Research Development Portfolio
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WORK IN PROGRESS. This version should be considered "final" in terms of submission for coursework, summer 2010, but my research development is very much an in-process experience. I would appreciate any feedback—please address questions/concerns/comments to robinfowler@umich.edu.

Current (as of 1:35pm, August 4, 2010) Statement of Research Interests

I am interested in exploring team-based design engineering learning and the support of team processes using technology. Specifically, I am interested in the team process and how it affects educational outcomes, as well as how learner factors such as gender, culture, and native language affect the team process. I am also interested in exploring how to facilitate teams to encourage both the development of creativity and team success.

The Evolution of my Interest Statement

My INITIAL research statement was really a list of twelve or so topics I find especially interesting. It included the team-facilitation topic I ultimately wrote up, along with a series of other topics, including computerized essay scoring; a cognitive perspective on online reading; and how research reports are disseminated and consumed, given new technologies. Reassurance and advice from Dr. Matt Koehler, one of the instructors of this course, along with ideas from friends and recent EPET graduates, Drs. Andrea Francis and Howard Glasser, helped me narrow it to an initial single statement:

> I am interested in investigating cognitive predictors of success with various technology-enhanced learning tasks and in understanding the possibly bidirectional relationship between new media and cognitive skills. More specifically, my research is focused on understanding the ways that humans interact with new media—how our attentional control, working memory ability, and visuospatial skills affect our ability to process new media and also how our interactions with new media affect our cognitive abilities. Characterizations of this bidirectional relationship and information about how learners' individual differences affect their responses to particular new technologies can inform design decisions for learning technologies.

That statement in hand, I sought advice from my assigned advisor, Dr. Patrick Dickson, who asked why I wasn't taking advantage of my current situation (teaching engineering at UM) in my statement. I reconsidered my longer list of interests, and thought also about what types of research might best inform my current teaching, and what types of research I wanted to be doing after the program is over. Concurrently, I met with people at my own institution and talked about possible projects (was reassured that looking at communication patterns of International Students on teams and the facilitation of creativity might be interesting avenues for study) and ended up with this version, which is almost identical to the current formulation:

> I am interested in exploring team-based design engineering learning. Specifically, I am interested in the team process and how it affects educational outcomes, as well as how learner factors such as gender, culture, and native language affect the team process. I am also interested in exploring how to facilitate teams to encourage both the development of creativity and team success.

From that version, I was asked an important question by both Dr. Cary Roseth (the other instructor of my summer course) and Karen Bedell, a fellow student: You're in a program for Educational Psychology and Educational Technology. Where is the technology in your statement?

I actually hadn't intended for it to be omitted, but I also don't see it as the major focus of my research. I am interested in how to facilitate these teams so that more students learn more, and I suspect that technologies will be part of that. In my classes, I help students find technology tools that will make their work more effective and efficient (such as Google Docs, Microsoft Project, and Doodle). I hope to continue to do so, and to do so more intentionally. I believe that my research will consider how technology is used in team facilitation, but I hadn't been explicit about that in the earlier version. I hope that the current version is more clear.

Resources for more information (including experts)

For this class, we were asked to identify three "experts" in our area of interest, and I list three people here (along with my rationale for including them). I believe this part of the assignment was to help us start thinking about resources we might find that can help us hammer out our interests further, so I will include some information on some of those as well. Resources here are presented in alphabetical order.

American Society for Engineering Education. http://www.asee.org/

I have been a member of this organization since Fall 2007. I receive their magazine and read some of their journals online. I haven't yet been to their conference—and likely won't make it until after the PhD program, as it's always at the end of June—but later in my career, I hope to/ plan to be a regular attendee.

This organization sponsors much of the dissemination of Engineering Education information. I will continue to periodically peruse their publications and perhaps also seek out listservs of interest. I am a member of the Educational Research Methods interest group, and I may try to take a more active role in that group.

Center for Engineering Education Research at MSU.
http://www.egr.msu.edu/news/2009/08/25/center-engineering-education-research-established-msu

I have been unable to find much information about this Center for Engineering Education Research. I plan to email Jon Sticklen, the director, and learn what projects they are currently working on. One of my concerns, as I begin this focus for my PhD research, is that the EPET faculty may not be as

familiar with engineering-education-specific interests. I would like to find someone at MSU (or perhaps Cindy Finelli at UM, see below) to also serve on my committee and represent the engineering focus.

Richard Felder. http://www4.ncsu.edu/unity/lockers/users/f/felder/public/RMF.html

I include Richard Felder because I believe he is a primary driving force behind the interest in Engineering Education. I am lucky to be riding on a bandwagon he started, where faculty in Colleges of Engineering across the country are now beginning to research pedagogy and read pedagogy research. There are four or five well-known Engineering Education journals, all begun in the last couple of decades. There are four PhD programs in Engineering Education, all begun in the last decade. And Richard Felder seems to have been one of the first people conducting and publishing Engineering Education research.

Some of his work focuses on things I am less excited about, such as learner types and personality profiles, which I believe may have less psychological reality. He has also conducted great work, though, including longitudinal studies of student retention. I believe I would be remiss to say I was interested in researching an aspect of engineering education and not include him in my list of experts.

Cindy Finelli. http://www.engin.umich.edu/research/e3/people/finelli.html

Cindy Finelli is the director of the Center for Research on Learning and Teaching-North at the University of Michigan. This branch of the campus's Center for Research on Learning and Teaching focuses on Engineering Education, and Dr. Finelli actually has a PhD in Mechanical Engineering and only later in her career moved to studying education.

She has two major foci in terms of engineering education research: the development of ethical decision making among engineering students, and the assessment of students working on teams. She has her finger in a lot of pies, though, as she is the primary person at UM doing research on engineering education.

I met with her in the middle of this set of summer courses and explained to her what I'm imagining I might be interested to do in terms of PhD research. She has offered to be an outside committee member for me, and she seems very interested in my topic. Her research, which has focused on team ASSESSMENT, would certainly be applicable to team facilitation as well.

Barbara Oakley. http://www2.oakland.edu/users/oakley/

Barbara Oakley is a professor in the College of Engineering at Oakland University. Her main research seems to be in the area of Biomedical Engineering, but she has also conducted teacher-research on her own classrooms, and she has published a number of studies on team facilitation. I cite her studies at the curriculum committee meetings I attend, when I try to explain to my colleagues why I do what I do in my classes. Her findings inform my teaching in terms of how I design team assignments, how I assign teams, and how I assess teams. I will look at her studies to help me identify the types of information I should collect as I begin designing my own studies.

Annotations of Articles of Interest

In the last seven weeks, I've been intensively working on nine PhD credits. I haven't done as much reading as I would like to, and I'll hope to do some catching up over the next month. I have a file of PDFs on my desktop of over forty research articles that I expect will inform my research interests. I also tend to find articles "by snowball," meaning that each good articles leads to more (either from the articles they cite, or because I find out who has cited them). I expect I won't be short of reading materials for a long time.

For this course, we were asked to annotate six articles that inform my research interests, and those six are included below. I expect to substantially expand this over the next few months, though I'll likely make my annotations less formal and move them all to Mendeley.

Fruchter, R. (2001). Dimensions of teamwork education. ***International Journal of Engineering Education, 17*****(4-5), 426-430.**

This short paper presents a case study of the assessment of a problem-based learning framework employed by Architecture and Engineering programs at Stanford University. Fruchter begins by defining problem-based learning in the context of engineering as "learning that focuses on problem-based, project-organized activities that produce a product for a client… based on re-engineered processes that bring people from multiple disciplines together" (p. 426). In this model, Stanford creates multidisciplinary design teams that, at times, pair early-career students with graduate students and people from industry. This structure provides for modeling/ scaffolding/ coaching.

The methods of assessment used in this study may inform my later models/ things I may consider measuring. Specifically, Fruchter investigates level of cross-disciplinary mastery:

- Islands of knowledge (do students master all skills, or just the parts of the project they complete?)
- Awareness of other disciplines' goals and constraints
- Appreciation of other disciplines' goals and concepts, ability to ask appropriate questions
- Understanding of, ability to negotiate within other disciplines, using language of the other discipline

Students ranked themselves in one of these categories both pre- and post-project, and typically their self-rating improved.

I was especially interested in this study because it gives me some perspective on what another University is doing regarding ABET's initiative to better teach students professional skills, including both the design process and teamwork. I like Stanford's use of multidisciplinary teams. I believe that most of the teams at UM (in courses, anyway) are not multidisciplinary, and I think students' experiences suffer because of this. This article was weird as a study, though—it's really more like the internal assessment report my department is currently creating. There is no attempt to generalize the findings elsewhere. Reading this report helps me have a better sense of how UM's program is typical and atypical. The

report itself probably doesn't directly inform my research in that this program is so different from my context, and the limited case-study here is less ambitious than I would like to be in my research.

Gomez, E.A., Wu, D., & Passerini, K. (2010). Computer-supported team-based learning: The impact of motivation, enjoyment and team contributions on learning outcomes. *Computers & Education, 55,* 378-390.

This research study is based on some of the iterative team-based learning models I've been reading about, but it extends the research to a hybrid classroom where student teams are implemented partially via technology. Some of the parts of the model—such as lecture being completely eliminated from a course in order for it to be considered team-based—aren't obvious to me. I don't understand the rationale here (and by this metric, then, most of my courses aren't team-based, even though there is certainly a substantial team component. This paper may, however, have informed the instruction in our hybrid courses this semester!

The research questions evaluated in this study:

- Do students' perceptions of the value of their team members' learning contributions impact their perception of learning from the computer-supported TBL process?
- Does individual preparation affect perceptions of computer-supported team-based learning experiences?
- Do motivation and enjoyment impact the computer-mediated learning experience?

See their model, Figure 4. Subjects (n=73) were Masters level, enrolled in a hybrid "Information systems principles" course. Data was mostly self-report on questionnaires. Reliability of perceived learning construct was 0.906. A disadvantage of this study is that it's all self-report. Importantly, though, there were quite a few things I see as useful in this study:

-I could adapt parts of this for my own project; for example, I might be able to get instruments from these people. I will need to email at some point.

-The write-up is a good model for me because I see more reliability information and other statistics here than I'm used to seeing.

Knight, D.W., Carlson, L.E., & Sullivan, J.F. (2007, June). Improving engineering student retention through hands-on, team based, first year design projects. Presented at the *31st International Conference on Research in Engineering Education*, Honolulu, HI. ISBN: 0-87823-193-5. ©ASEE.

The authors begin by quoting retention rates for engineering programs. The rates throughout the US are even worse than the specific rates at UM. Throughout the US, only 48% of the freshmen who enroll in engineering programs leave with an engineering degree, and the graduation rates for women and

minorities are only 30% (each). This study sought to understand what impact a freshmen course—designed as team-based and taking students through the design-build-test cycle—might have on retention.

This research report explains a longitudinal study investigating students who took a team-based design-build-test section and students who did not. The study examined 5,070 students, 42% of whom took the course in question their freshmen year. Students who took the course were less likely to drop out of the engineering program (correlation here is reported as causation).

The authors attribute the increase to the students' participation in hands-on projects and development of a peer support network (via the teamwork aspect). These attributions were based, in part, on information gathered from focus groups of students who had participated in the first-year course.

This study presents a wealth of data. The conclusions are shaky because providing a correlation isn't enough. Perhaps I can explore some of the same issues using different methods. My study would need to be experimental (students randomly assigned to take or not take the section) rather than correlational, like this was.

Actually, my context may allow me to get at some of this. Students at UM are required to take a section of Engineering 100 ("Introduction to Engineering). In about half of those sections, students actually build something. In other sections, students design but don't build or test their device or system. I could replicate this study but compare populations who took each type of class to consider what aspects of the course might affect retention. For example, a couple of reasonable hypotheses: 1) it's the team component that is important—students bond with a small group and then have colleagues to encourage them and to rely on OR 2) it's the building component that is important—seeing the results of your work so early in a program is motivating.

Unfortunately, any study like this would be correlational for me as well. Students choose their own sections, though there may be some way to learn which students intentionally chose a building section or avoiding a building section and which were stuck based on other aspects of their freshmen schedules.

Melles, G. (2004). Understanding the role of language/culture in group work through qualitative interviewing. *The Qualitative Report, 9*(2), 217-240.

In this study, Melles investigates international students' experience in group projects by means of focus groups. He interviews 19 students from Indonesia and China (attending an Australian University) in groups of 3-6 at a time. Many of the students were enrolled in a nursing post-graduate program. When possible, he mixed the groups in terms of academic focus and ethnicity. The write-up for this study is quite long, and Melles spells out more of his methodology (there is a large focus on the room where the focus groups met, for example) than I am used to seeing. In the interviews, Melles determined nine broad themes and then coded transcripts using NUDIST software (a qualitative coding program). Melles

also addresses some cultural norms associated with the focus group, and how he needed to change his methodology in order to better match the norms of his participants. For example, he found his Indonesian students were often unwilling to criticize currently-employed methods and to more quickly strive for group consensus than has been reported in typical focus group literature (often conducted with Western participants).

Melles also conducts a discourse analysis on the interviews. The most interesting finding there, in my opinion, was students' use of pronouns. Students who were happy with their groupwork experiences used "we" to refer to their experiences in those projects with their colearners. Students whose experiences had been more negative, in contrast, used "we" to refer to other groups to which they had membership—for example, to the cohort of Chinese students studying at the University. I would be interested to see whether this was actually a difference in use of pronouns, or whether instead students who were happy with the groups talked about the groups more/ students who weren't talked about other things more, and the extra uses of "we" are an artifact of the linguistic focus.

I selected this study to look at partly because it emphasizes qualitative methods. Though I suspect I will need to rely on qualitative methods to address my research questions, I am much less familiar with/ comfortable with this methodology. In some ways, this study did not encourage me to consider qualitative methods as rigorous/ as truth-seeking/ as "good" as the quantitative methods I am more familiar with. The write-up of the article was littered with grammar and writing errors and made me question the author's credibility.

One methodology I will consider using to inform my understanding of group dynamics is focus groups. This article actually quotes a book that I will check out, but I liked the quote well enough that I wanted to include it here: "the objective [of focus groups]is not primarily to elicit the group's answers but rather to stimulate discussion and thereby understand (through subsequent analysis) the meanings and norms which underlie the group answers" (Bloor, 2001).

Porter, C.O.L.H., Gogus, C.I., & Yu, R. C-F. (2010). When does teamwork translate into improved team performance? A resource allocation perspective. *Small Group Research, 41*(2), 221-248.

This study examined a few team behaviors in the context of business students working on teams. In particular, teams that experienced a workload distribution problem benefited from devoting resources to more active monitoring. Basically, the researchers argue that behaviors we consider good indicators of good teamwork—such as backing up and supporting other team members, frequent monitoring of people's progress-- come at a cost to team effectiveness, since resources (time, money, energy) spent doing those things isn't doing something to further the team's goals. This study examines what those boundary conditions, then, are.

Groups were assigned randomly to one of two conditions: experiencing an (external) workload distribution problem or not. Groups then worked on the task (a DoD team monitoring project) over two episodes, and behaviors and performance indicators were compared. Of interest were ultimate success

as well as whether the team checked in on individual progress (monitoring) and whether the team took over each others' workloads (backing up). In terms of results, backing up behavior and performance monitoring were not significantly correlated. A workload distribution problem had a significant, negative effect on team performance. Monitoring, but not backing up, had a positive effect on team performance overall. Backing up, however, had a positive effect on team performance when there was a workload distribution problem (there was a 2 way interaction).

This study comes from a theoretical base that I'm not familiar with, and I got a lot of good ideas and resources from it. In particular, I've identified other studies I need to read and some of the psychological constructs that will be relevant to team dynamics. I can tell I'm going to need to read more widely in this field before I'm comfortable with the discourse, though. This particular study, while conducted with students, doesn't really translate to facilitating student teams because it isn't long-term (it's a one-time group activity, which has very different characteristics than the long term work teams I'm interested to explore). I'm excited to learn of this journal, though, which might have very relevant research. I need to explore their last few issues and see what other types of studies are being published here.

Woods, D.R., Felder, R.M., Rugarcia, A., & Stice, J.E. (2000). The future of Engineering education III: Developing critical skills. *Chemical Engineering Education, 34*(2), 108-117.

Woods et al. discuss promoting process skill development with engineering students. They make eight recommendations:

1. Identify the skills you want students to develop, include them in the syllabus, and communicate their importance to students.
2. Use research to identify them—and share that research with students.
3. Make explicit the implicit behaviors associated with success in these skills.
4. Provide extensive practice in the application of these skills.
5. Encourage self-monitoring
6. Encourage reflection
7. Grade the process, not just the product
8. Use a standard feedback and assessment form (across all instructors of a course)

This report is not of original research. In some ways, it's a summary article considering existing research on these areas. In this way, it probably hasn't directly informed my research—but it may have informed my teaching (I'll need to talk to some of my colleagues about #8). It also has pointed me to additional resources.

Further steps

The final part of our Research Development Portfolio was to determine our future steps in terms of our research interests. I have quite a few. I hope to make a large dent in this list over the next month

or so (classes start for me September 7) and then continue working, albeit more slowly, once I'm back to work and taking another class.

Specifically, I need to:

- Learn about the methodologies most common in the field. I believe most of the group research is fairly qualitative and self-report. Large-scale surveys are also common. I have taken a 3-credit PhD course in qualitative research, but that was about 5 years ago. I need to re-familiarize myself with some of that methodology. I may skim my old textbook. I also figure I will learn by reading articles, and I've identified a slew of them to look through.
- Continue reading articles (as I mentioned before, I have 40-50 saved in a file on my desktop, and as I read, I will likely identify more). I will also continue searching, via PsycInfo, Engineering Village, and Google Scholar, for additional articles of interest. I will transfer these annotations, and begin putting all of my notes, into Mendeley.
- Learn about the boards governing any research I want to do (IRBs at both MSU and UM, probably).
- Meet with Julie Young (meeting set for Friday, August 6) to write the executive summary for an NSF proposal she is working on. We are going to add a RQ involving teamwork to her study—right now, it's something about how to get students to make creative design decisions in the context of energy use of underwater vehicles.
- Learn more about survey methodology. I've never been involved in research that was primarily survey-based, but I suspect my future studies may be. I don't know much right now about how to design reliable/ valid surveys.
- Create a resource for students on technologies available to help them in teams. I've previously done a handout listing things like Doodle Polls and Microsoft Project for designing Gantt Charts. I want to be much more intentional about this and determine how I could use this in my research.