submitting assignments. From these authors' experiences, it is not uncommon for undergraduate faculty to generally ignore common grammar mistakes and poor sentence structure (mechanics of writing) simply because of the reactions of many students when grading anything other than the subject matter of the course. Students may become unhappy with writing direction at the undergraduate level if faculty try to enforce guidelines on written assignments, especially in classes other than English/composition classes. Often students do not understand the importance of writing skills in their discipline courses, particularly in quantitative disciplines such as engineering and technology. The authors posit that the shorthand method of texting messages on cell phones many times carries over to the

classroom assignments. For these reasons, undergraduate faculty are placed on the horns of a dilemma in grading assignments in their disciplines (e.g., engineering or technology). Either faculty ease up on strict adherence to writing standards on written assignments, or they risk the retaliation by students who may give them low instructor ratings. Most untenured undergraduate faculty cannot succeed without receiving high student evaluations when it comes to raises and promotions. Thus, some junior faculty succumb to the pressures of the tenure requirements and may not enforce standards as forcefully as necessary to produce good writers in graduate school. The experience of these authors leads us to conclude that many undergraduate students consider it unfair for grades to be determined on anything other than the subject matter of the course, certainly not writing standards. Thus, because of a lack of rigorous adherence to standards, many undergraduate students are ill prepared to produce high quality scholarly written work before entering graduate programs.

The authors of this paper are not alone in their opinion that pressures on faculty do not produce good results in the teaching of writing to undergraduates. Mark Bauerline, a frequent contributor to The Chronicle of Higher Education, notes that writing is just "too much work for both sides" (faculty and students).[9] Intensive grading of undergraduate writing is not rewarded, but faculty work in their own writing is, as published faculty writing/research leads to tenure and promotion. William Pannapacker, under his pseudonym of Thomas H. Benton, has also asserted that student evaluations of teachers, among other factors, pressure faculty members to teach in a way that leads to high student evaluations, and that does not include rigor in the classroom (but does, in his opinion, include expecting little, smiling a lot and giving high marks).[10]

Writing Challenges for Students

Whatever the root causes, graduate faculty are presented with challenges in coaching and mentoring graduate students in producing competent scholarly written work. Even the top students have difficulty in producing high-quality scholarship without some practice or apprenticeship. The following is a discussion of some of the recurring issues which educators face in working with graduate students.

Mechanics

Typical problems with student writing (at both graduate and undergraduate levels) can include issues with mechanics (grammar, etc.), failing to cite figures or reference sources, data presentation (visual presentation of data), discussion of results, how much detail to include, conclusions not supported with logical inference, voice and use of first person, and failure to understand the intended audience (i.e, that the work is *not* directed to the instructor or faculty advisor).[11] Specifically, in relation to the graduate writing process, such problems as difficulty in focusing the scope of the research, lack of conciseness and organization, inappropriate use of graphics, and sentence level errors (punctuation, usage and grammar) have been cited.[12] It appears that problems that appear in freshman work, where Beams and Niiler noted that freshmen showed marked deficiencies in content, mechanics, language, tables/figures/graphs, and technical merit,[13] also appear in later student work. The authors of this paper would argue that while technical merit may have improved by the time these students reach the master's level, many of the same problems plague student writing skills even at the advanced level despite

writing initiatives, such as writing to learn or writing across the curriculum, in technical education.

Other aspects of mechanics can include tone, voice and choice of pronouns, which are closely linked in student writing. Many students approach their scholarly writing with the first person active voice—"I performed the experiment" is a typical construction. Students tend to address their written work to their professors as if they were making an oral report directly to that professor, which leads to immediate problems. The work will not meet scholarly style requirements because it reflects an informal tone. A review of literature in engineering and technology will reveal that almost no published scholarly work uses the first person in describing the technical data or the process employed. This is often the result of students not having familiarity with the literature in the field or the style of writing expected. Many of them have written first-person experience papers or statements, but not lengthy research-based works. This problem is also a result of student confusion on who the audience is for their writing—scholarly writing is not addressed to the instructor but to their professional peers in the discipline.[14] Most faculty will encourage the use of passive voice to address these issues. This avoids the first person problem that students fall into, and helps create the proper academic tone.

Citation and Attribution of Sources and Academic Honesty

The concept of research ethics and academic honesty in regard to written submissions by graduate students is of significant importance to all graduate faculty members. Unfortunately, many graduate students do not know or fully understand the concept of academic honesty or proper attribution of sources according to scholarly standards in the United States. Graduate students may understand that they must research ideas and concepts from other authors and writers, but many of them do not understand (or care) about the requirement for proper attribution of this work. As the subject matter available for online research expands and as it becomes easier and easier to copy-and-paste from online sources, students seem have more and more difficulty in meeting standards for proper attribution in the submission of their work. The authors have found that graduate students who are non-native speakers of English, and who have studied outside the United States' educational system, have very different understandings of what is appropriate in terms of citation and attribution, particularly in how to paraphrase from sources. Concepts that "everyone already knows" in the discipline are often cited without attribution, even though this is not acceptable for scholarly work.

The existence of an Honor Code at Purdue University Calumet has not been entirely effective in minimizing the academic honesty issues. Even though clear guidelines are imposed on University students by the Honor Code, faculty members (the authors of this paper included) find significant numbers of examples of academic dishonesty and plagiarism in the submission of required reports and papers. This parallels national statistics which indicate that nearly 70% of the total student population in the US is involved in some form of academic dishonesty during their schooling.[15] When asked about the sources of some of their work, students will often raise the defense of "I didn't know how to/or that I needed to cite this", so that the issues of attribution and academic honesty often come bundled together. Although the authors use citation checking services such as Turnitin or Safe Assign (and would highly recommend their use to others), many students do not understand the results from the review by either service. Students who

have received reports of 40-70% of work that matches other sources have asked the significance of having received results in that range.

Second Language Issues

Non-native speakers and writers of English, referred to variously over time in the research as non-native speakers, ESL or L2 students, present special challenges to faculty in providing guidance on written work. A wealth of research has been done in this area. For faculty advising graduate student writers, the decision often comes down to how thoroughly to mark a student's paper and whether to impose the same standards on non-native speakers. The time involved in coaching non-native speakers can be greater than the time for native speakers—and faculty are already strapped for time. For many faculty members, there is a balancing act between producing a quality result and doing so much revising, editing and feedback that the student becomes discouraged with the process. These students are struggling with the language as well as the unfamiliar writing style. Some common issues, like missing articles (a, an, the), are common to students who come to English as a second language, and are relatively minor in the overall picture. However, some students, particularly in quantitative disciplines such as engineering and technology, may not have had to write significant amounts, or may not have been graded on their English writing skills in their undergraduate studies. Referring some of these students to the University writing center or to other writing resources can be helpful. However, it should be noted that this may require significantly more time (and drafts) than working with domestic students who have writing issues.

Techniques for Helping Graduate Students Write

What follows is a discussion of some techniques which may be helpful to keep in mind in working with graduate students to improve their writing. There are a few techniques which will help graduate advisors and educators improve the writing of their students: providing sample work and requiring reading of the type of work they are expected to produce; mind mapping; writing plans and schedules; extensive rewriting; and setting specific goals for the student work.

Reading and Sample Work

Students will not know what good scholarly writing is unless they have been exposed to scholarly works through reading and writing. A frequently used technique involves requiring the students to read extensively the type of work they will be expected to produce. Asking them to read and critique the writing of other scholars allows the instructor the opportunity to emphasize what is important about scholarly writing. This is one of the most important processes, due to the lack of exposure to the type of scholarly work they are expected to now produce. A graduate advisor or faculty member cannot assume that merely reading this type of work will be enough for the student—they must practice critiquing and writing as well.

Generating Ideas; Mind Mapping

Many inexperienced writers are at a loss on where to begin a large scholarly writing project, and may have trouble coming up with a suitable topic for enquiry and a plan on how to approach the project. Mind mapping is a concept that is often used in the creative process that lends itself to

writing of all types. Mind mapping is a nonlinear tool to explore and generate ideas that may be linked together or even to help narrow a research topic. Through mind mapping, writers can explore a topic in a creative freethinking process. The nonlinear mind map diagram is used to link central key words and ideas around their topic. See the sample mind map in the Appendix. Additionally, the word elements of a mind map are arranged intuitively. As the student reads and explores research reports and course materials, he or she has the opportunity to add to the mind map and to freely rearrange and explore ideas without the structure of writing. This then gives the student the opportunity to classify the important concepts, with other groupings, branches, or areas, with the goal of representing semantic connections between key words and phrases germane to their topic.[16] The layout of the brainstorm branches provides a way for students to arrange ideas, concepts and words without prioritizing them at the onset. This is in contrast with a linear list of concepts, words, ideas and sentences. The students have the opportunity to begin without a conceptual framework, brainstorm ideas and eventually make visual connections through the mind map. The mind mapping process can be used throughout a course or research project as a student progresses from topic, to problem statement, to research questions or hypothesis. There may be many iterations of the same mind map, taking on a structure through each repetition. Sometimes mapping the literature in a field can help the student find areas for further exploration, or understand how to synthesize and present the research in a literature review.

Planning

In addition to mind mapping, guidance on planning and "project management" of the writing project can be helpful to inexperienced student writers. Many if not most students have not tackled a writing project of the length required in graduate work. To one author's astonishment, some students have no idea how to tackle a large writing project, so they start at the beginning with an abstract and try to write through to the conclusions and analysis. This is not a very effective technique. As Craig has pointed out, this divorces the writing part of the process from the cognitive part of the process, and causes problems for the student writer.[17] Experienced faculty may not remember this stage of their writing development and forget to provide students with some very basic guidance in structuring the writing process. Similarly, student writers often have a very optimistic idea of how long it will take to complete a large writing project, and consequently either run out of time or fail to allow for polishing and editing the draft, which is critical (rewriting).[18]

One of the authors of this paper has structured the directed project proposal course to follow the thought process of research and writing. In that course, the assignments start with a topic, progress to annotated bibliography, problem statement and significance of problem, initial statement of deliverables or goal of the project, then to full literature review, limitations and delimitations, assumptions, methods, introduction and abstract. Upon completion of each of these sections, the student would be able to assemble the components into the proper order for a proposal. The course schedule allows at least two weeks at the end of the semester for polishing the draft. While this structure makes intuitive sense to the instructor, there have been a number of student questions indicating that the students did not understand that the pieces written throughout the course of the semester as individual assignments could be assembled into the final document; nor did they understand that significant polishing would need to be done on the draft

once assembled. Since receiving these comments and questions, the course has incorporated more explanation to help address these gaps so students understand why the course is structured as it is. A similar model has also been proposed by Craig, cited above.[19]

However, most students do not structure their work according to the cognitive processes, i.e., their work grows out of the research basis (literature review). In fact, many students start with the end result or where they want to be (or what they think the answer is), then do the supporting research. In addition to being a poor research technique, it leads to major issues when the students then do the supporting literature research and find that it does not support their project, or that the research as they have designed it has already been done or that it is impossible to perform.

Editing and feedback

One common phrase among writers is that all writing is rewriting. Writing not only communicates with others, it clarifies one's own thoughts. It is rare indeed that one can write clearly and precisely on the first try. Students are notorious for being so relieved that the dreaded writing process is over that they do not rewrite, they merely "dress up" the draft with spelling and punctuation corrections without touching the substance written. Faculty should emphasize that the writing process is not only writing but rewriting, and revision is an expected and vital part of the process. Any discussion of a schedule for turning in completed work should include a substantial amount of rewriting time. Time for rewriting of the various sections of a scholarly writing project should also be worked into the schedule where possible to minimize the amount of extensive rewriting that will be needed in the final draft. It is less overwhelming for students to rewrite smaller sections, rather than rewriting the entire draft at the end of the process. By the time a draft is assembled, the final revisions should be aimed at smoothing transitions and polishing.

Setting Goals

One helpful technique for graduate faculty working with graduate student writers is to set targets or goals for the number of sources or the pages of a literature review (e.g., literature review is a minimum of 10 pages in a proposal, etc.). Another goal might be that the proposed work be reviewed in an attribution checking service, and the resulting report show that no more than x% of the submitted draft overlaps with other sources. Giving general guidelines on good writing may be difficult for novice writers to put into practice, and specific goals can help them reach at least the minimum standards.

Use the University Support Available

Faculty should encourage all students with writing issues to gain one-on-one assistance from a writing center for each writing project, and they should be encouraged to start using the assistance as early as possible. This can help relieve some of the load from advisors and graduate faculty. There are also some quality online writing resources, such as the Purdue Online Writing Lab, but some students may find those more difficult to use and understand and need face to face discussion of their writing.[20]

Encourage students to schedule an appointment with a University reference librarian who can give the student specific guidance in quality sources for his or her particular discipline. And while Google Scholar is a useful tool, many students do not have the judgment to appropriately assess the available information (even though it is certainly a step up over other search methods used by students).

Encourage the Use of Appropriate Style Manual

In the graduate research methods course, students may be required to use a style manual, such as the American Psychological Association (APA) style manual[21], and may be provided with additional online APA and grammar resources, and examples of how to write in a scholarly tone and cite sources. Although the authors take this approach, they recognize that not every research methods course is as focused on writing. Faculty may also direct their graduate students to a particular journal or discipline-based publication to have students learn appropriate style and citation.

Deconstructing Scholarly Writing

Students may learn about scholarly writing from the process of taking it apart, or deconstruction. First, students can be provided with the criteria for determining whether a journal article or research report meets scholarly requirements for validity. Many of the criteria can be found in the research methods books or style manuals.[22] The criteria can be discussed in class or in online discussion boards, along with appropriate examples, to help guide the students. The students can then be given several written assignments where they critique a scholarly article or research report to establish if-and-why the article is scholarly and whether it follows citation or style guidelines. Finally, students can use the criteria for validity as scholarly research and what was learned in the discussions to write their critique reviews.

Tips

1. Students need exposure to many good examples of the type of writing that they are expected to produce. They need to read and critically examine those examples, and have samples of the type of work available to them to review in courses.
2. Feedback to students should emphasize what is done right as well as areas for improvement. Feedback should be given often. Try to guide the development of the writing by having the student address fundamental flaws in one draft, then mechanics in the next, then citations in the next. Marking all in one draft can be overwhelming for student as well as faculty.
3. Students need help breaking down a large writing project into manageable tasks. Help them focus on writing one section at a time in a logical research (cognitive) order, with multiple submissions (drafts) for feedback and guidance.
4. Make sure students have guidance on the style manual or format of the writing they are expected to produce. Direct them to a particular journal or style manual for guidance on how to format and cite information. Do not assume that they will be able to use the manual or style guide without a significant amount of practice and exposure.

5. Build into the student's writing schedule time for writing and rewriting of sections and the entire manuscript. Set specific goals for the student in the components of their work.
6. Citation examples should be provided to the students throughout a research or writing course. Give students a list of references and have them deduce the rules of citation or style from the list.

Conclusion

Given the issues that face undergraduates in acquiring writing skills, helping graduate students acquire and improve writing skills will continue to be a daunting task. The authors encourage graduate faculty to continue to explore the issue and share effective techniques for improving scholarly writing in graduate students. Although some of the contributing factors will need to be addressed on a campus level, if not a societal level, educators who are dealing with the need to improve writing skills in their students on a day-to-day basis should still strive to address the needs of the students where possible.

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[2] Daniell, Figliola, Moline and Young, Learning to Write: Experiences with Technical Writing Pedagogy Within a Mechanical Engineering Curriculum , Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition.

[3] Daniell, Figliola, Moline and Young, Learning to Write: Experiences with Technical Writing Pedagogy Within a Mechanical Engineering Curriculum , Proceedings of the 2003 American Society for Engineering Education Annual Conference & Exposition.

[4] Similar issues were experienced in a Ph.D. program in chemical engineering at Mississippi State University when first and second year graduate students were asked to write NSF style research proposals. Minerick, A. and Hernandez, R., Graduate Student Qualifying Exam Approach: Course to Guide Students through Writing a Research Proposal, Proceedings of the 2010 American Society for Engineering Education Annual Conference & Exposition.

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[7] David Glenn, Writing Assignments Are Scarce for Students in 2 Majors at Texas Colleges, The Chronicle of Higher Education, January 18, 2011, retrieved March 1, 2011 from www.chronicle.com/article/WritingAssignments-Are-Scarce

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[10] Thomas H. Benton, A Perfect Storm in Undergraduate Education, Part I, The Chronicle of Higher Education, February 20, 2011, http://chronicle .com/article/A-Perfect-Storm-in/12451/ . Benton asserts that lack of student preparation, grade inflation, student retention, student evaluations of teachers, enrollment minimums, lack of uniform expectations, contingent teaching, time constraints, curricular chaos and demoralized faculty members contribute to the "perfect storm" in undergraduate education.

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[13] Beams, D. and Niiler, L., How Engineering Students Learn to Write: Fourth Year Findings and Summary of the UT-Tyler Engineering Writing Initiative, Proceedings of the 2009 American Society for Engineering Education Conference & Exposition.

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[15] http://wwwhomemorals.com/moral-value/honesty/why-is-academic-honesty-important.html

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[18]Craig, J., Writing Strategies for Graduate Students, Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition

[19] Craig, J., Writing Strategies for Graduate Students, Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition.

[20] For example, the Purdue Online Writing Lab (OWL) is an excellent resource. http://owl.english.purdue.edu/owl/

[21] Style Manual of the American Psychological Association, 6th Edition

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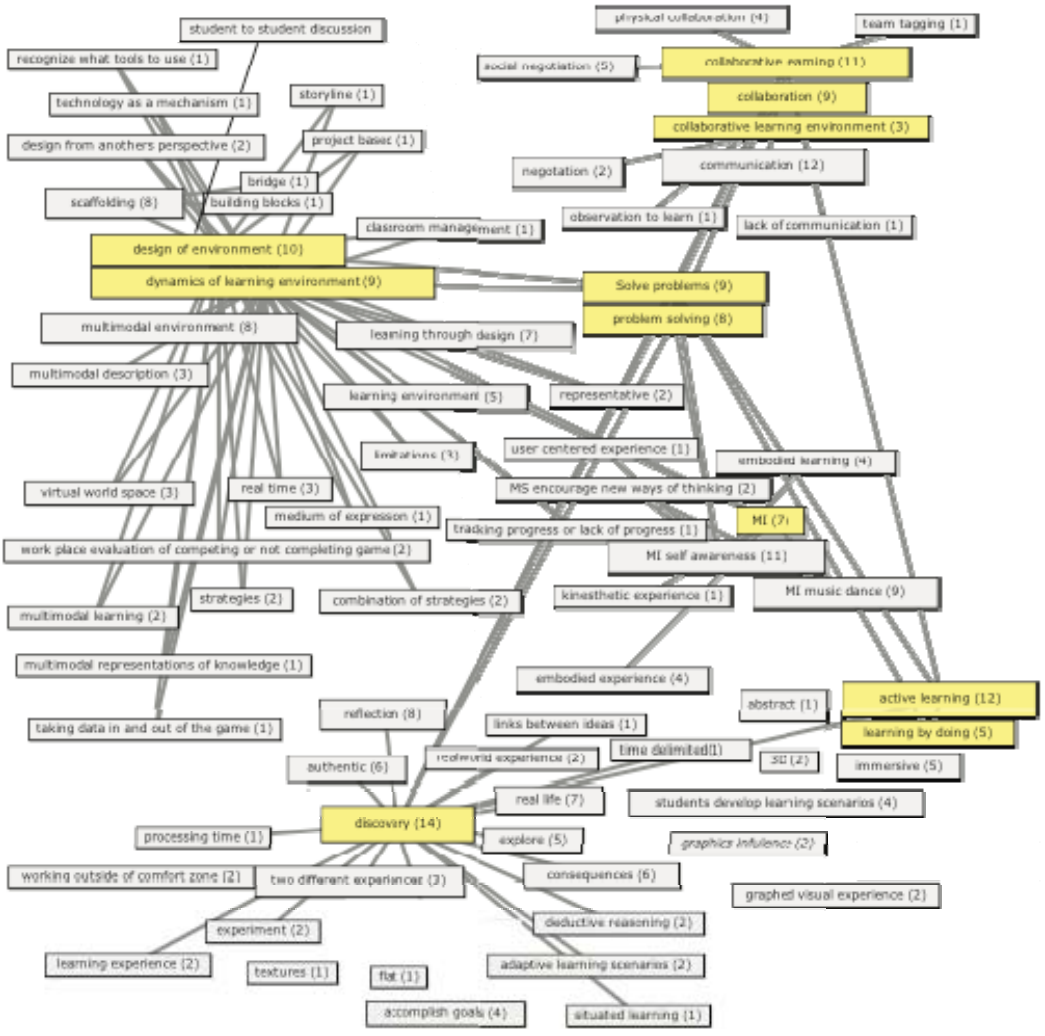
Appendix


student to student discussion
recognize what tools to use (1)
technology as a mechanism (1)
storyline (1)
design from anothers perspective (2)
project based (1)
bridge (1)
scaffolding (8)
building blocks (1)
design of environment (10)
dynamics of learning environment (9)
multimodal environment (8)
multimodal description (3)
virtual world space (3)
real time (3)
medium of expression (1)
work place evaluation of competing or not completing game (2)
strategies (2)
multimodal learning (2)
multimodal representations of knowledge (1)
taking data in and out of the game (1)
reflection (8)
authentic (6)
discovery (14)
processing time (1)
working outside of comfort zone (2)
two different experiences (3)
experiment (2)
learning experience (2)
textures (1)
flat (1)
accomplish goals (4)
situated learning (1)
adaptive learning scenarios (2)
deductive reasoning (2)
graphed visual experience (2)
consequences (6)
explore (5)
real life (7)
students develop learning scenarios (4)
time delimited(1)
links between ideas (1)
abstract (1)
active learning (12)
learning by doing (5)
immersive (5)
MI music dance (9)
kinesthetic experience (1)
MI self awareness (11)
MI (7)
tracking progress or lack of progress (1)
MS encourage new ways of thinking (2)
embodied learning (4)
user centered experience (1)
representative (2)
learning environment (5)
learning through design (7)
problem solving (8)
Solve problems (9)
classroom management (1)
lack of communication (1)
observation to learn (1)
negotiation (2)
communication (12)
collaborative learning environment (3)
collaboration (9)
social negotiation (5)
team tagging (1)