

A New Paradigm for Understanding Communication that Can Transform Engineering Communications Learning and Teaching

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Abstract - In the Engineering Communications Program (ECP) in the College of Engineering at Cornell University, we are proposing, indeed already integrating into the curriculum, a new paradigm for understanding communication – communication as individual and social action. Our paper begins with a brief presentation of the current skills paradigm and a critique of the resulting pedagogy for communications learning and teaching. Next, we describe our new paradigm for understanding of communication. We then describe how such an understanding of communication can be integrated into engineering curriculum through the concept of genre and how discourse analysis enables us to study and to assess that integration. And finally, we briefly suggest how our alternative understanding might transform curriculum design in order to enhance engineering communications learning and teaching.

Index Terms – Communication, engineering education, assessment, curriculum design.

THE NECESSARY TRANSFORMATION OF COMMUNICATIONS TEACHING AND LEARNING

In a recent and, arguably, the most thorough survey of technical and professional communications instruction in US and Canadian schools and colleges of engineering, we learn a number of things that we already know [1]. We learn that the ability to communicate is considered “essential to success” [1]. We learn that there is a “large gap between the workplace needs and engineering graduates’ communications skills” [1]. We learn that either there is not enough instruction or enough of the right kind of instruction. And finally, we learn that those schools and colleges that wish to “differentiate themselves as providers of top-quality engineering education” need to “develop strong communication programs” [1]. In other words, we learn that there is almost total agreement on the formulation of the problem. Since communication is important and engineering graduates seem to be lacking communication skills, something must be done. And, we learn that there is almost total agreement on the perceived solution.

The something that we must do is to provide more communications instruction and more of the right kind of communications instruction.

However, for as long as communication has been understood by the academy as a skill, there have been similar calls for and, as a result, a constant proliferation of communication courses, support services, programs, and even departments. Specifically, in the field of engineering, the survey itself documents the increasing number and variety of opportunities for engineering undergraduates to receive communications instruction. So, if schools and colleges of engineering have been providing more and presumably more of the right kind of communications instruction, why does the “large gap” continue to exist, and why are our graduates’ skills “repeatedly ranked low?”

For over a century now, we have had the idea that communication is a skill, more recently (and more revealing of the misunderstanding) that communication is a “soft skill” or “professional skill” or “process skill,” something very important but distinct from the so-called “hard skills” [2]. Consequently, our academic institutions, to the extent that they address issues related to communication -- reading and writing, speaking (oral presentations) and talking (cooperative/collaborative group/team work) -- make four assumptions: 1) that as a skill, the ability to communicate is a kind of practical knowledge; 2) that that skill, because it is considered practical, can be separated from the foundational knowledge of a particular subject, area, or field – in other words, it is discrete; 3) that that skill, because it is discrete, is widely applicable, indeed is generalizable across different subjects, areas, or fields; and 4) that that skill, because it is practical, discrete, and generalizable, is knowledge that can be learned once and for all.

Based on those assumptions, then, we create distinct curricula that are very often considered preparatory, either for other discipline-specific courses or the world of work. We create a content for those curricula that is isolated from or is connected only in the most generally referential of ways. And finally, we encourage students to focus on mastery or, more likely, focus on remediating their failure to master through

drill and demonstration. We choose to believe that if we provide students with the opportunity to master these so-called professional skills, that practical knowledge; then that skill/knowledge will be completely, now and forever, and in all ways and in all contexts at least serviceable. Indeed, we choose to believe this despite all our first-hand experience and research findings to the contrary [3,4,5]. Instruction that is focused on the mastery of practical, discrete, and generalizable communication skills is misdirected. Such instruction and a curriculum designed to provide that instruction, and this is extremely important, will continue to fail because the understanding of communication as a soft, professional, process skill is most certainly false.

An Alternative Understanding of Communication

In the Engineering Communications Program (ECP) in the College of Engineering at Cornell University, we understand communication differently. Communication or, as we would prefer, “language use” even “linguaging” is not a skill [6]. Neither is it simply practical, discrete, and generalizable knowledge. Rather, ***language use is both individual and social action***. When we use language, and when we use language jointly with others, we are doing something in order to get something else done. Language use is a part of not apart from the doing and the something done. Neither is communication discrete, separated from the knowledge of a particular subject, area, field, or even community. ***Language use is always and everywhere situated or context-bound***. Language use as an action can never be separated from context because we lose, then, our resources for appropriate interpretation and the perspective that that context always provides. Further, if language use is always and everywhere situated, then it cannot be generalizable. ***Rather, language use is all about the particular (and sometimes peculiar) processes of participation that are appropriate to purpose(s) and constitutive of an identity***. In fact, it is only through participation, and the practice that that participation affords, that we can develop strategies for learning to learn how to use language in order to be able to participate. And finally, understanding communication as skill encourages, eventually requires demonstrations of mastery, an unrealistic and therefore misguided aim given the constancy of change in purpose, context, and identity. ***Instead, language use encourages, indeed privileges experience***. Linguaging seeks opportunities to practice and become practiced, in ways that emphasize inclusion, being a part, rather than gate-keeping, being apart; and diversity and variability and therefore creativity rather than (but not in opposition to) conformity.

Communication – reading and writing, speaking and talking – or language use is not practical, discrete, and generalizable skill/knowledge that can be mastered. Communication is instead a collection of practices and activities – individual and social actions – that are as foundational, as fundamental to any particular enterprise as are any other practices and activities. ***Only communications instruction and an engineering communications curriculum***

that understands communication or language use as action, as always and everywhere situated, as learned through processes of participation, and as sometimes instrumental, representative, and even constitutive of the work of engineering will offer enough and enough of the right kind of communications learning and teaching.

ENGINEERING AND COMMUNICATION

Communication is not practical, discrete, and generalizable knowledge that can be mastered. It is not a skill. Instead, communication is that collection of practices and activities that are as foundational, as fundamental to engineering and students’ emerging identities as engineers as are any other practices and activities that they enact while doing engineering.

This fact does not mean, however, that, as teachers, we should focus on communication rather than mathematics, communication rather than problem-solving, communication rather than design. In the same way that the work of engineering requires mathematics, problem-solving, design; so too, it requires language use. By the way, it also requires ethics, social and cultural awareness, and lifetime learning – all as a collection of practices and activities as well. Instead, our aim should be to create good and useful and powerful engineering experiences for our students in ways that enable them to enact, practice, and eventually perform all the above.

We already have a very good start. Our emerging “pedagogies of engagement” – undergraduate research, inquiry and problem-based learning, team project, service learning, and design thinking – offer valuable engineering experiences [7]. The challenge is integration. The engineering experiences that we provide our students are only as good, as useful, and as powerful as are all the above practices and activities integrated into the particular engineering performance. In what remains of this paper, we will describe how communication, no longer understood as a skill but as language use, can be integrated into performing engineering through the “concept of genre” and how discourse analysis enables us to study and to assess that integration – to understand better not only what our students can do, but also what they will need to be able to do in the future. [8]

Engineering, Communication, and Genre

Genre “has traditionally been . . . [understood] in a classificatory sense to designate a . . . discursive category, such as a sonnet, legend, oration or greeting” [9]. As a discursive category or type of communication, we attend primarily to the regularities of “textual form and the linguistic features” in those respective types [8]. More recently (depending, of course, on the discipline), another understanding of genre has been emerging. This other understanding still attends to the regularities of form and feature, but does so in ways consistent with our understanding of communication as language use. So, as a type of communication, genre is a situated and recurring instance of discursive action, a way of using language learned through

participation or some suggest “enculturation” within a particular community and experienced as instrumental to or representative, even constitutive of performing as a member of that community [8]. As our students engage in the work of engineering, they should also be enacting the genres peculiar to that work – not only to learn the regularities of form and feature, but much more importantly, to begin, first, to associate language use as part of not apart from performing that work, as well as, and second, to begin to develop strategies for learning to learn how to use language as part of not apart from their future work in engineering.

There is a vast literature relating to genre. Much of it is very interesting and applicable. The one avenue, however, that is perhaps most relevant to our particular focus on communication in engineering is what Charles Bazerman (1999) calls “the North American approach to genre” [10].

According to Bazerman, this “North American approach to genre directs our attention to the typification of rhetorical action – that is, the repeated communicative actions people do with each other, the repeated forms by which they do it, and the interpretive practices by which they recognize what they are doing” [10]. In other words, genre refers to those particular practices and activities related to communication that are typically, routinely, and (we would argue) necessarily part of the work of engineering. So, when we imagine, begin to create the kinds of engineering experiences we hope that our students will have; it is important for us to consider those ways of using language, those genres that are part of the experience, part of the work. Further, he suggests that this approach also “directs our attention to the historical emergence of current practice, the current social organization of communication, and people’s strategic use of forms to participate in socially organized activities” [9]. In other words, genres have a history of like practices and activities and present-in-time conventions that relate to doing or language use. Again, it is important that we help our students access that history, acknowledge those conventions. That history and those conventions provide the scaffolding for their participation as language users, for enacting those genres in ways that are appropriate, effective, and efficacious. Bazerman goes on to suggest that this approach attunes us “to the particularity of processes” [of our participation] . . . by showing us how specific texts [examples of particular genres] functionally mediate the socially organized practices of engineering” [10]. In other words, genres are always “specialized” and as such require “focused assignments, explicit instruction, and supervised practice” in order for students to understand the action genres perform, how they are about getting something done [10]. Finally, he concludes by stating that “a genre-based . . . education [in language use], beyond helping students develop a first set of communicative practices to begin professional work, should provide students with analytic tools [and a framework] to recognize and adapt to the changing genre landscapes their professional lives will travel across” [10]. To offer students the opportunity to identify genres, to appreciate the history and conventions of their use, to understand their particularity in relation to identity, context, and function is to offer them

the opportunity to develop strategies for learning to learn how, the opportunity to participate as engineers and language users in doing engineering.

In an extremely helpful article, “Genre Analysis in Technical Communication,” Maria Jose Lizon does a very adept job summarizing what she calls “teaching genre from a social perspective” [8]. Teaching genre from a social perspective is a pedagogy that is consistent with our understanding of language use. It is a pedagogy that understands that language use is action. It recognizes that students learn these actions and their function(s) primarily by participating in the engineering community. And, its aim is to encourage students to develop “strategies that will allow them to face [and, we presume, succeed in] communicative situations that may take place in the workplace” [8]. She even cites a number of recent research studies [11,12, 13, 14] that support the promise of this approach. So, the concept of genre taught from a social perspective seems a very hopeful way to integrate communication with the work of engineering. Still, for such a pedagogy to be successful, actually realize its aim, then the integration of genre into students’ experiences of doing engineering needs to be more systematic and systemic. That is where discourse analysis and its use for assessment become critical.

Engineering, Communication, Genre, and Discourse Analysis

The focus of discourse analysis is not “language as abstract system,” but rather language use or what most people think of when they “exchange information, express feelings, make things happen, create beauty, entertain themselves and others” [15]. Discourse analysis attempts to discover “what happens when people draw on the knowledge they have about language, based on the memories of things they have said, heard, seen, or written before to do things in the world” [15]. And because people use language in many, many different ways to do many, many different things, discourse analysis, as a method, is wonderfully ubiquitous. That is, with a very wide range of possible ways of using language, it offers a method for “taking things apart” [15]. For example, it offers us a way to study an academic research article as well as a service exchange in a telemarketing phone call; small talk at a cocktail party as well as the design of a website; the tables, graphs and charts particular to the community of engineers as well as a TV commercial. The instances of languaging in each of the above performances are different. It is a written text for the academic research article and scripted speech (at least for the caller) in the service exchange. It is friendly chatting (generally about the weather, food, sports, fashion, family and children) in small talk and the complex interrelation of various semiotic systems (i.e., words, pictures, metonymic symbols, colors, maybe even sound) in a website. Finally, it is the visual re/presentation of data (which itself is a re/presentation of reality) and the video/film construction of product meaning.

As seemingly different as all of these instances of language use are (and while some may not be of immediate concern for engineers), they are all communicative actions

Session T1A

situated within particular professional performances. There is a history and there are conventions that direct their enactment. They all have a purpose, sometimes even multiple purposes. They all create identities, ranging from the professional to the personal to the corporate. In addition, all require that the language user and/or users display an awareness of all the above and of themselves as actors in these performances. And, there are audiences, and like with all audiences, there are consequences contingent upon poor, adequate, or interesting even creative enactments. Discourse analysis enables us to look carefully at these situated actions – genres. And, more importantly, it enables us to look carefully at how the actions themselves and the communities and cultures within which they are located give them meaning.

While the focus of discourse analysis is language use and the method offers a way or rather ways to take things apart, its aims are both “descriptive” and “critical” [15]. That discourse analysis is descriptive simply means that, when we take things apart, we do so in order to better understand how language use works, to better understand what happens or is happening when people use language in order to do things in the world. So, discourse analysis that is descriptive of an abstract for a technical report, for example, might help us to better understand how such an abstract works. It may help us to understand the particular topics that such an abstract must present, i.e., the problem or issue, methods of investigation, results, conclusions and/or recommendations. It may help us to better understand the particular design, or the relation of the above topics to one another and how that design in effect recreates something of the research experience that was part of the report performance. Of course, the topics and design may change somewhat in an abstract that is part of another kind of performance – an abstract for an academic conference or for a theoretical research article or for a grant application.

That discourse analysis is also critical is somewhat more complex. When we take things apart to better understand how languaging works, we do so not just because we want to understand language use. Specifically, in an educational setting, we do so because we believe that that understanding will afford us a greater awareness certainly, but perhaps also a greater control over the practices that represent our language use – to actively choose and evaluate strategies, consider resources, and receive feedback. Again, and for example, we may want to provide students more help in learning to write abstracts for technical reports. So, we take apart an abstract or abstracts, in order potentially to enhance their awareness of those various topics and the design of their presentation. Clearly, we hope that such awareness will enable them to better understand how abstracts as situated actions help do the work of a particular engineering performance. That is our first sense of critical.

There is an additional sense. Not only do we want to enhance awareness and enable action, we also want to foster the ability to critique or to be able to discern the professional even ideological assumptions that underlie and inform the presentation of those topics in a particular order or design. James Paul Gee writes that “language has a magical property:

when we speak or write we craft what we say to fit the situation But, at the same time, how we speak or write creates that very situation” [16]. Indeed, experts’ ability to critique, negatively and positively, often begins with those assumptions as those assumptions are re/presented and recognized in the various topics, their design, and their implications. Through practice, experts understand that magical property of language. They understand both how to adapt their language use to the situation and how to create the situation through language use. That we associate experts with awareness, action, and the ability to critique suggests that those characteristics oftentimes constitute membership, processes of participation within the engineering community and competence in engaging in the work of engineering. Earlier, we suggested that being systematic in our integration of genre into students’ experiences of engineering performances was important. Discourse analysis, by offering us ways to be descriptive and critical, enables us to be systematic in our exploration of that language magic.

Engineering, Communication, Genre, Discourse Analysis, and Assessment

By proposing a new paradigm for understanding of communication, we are encouraging a move away from a pedagogy and a curriculum that emphasizes skills and the mastery of information. We are encouraging a move toward a pedagogy and curriculum that provides good, useful, and powerful engineering experiences and encourages practice and participation as the best way of learning. By suggesting that we attend to genre, in particular, we are encouraging an understanding of language use as a part of not apart from doing engineering. And, by proposing discourse analysis as a method for looking carefully at language use as situated action, we are encouraging a systematic way to study – descriptively and critically – the relationship of that action to those performances. In effect, we are also encouraging a new understanding of assessment.

Currently most faculty, both engineering and communication faculty, seem to understand communication as practical, discrete, and generalizable knowledge that can be mastered; consequently, what we tend to count as evidence of learning are demonstrations of the mastery of that knowledge. However, when we compare those demonstrations across the curriculum, even across instructors teaching the same course, what we consider mastery tends to vary enormously. As a result, any attempt at a curriculum-wide approach to assessing student communication learning and teaching becomes extremely unempirical simply because we do not agree about what to count, either specifically or more generally, as evidence. Furthermore, since the range of learning and teaching environments within which communication is taught and learned are radically different, and growing increasingly so, the difficulty is certainly amplified. Then, add to this our hope and expectation that students will learn to communicate across cultural boundaries, to be cognizant of the impact that professional experience, gender, ethnicity, socioeconomic

background (and more) have on communication; and assessment as a valid and reliable measure of outcomes seems nearly impossible. If it is attempted at all, assessment is reduced primarily to isolated and localized representations of peculiar outcomes or to anecdotal teachers' stories that while sometimes persuasive to our commonsense do not comprise substantial or widespread – real – evidence.

Again, underlying the difficulty with assessment is that profound (and pesky) misunderstanding of communication. Instead of comparing demonstrations of mastery, we should be attending to genres particular to the engineering experiences we are providing. Instead of searching for agreement about what demonstration to count, we should be exploring the particular processes of participation, the situated ways of using language that get something done. And, instead of attempting to homogenize learning and teaching environments, instead of paying lip-service to the impact of culture, gender, ethnicity, and so on; we should be taking advantage of our differences in order to discover, describe, and explain our diversity. The only rationale for assessment, at least if we are to consider language use as foundational, as fundamental to doing engineering, is to continue to learn more about how learning happens or better – how students develop as able engineers.

In ECP, we think of assessment more as inquiry than evaluation, more as teacher-research than generating and measuring outcomes. That is not to suggest that evaluation or outcomes are bad or unimportant. Rather, because we understand communication as emergent from within complex processes of participation, we must learn more about those processes before we evaluate. Indeed, evaluation is a very important component – it enables reflexivity. However, we must learn more about the ways of using language that do some of the work of those engineering performances. We must learn more about the particularity of the relation between language use and doing engineering. And, through learning more, through inquiry, we can then model for our students the learning to learn how strategies that we hope that they will adopt. With discourse analysis we have discovered a method that will enable us to be systematic in our inquiry. The way we will be systemic is to mentor and to model a process of learning to learn how. The target for our assessment should not be demonstrations of mastery, but strategies for participation, strategies that enable us to consider resources, receive feedback, strategies that enable students to apply the processes of learning to new engineering experiences. Perhaps the best example of the potential for using discourse analysis in an engineering educational context and of the approach to assessment that we are suggesting is already happening at the University of South Carolina in their Research Communications Studio (RCS).

Lori Donath et al., set as their goal “to describe, illustrate, and analyze discourse in the . . . [RCS] . . . a novel community of practice in which peers and near-peers work in an environment of distributed cognition. In this setting, discourse analysis is used to characterize active learning as a set of communicative processes wherein group members with

different expertise and perspectives are valuable to one another's learning” [17]. The participants in RCS are “undergraduates in chemical, electrical, and mechanical engineering who conduct independent research”. . . . [and they] meet weekly in an RCS group composed of three or four undergraduates, an engineering graduate student, a communications graduate student, and a communications faculty member [17]. We found two things about this program and their research quite remarkable. First, the authors identify seven “speech events,” (we would call them situated communicative actions or instances of language use) that occur in the weekly meeting of the participants. They are “critique, elicitation of critique, internalization and awareness of knowledge gained, contextualization and explanation of research or related ideas, and negotiation and consensus-building” [17]. We believe that these speech events, identified through discourse analysis, are not only illustrative of “a processual view of active learning,” but on a sub or pre-genre level indicative of the ways of using language necessary for that particular experience known as undergraduate engineering research and eventually for professional, expert research [15]. Second, the authors' offer not only “a first step towards characterizing active learning in multiple contexts,” but they also take a first step in establishing a collection of practices and activities that can serve as a model for assessment of students' participation in undergraduate research and for their participation as professional and expert researchers [17].

So considered, discourse analysis and assessment are never neutral. In fact, there is no position from which to inquire into learning that is unbiased or objective. Rather, we learn more about learning in order to learn better ourselves and to better teach our students, which invariably means to advocate a particular understanding of learning and approach to teaching. And, while there is always a challenge to become as aware as possible of the limitations of any understanding and/or approach; the discovery, the descriptive, and the explanatory processes should be more activist than orthodox.

ENGINEERING, COMMUNICATION, AND AN EMERGING, EVOLVING, COMMUNICATIONS CURRICULUM

In the Engineering Communications Program (ECP) in the College of Engineering at Cornell University, we are not the first to discover the importance of integrating writing and reading, speaking and talking throughout the curriculum both as an effective means of communications instruction and as a principle for curriculum design. However, we may be the first in other ways:

- 1) We offer a new paradigm for understanding of communication that provides a theoretical rationale for the integration of writing and reading, speaking and talking within a wide-range of educational opportunities: service learning, inquiry and problem-based learning, team projects, undergraduate research, design thinking and so on. Because communication is a form of action that is fundamental, always and everywhere situated, learned through the processes of participation, and sometimes instrumental, representative, and

even constitutive of doing the work of engineering; only communications instruction that occurs in authentic engineering experiences can provide effective instances for learning to learn how to communicate.

2) We offer genuinely empirical methods – discourse analysis and critical discourse analysis – for studying language use or communication in doing engineering. These methods allow us to investigate language as action, both in terms of how certain engineering experiences determine language use, genre and the conventions related to them, and in terms of how particular language users can modify even change those genre and conventions through their own practices and activities within those experiences. Further, we expect that such an investigation will enable us to create: (a) scaffolding for student teaching, i.e., teaching materials that help students and faculty to see the connections between the work of engineering and genre and (b) an assessment of student learning, i.e., helping students and faculty to understand the constraints imposed by genre and the possibilities for variation in particular instantiations of those genre.

Because the *new* paradigm offers an alternative understanding of communication, we cannot be exactly sure yet what the corresponding *new* communications curriculum might look like. However, whatever it looks like generally (we will offer a few specifics below), it should manifest the primary strengths of that alternative understanding. First, it should include language use as experiences of individual and social action. Second, those experiences, opportunities to act as a language user, should be situated in particular engineering experiences and be participatory. Third, because our ways of using language ably, strategically, efficaciously are so dependent on practice; it should provide students with repeated opportunities to act communicatively across a wide array of engineering experiences. Finally, that curriculum should not only foster teaching of communicative action, but research into the communicative actions required for doing the particular work of engineering.

Specifically, such a communications curriculum might have the components typical of most today – albeit changed in important ways. It should offer at least one stand-alone course – no longer to teach generalizable skills, but to provide the theoretical background about communication that will help students to be ready communicative agents, actors in particular engineering experiences. It should integrate communications instruction throughout the larger engineering curriculum. Not as it does so often now: one-time lectures to students, special issue workshops for students and faculty, or as consultants whose role is to solve communication problems. Rather, that integration would look more like long-term collaborative and cooperative teaching partnerships with an important aim being research into the relation of language use and doing the work of engineering. And finally, such a curriculum should offer a communication center, not as a location for remediation. Rather, that communication center should become an environment that fosters routine

communications mentoring and modeling with a focus on collective inquiry. Only when our communications curriculum looks more like what we have suggested above will the findings of all our future surveys of communications learning and teaching in engineering actually change.

REFERENCES

- [1] Reave, Laura. "Technical Communication Instruction in Engineering Schools: A Survey of Top-ranked US and Canadian Schools." *Journal of Business and Technical Communication*. Vol. 18, 2004, pp.452-490.
- [2] Shuman, L. J., Besterfield-Sacre, M., McGourty, J. "The ABET 'Professional Skills' – Can They Be Taught? Can They Be Assessed?" *Journal of Engineering Education*, Vol. 94 No. 1, 2005, pp.41-55.
- [3] Dias, P., Freedman, A., Medway, P., Pare, A., *Worlds Apart: Acting and Writing in Academic and Workplace Contexts*, London : Lawrence Erlbaum Associates Publishers, 1999.
- [4] Beaufort, A. *Writing in the Real World : Making the Transition from School to Work*, New York, Teachers College Press, 1999.
- [5] Dias, P., and Pare, A. , *Transitions: Writing in Academic and Workplace Settings*, Cresskill, NJ: Hampton Press, Inc. 2000.
- [6] Becker, A. L. *Beyond Translation: Essays Toward a Modern Philology*, Ann Arbor: University O Michigan Press, 1995.
- [7] Smith, K. A., Sheppard, S. D., Johnson, D. W., Johnson, R. T. "Pedagogies of Engagement: Classroom-Based Practices," *Journal of Engineering Education*, Vol. 94, No. 1, .2005, pp. 1-15.
- [8] Lizon., M. J. "Genre Analysis in Technical Communication," *IEEE Transactions on Professional Communication*, Vol. 48, No 3, 2005, pp. 285-295.
- [9] Bauman, R., "Genre," *Folklore, Cultural Performances, and Popular Entertainments : A Communications-Centered Handbook*, Bauman, R. ed. New York : Oxford University Press, 1992, pp. 41-49.
- [10] Bazerman, Charles, "Introduction: Changing Regularities of Genre," *IEEE Transactions on Professional Communication*, Vol. 42, No. 1, 1999, pp. 1-2.
- [11] Kryder, L. "Mentors, Models and Clents: Using the Professional Engineering Community to Teach Engineering Genre", *IEEE Transactions on Professional Communication*, Vol. 42, 1999, pp. 3-10.
- [12] Sheehan, R., and Flood, A. "Genre, Rhetorical Interpretation and the Open Case: Teaching the Analytical Report," *IEEE Transactions on Professional Communication*, Vol. 42, No 1, 1999, pp. 20-31.
- [13] Winsor, D., *Writing Like an Engineer: A Rhetorical Education*, Mahwah, NJ: Lawrence Erlbaum Associates Publishers, 1996.
- [14] Blakeslee, A. M., "Bridging the Workplace and the Academy: Teaching Professional Genresthrough Classroom-Workplace Collaborations," *Technical Communication Quarterly*, Vol. 10, No. 2, 2001, pp. 169-192.
- [15] Johnstone, B., *Discourse Analysis*, Oxford: Blackwell Publishers, 2002.
- [16] Gee, J. P., *An Introduction to Discourse Analysis: Theory and Method*, London: Routledge, 1999.
- [17] Donath, I., Spray, R., Thompson, N. S., Alford, E. M., Craig, N., Matthews, M. A., "Characterizing Discourse Among Undergraduate Researchers in an Inquiry-Based Community of Practice," *Journal of Engineering Education*, Vol. 94, No. 3, 2005, pp.403-418.