An International Study of the Teaching and Learning of Communication: Investigating Changes in Self-Efficacy in Four Undergraduate Engineering Programs

Dr. Lori Breslow, Massachusetts Institute of Technology

Lori Breslow is the founding director emeritus of the Teaching & Learning Laboratory (TLL) at the Massachusetts Institute of Technology. An internationally recognized expert in teaching and learning in higher education, she conducts research on the development, diffusion, and assessment of educational innovation, particularly in science and engineering.

Dr. Christina Kay White, Massachusetts Institute of Technology

Dr. Christina White is currently a postdoctoral engineering education research associate with Singapore-MIT Alliance for Research and Technology (SMART) Innovation Centre. She completed her Doctoral degree from Teachers College, Columbia University where she studied engineering education. She is the Global Chair and founding director of the National Academy of Engineering Longhorn Grand Challenges Scholars & K12 Partners Program at The University of Texas at Austin. Dr. White is also the director of an outreach program called Design, Technology, & Engineering for All Children (DTEACh) which has reached more than 1000 teachers and 85,000 students. She is the lead inventor on a patent for assistive technology. Her current research includes global competencies, innovative design-based pedagogy, humanitarian engineering, and ways to attract and retain traditionally underrepresented groups in engineering education.

Dr. Daniel E. Hastings, Massachusetts Institute of Technology

Professor Hastings is currently the Director and CEO of the Singapore MIT Alliance for Research and Technology (SMART). He earned a Ph.D. and an S.M, from MIT in Aeronautics and Astronautics in 1980 and 1978 respectively, and received a B.A. in Mathematics from Oxford University in England in 1976. He joined the MIT faculty as an assistant professor in 1985, advancing to associate professor in 1988 and full professor in 1993. He has been a visiting scholar at the Air Force Research Laboratory and the Singapore University of Technology and Design, Harvard University School of Engineering and Applied Science and the Science and Technology Policy Institute.

As a professor of Aeronautics and Astronautics & Engineering Systems, Professor Hastings has taught courses and seminars in plasma physics, rocket propulsion, advanced space power and propulsion systems, aerospace policy, technology and policy, and space systems engineering. His teaching has ranged from freshman classes to doctoral seminars.

His research has spanned five areas. He has worked in laser material interactions, fusion plasma physics, spacecraft plasma environment interactions, space plasma thrusters and space systems analysis and design. He has published over 120 papers and written a book on spacecraft environment interactions. He has chapters in several other books. He has won five best paper awards. His recent work has been on complex aerospace system design including work on beyond first use properties.

Professor Hastings is a Fellow of three professional societies, the American Institute of Aeronautics and Astronautics (AIAA; for his work on spacecraft plasma environment interactions), the International Astronautical Federation (IAF; for his work on space plasma thrusters effects) and the International Council on Systems Engineering (INCOSE; for his work on Space systems analysis and Engineering Education). He has worked on national committees on Engineering Education including the NAE Board on Engineering Education and the NAE Engineer of 2020 study. He was the co-lead of a study on engineering education while serving on the National Science Board. He has spoken on Engineering Education all over the world.

An International Study of the Teaching and Learning of Communication: Investigating Changes in Self-Efficacy in Four Undergraduate Engineering Programs

Introduction

Pressing social and economic needs call for engineering schools and departments to produce diverse leaders who can create innovative solutions to the world's most difficult problems. Indeed, as reports by both the National Academy of Engineering and ABET have concluded, the challenges that must be addressed by the next generation of engineers are becoming increasingly complex as society continues to grow more interconnected [1-2]. To be effective engineering leaders in a global workforce, engineers need strong communication skills that will allow them to interact with a wide-ranging audience, including entrepreneurs, policy makers, community leaders, and the general public—most of whom do not necessarily have a background in engineering, science, and technology.

This study explores four specific communication capabilities—writing, creating and delivering oral presentations, developing and using skills in visual literacy, and participating in teams—and how those communication capabilities develop through four undergraduate engineering programs, two in the Northeastern United States and two in Singapore. While we recognize that communication encompasses a variety of activities undertaken by engineers (e.g., interacting in meetings, talking on the telephone, writing e-mails, or creating computer-aided drawings), we focus on these four skills because we believe they are the foundation of the communication competencies that engineering graduates need to master [3]. Here we build upon the Organization for Economic Cooperation and Development's (OECD) definition of competency as:

> . . . more than just knowledge and skills. [Competency] involves the ability to meet complex demands, by drawing on and mobilizing psychosocial resources (including skills and attitudes) in a particular context. For example, the ability to communicate effectively is a competency that may draw on an individual's knowledge of language, practical IT skills and attitudes towards those with whom he or she is communicating [4].

It is imperative that undergraduate engineering programs not only teach deep technical skills but also foster the improvement of such 21st-century skills as communication, as both are needed to practice effective engineering, lead companies, and strengthen communities [5-6].

Background

Over the last two years, we have set the foundation for an interdisciplinary, inter-institutional, cross-cultural study of the teaching and learning of communication at four partner institutions. We began the study by visiting with administrators from each campus. Our goal was to identify the scope of the study collaboratively in a way that would allow us to investigate our research questions while meeting their needs as they worked to understand and improve their instruction in communication. We continue to work closely with each university's point-of-contact and also to collaborate with faculty in the study of their own school. We received approval for the study from the Institutional Review Boards of each of the participating universities.

Broadly, the aims of the study are to investigate the value that both students and faculty place on communication skills, the students' perceptions of themselves as communicators, how those skills are developed within the wider curriculum, how proficient the students are upon graduation, and how these capabilities can be strengthened through improved pedagogical methods. Throughout the study, we use five different data collection techniques: (1) an inventory of the types and frequency of communication instruction and assignments through a content analysis of syllabi; (2) two online student surveys, one administered at the beginning of the students' undergraduate career and one given before graduation, to measure self-efficacy for communication; (3) a faculty survey to gauge the value instructors place on communication, as well as their confidence to teach and assess these skills; (4) student focus groups; and (5) analyses of student work products, including their writing and observations of presentations they deliver.

This paper focuses on the results of the two self-efficacy surveys, indicating changes in self-efficacy between entry and the final semester before graduation. We report on results from all four institutions and for all four competencies. We examine commonalities in students' self-efficacy for those skills, what they perceive their weaknesses to be, and their goals for strengthening their ability to communicate. Since we assert that 21st-century engineers are expected to communicate engineering concepts and highly technical matters to those without an engineering or technical background, we study student self-efficacy for that ability as well [7-14].

Research Questions and Methodology

Research Questions

We hypothesize that students at varying stages of their academic journey, as well as in diverse pedagogical and cultural contexts, will report different levels of self-efficacy in communication capabilities. Our specific research questions that guided this portion of the study (i.e., the development and analysis of the student surveys) are:

a. In what ways, if any, do students' self-efficacy for communication capabilities change from their entry to their last semester before graduation?
b. Do students report differences in self-efficacy by communication type (i.e., writing, presenting, visual literacy, teamwork)?

Developing the Survey

The development of the survey began with a review of the research on teaching engineering students communication skills [5-9], as well as the experience of instructors who teach professional communication. We also drew on the classic literature on self-efficacy, which, according to Bandura, is the belief in the ability to succeed in a specific domain or with a specific task [10-14]. One of the goals of teaching communication skills is to develop students who feel competent and confident in the use of those skills. Those individuals who develop a strong sense of self-efficacy are well equipped to educate themselves when they have to rely on their own initiative. Our student survey is designed to measure the extent to which students at our study sites feel they are able to communicate using a variety of media in a range of circumstances to audiences who may or may not have a technical background. We used Bandura's guide for constructing self-efficacy scales [10-12], asking respondents to rate their self-efficacy on a Likert scale of 0-100 (with 10 point intervals) where 0 indicates no confidence, 50 is moderately confident, and 100 is highly confident. We chose a 0-100 scale because it is a stronger predictor of performance than a 5-interval scale [14].

We divided each of the four overarching communication types (i.e., writing, presenting, visual literacy, teamwork) into component sub-skills and asked students to rate their self-efficacy for each. For example, for oral presentations, we asked students to rate their confidence in their ability to "identify the characteristics of the audience to whom I am speaking," and for writing, we asked them whether they felt they could "meet the audience's needs and my own purposes." In all, we inquired about 44 sub-skills that contribute to the four major communication types. Additionally, we asked three open-ended questions: What are your greatest strengths in communication? If you could improve in communication, how would you like to improve? What kinds of skills are valuable for an engineer? The combination of quantitative and qualitative data provides a fuller understanding of students' perspectives on communication than either could individually.

Piloting the Survey

We piloted the survey at both Singaporean universities and one of the two universities in the Northeast U.S. (at the time the pilot survey was administered, the second U.S. institution was awaiting IRB approval for the study).

For the first phase of the pilot, members of the research team met with a total of twenty student volunteers, ten students from the U.S. university and ten from the Singaporean universities. These student volunteers were diverse in multiple ways, including the engineering discipline in which they were majoring, ethnicity, gender, first language/native tongue, and academic performance. They had the opportunity to use their own device or one of the computers at the research sites to take the survey online, and they also had a hard copy upon which to take notes.

We first explained the study to the students using a script so there would be a common protocol. Then the participants were asked to read each question out loud, tell us what they thought the question was asking, and, finally, give their answer. We checked to see if the general wording of the questions was clear, or if any of the individual words or phrases were confusing. We discussed with the students the design of the survey and the process of taking it. The students were also asked to describe their feelings about the options on the response scale and if it made sense. We wanted to know their opinion about the length of the survey, including if they would be motivated to finish it, and if they felt it was too long, to indicate at what point they began to feel that way. At the end of the session, students were prompted to provide their perspectives on the layout of the survey, and they were asked if they had any additional feedback that might improve it. The research team made modifications to the survey based on the insights from this

first phase, including decreasing the number of questions (although we did add two sub-skills to teamwork at a later stage).
In the second phase of the pilot study, the survey was administered to first-year engineering students at both Singaporean institutions and one of the universities in the Northeastern U.S. A total of 523 students responded, including a diverse representation of engineering disciplines, ethnicity, gender, and first language/native tongue.

One of the benefits of conducting this pilot was that we have used the results as a springboard to develop topics for our focus groups, guidelines for our course observations, and standards for our curriculum review. By undertaking a preliminary analysis of the skills that students reported as being the most and least confident in, we could begin to identify patterns that have guided the next phases of the study.

Administering the Final Survey

We first administered the final version of the online survey to students at all four schools within the beginning weeks of their first semester so we could collect data before they received any instruction in communication. (Please note that Singaporean and U.S. universities begin the academic year at different times.) The graduating students were asked to complete the survey in their last semester of college. The online student surveys were disseminated via email from a local representative at each university (e.g., Office of Student Life). The recruitment email with survey link was sent to the students each week for one month and then the survey was closed. In both cases, entry and final semester, students were told they would be entered for a random drawing for a mini iPad if they completed the survey. The incentive helped increase our response rate.

Survey Analysis

We analyzed the data to compare means in self-efficacy between entry and final semester for the students at each of the four different universities at these two points in time. We used a sample size calculator to determine the number of respondents we needed to allow us to report results with a 95% confidence interval with 5% margin of error. As our data sets are independent and are unequal in population, we first used an F-test to determine if the variances were equal or unequal. Then, we ran a two-tailed T-test to calculate for a low P-value ($p < .05$) that allowed us to compare the means of each survey response. We were also able to compare communication types to each other to determine trends in the communication areas of most and least self-efficacy. Below we convert the students' ratings from our scale of 0-100 to 0-10 to make the findings easier to read.

Findings

The universities are identified as A-D for privacy. Table 1 provides an overview of the demographics of the respondents, including gender and whether the respondents' first language was English or a different first language. Note that in Table 1, the entry semester and last semester are abbreviated as ES and LS respectively.

Variable	University A (Northeast U.S.)	University B (Singapore)	University C (Northeast U.S.)	University D (Singapore)	All Universities
Number of Respondents	ES = 478 LS = 20*	ES= 316 LS= 245	ES= 55 LS= 18	ES= 326 LS= 251	ES= 1175 LS= 534
Female**	47.0%	32.5%	53.0%	46.5%	44.7%
Male**	48.0%	67.5%	46.0%	53.5%	53.7%
First language English	71.5%	52.0%	95.0%	58.0%	69.2%
First language other than English	28.5%	48.0%	5.0%	42.0%	30.8%

Table 1: Demographic characteristics of survey respondents

Comparisons of means from entry to last semester before graduation across universities and communication types

We found significant differences in the means students reported ($p < .05$) between their self-efficacy upon entering college and their final semester (Table 2). We find growth in self-efficacy across all four universities and every communication type. Students in University A reported the greatest change in any competency; their self-efficacy for oral presentations rose by over one point from entry to last semester. Students in University C reported the smallest change—in their confidence in their writing (.03)—for any university or any communication type. Students in University C also did not report as large an increase in their ability to work with visuals as the students at the other three universities. As shown in Table 2, deltas for each communication competency ranged from a low of .03 to a high of 1.04.

*Students from only one engineering department at the university were asked to complete the survey.
** Students were given the option to respond to the gender question by answering: female, male, transgender, other (fill in blank), or not to answer at all. This is why the responses do not equal 100%.

Communication Type & Year	Univ. A	Univ. B	Univ. C	Univ. D
ORAL Entry semester	6.50	6.52	6.94	6.03
ORAL Last semester	7.54	7.28	7.84	6.56
DELTA	1.04	0.76	0.90	0.53
WRITING Entry semester	7.04	6.81	7.54	6.27
WRITING Last semester	7.80	7.32	7.57	6.77
DELTA	0.76	0.51	0.03*	0.50*
VISUAL LITERACY Entry semester	6.86	6.65	7.08	6.28
VISUAL LITERACY Last semester	7.65	7.41	7.31	7.07
DELTA	0.79	0.76	0.23*	0.79
TEAMWORK Entry semester	7.47	7.21	7.89	6.79
TEAMWORK Last semester	7.96	7.83	8.14	7.20
DELTA	0.49*	0.62	0.25*	0.41*

Table 2. Means comparisons and deltas showing increase in self-efficacy from entry to last semester across all communication types and each university. * indicates $p < .10$ rather than $p < .05$.

In comparing communication types to one another, students in each university—whether in the Northeastern U.S. or Singapore—felt most confident in their ability to work in a team both upon entering university and upon graduating; this may account for why they reported their teamwork skills had strengthened less over their college careers than the other communication types (Table 3).

Year & Delta	Presenting	Writing	Visual	Teamwork
Entry semester	6.50	6.91	6.72	7.34
Last semester	7.30	7.36	7.36	7.78
Delta	.81	.45	.64	.44

Table 3: Comparison of means for self-efficacy in each communication type, all universities

On average, students reported their ability to design and deliver an oral presentation improved the most, with their confidence in that skill being the weakest when they entered college. However, upon graduation, they still were not confident in their talent for speaking when compared to their ability to write, communicate through visual media, or work in a team (Table 4 and Table 5).

	Univ. A	Univ. B	Univ. C	Univ. D
Entry semester	TEAM	TEAM	TEAM	TEAM
	7.47	7.21	7.89	6.79
Last semester	TEAM	TEAM	TEAM	TEAM
	7.96	7.83	8.14	7.20

Table 4: Communication types for which students felt most self-efficacious

	Univ. A	Univ. B	Univ. C	Univ. D
Entry semester	ORAL	ORAL	ORAL	ORAL
	6.50	6.52	6.94	6.03
Last semester	ORAL	ORAL	VISUAL	ORAL
	7.54	7.28	7.31	6.56

Table 5: Communication types for which students felt least self-efficacious

Comparison of sub-skills along mechanical-strategic/critical continuum

When we began to analyze the results from our pilot surveys, we began to see that we could categorize the 44 sub-skills for each competency along a continuum from "mechanical" to "strategic/critical." This observation mirrors the work of the educational psychologist David Ausubel who, in the 1960s, proposed a continuum of cognitive tasks from rote memorization to meaningful learning [15]. In our classification scheme for communication competencies, examples of mechanical skills include "use punctuation correctly" or "speak with few fillers such as 'umm'." Examples of strategic/critical include "provide evidence in an oral presentation that supports the main idea, argument or recommendation" or "write to meet the audience's needs and my own purposes."

When we looked at the comparison of means for sub-skills, we were interested to see that students from each of the universities and at each level (i.e., entry and last semester) rated oral presentation skills, both mechanical and strategic/critical, as capabilities they are least confident in. However, they are fairly confident in their mechanistic skills in writing, which include use of grammar and punctuation, both upon entering the university and upon graduating. Self-efficacy for strategic/critical skills in writing are lower than those for mechanistic writing skills. Similarly, when we examined the sub-skills that composed teamwork, we note that students at all four universities are more confident with what we categorize as mechanistic aspects, such as delegating tasks in team, than with such strategic/critical skills as communicating cross-culturally or identifying problems within their team. The same holds true for visual literacy: Students rated their mechanistic skills like image editing or labeling higher than their strategic/critical ones. We assume that most of the students have edited or labeled photos before entering college because of their use of social media, so they are familiar with those activities. In comparison, at each university students reported they were not confident in legal restrictions on uses of visual media. A discussion of these restrictions and proper citations for images can easily be included either in professional communication courses or in the wide range of ethics courses that are already embedded in engineering programs.

Discussion

These surveys have allowed us to see how confident students are in their ability to communicate in the ways they will need to professionally, both with fellow engineers and with audiences who do not have technical backgrounds. These data give us insights into how we can improve their communication competencies, particularly where we should focus our efforts, strengthening pedagogy and increasing opportunities for students to practice these skills.

In most cases, students feel least confident in their oral presentation skills at they enter the university, and this lack of confidence persists as they are about to graduate. Even though there is growth in their confidence to present, when we look at the sub-skills of oral communication, students from each university rate both their mechanistic skills (e.g., maintaining good eye contact, minimizing the use of fillers, and using appropriate body language), and strategic/critical skills (e.g., adapting the presentation based on the characteristics of the audience or competently answering questions) as areas in which they are least confident. These results indicate there is a need for students to have increased opportunities to develop their ability to speak confidently in front of an audience.

Whereas confidence in the mechanistic skills associated with oral presentation were rated low across universities, the mechanistic skills in writing were rated relatively high and higher than strategic/critical skills. This may be because students are well educated in grammar, punctuation, and spelling in primary and secondary schools, but once they reach university, they are not taught as explicitly the approaches to writing within their discipline or how to write for professional purposes. Teaching this within an engineering curriculum could improve students' confidence in their ability to write in the professional world, addressing audiences with different needs and interests.

We believe the same problem regarding lack of explicit instruction may exist for teamwork skills. Anecdotally, we know students are often asked to work in teams without being provided guidelines for how effective teams function. We can help students learn teamwork by discussing such simple things as how to develop an agenda for a meeting to more advanced capabilities such as communicating cross culturally.

Perhaps most telling is that when we explored the improvement (delta) in each communication area, we noted that the universities with systematic models to improve communication (University A and University C) resulted in students with a higher self-efficacy in each of the four types of competencies by the time they graduate. Examples of ways in which these two universities focused on the development of communication in their students include offering communications-intensive courses within each major; co-teaching pedagogy where engineering faculty and communications experts collaborate on curricular design, instruction, and assessment; and including a wide variety of communication activities embedded into engineering courses across multiple semesters. We also noted that University C includes evaluation of various communication skills within the application process of students entering the program. This may be why we saw that first-year students at University C rated their self-efficacy significantly higher than the other three universities.

The open-ended questions in the survey allowed us to hear from students in their own words about their communication development. As the analysis of the quantitative data indicates, responses to the open-ended questions suggest that across the universities, most students feel more confident in the strength of their written communication than in their oral presentation skills. In responding to the open-ended questions about areas of growth, students at all four universities noted they want to develop confidence in public speaking. For example, one student stated, "I want to be able to cultivate a personal voice in my presentation" and another wrote, "I need to improve my oral presentation skills so I have an effective speaking pace and volume." The ability to speak confidently extends to group settings, as well, as respondents said they want to be more assertive in sharing ideas. One student wrote, for example, he/she wanted "the confidence to speak up in group discussions" and another that, "I would like to improve the way that I communicate with my team members in a group setting. I often don't communicate my ideas or worries clearly or effectively which can add stress to a stressful situation when a problem arises." Interestingly, students report one of their greatest strengths in communication is their ability to listen respectfully to others.

The students across all universities identified the many communication skills they felt engineers needed, including: (1) tailoring the engineering message to diverse audiences; (2) communicating concepts to audiences with various levels of engineering and technical backgrounds; (3) being concise; (4) simplifying complex ideas; and (5) working in a team. For example, one student wrote, "Engineers need to be able to talk to others in a friendly and personable way so as not to seem cold or aloof. They need to be able to explain their ideas to other engineers as well as to other people who may not be as familiar with engineering concepts." Another said, "Engineers should able to explain concepts to audiences with varying backgrounds and levels of expertise. I also think that engineers should actively seek input from others and be willing to listen to all ideas." We hear more about teamwork when a student writes, "I believe the most important communication skills for engineers are the abilities to discuss calmly and to be an active listener. This is because a majority of engineering work happens in a group setting, so the members must be capable of accessing and improving an idea in a constructive and cooperative way." The ability to communicate in a team resonated with students at all of the universities as one of the most important skills for an engineer to possess.

Future Research

In this phase of our ongoing research, we conducted student surveys on self-efficacy to answer our research questions about changes between entry and final semester, and differences in students' confidence to use each communication type. For the next phase of research, we will conduct data analysis that includes MANOVA to explore possible effects of gender, first language, and geographical location. We will also delve more deeply to see if there are interactions between these demographic factors and the curricular approaches taken at each university. Another facet of the study is an online survey of faculty members at each university to learn more about their perspectives on communication development in undergraduate engineering programs. We are curious about how they perceive the value of communication skills; how much (if any) course time they feel should be dedicated to teaching these skills; where and how they should be taught; and their confidence in their own ability to teach and assess communication. Finally, we are in the process of collecting and analyzing student assignments, including examples of writing and recorded presentations, so that we can understand if students' perceptions of their self-efficacy match their performance.

These additional methods of data collection and analyses aim to provide a complex view of communication development in undergraduate engineering programs from the perspective of the students and the faculty, as well as what an analysis of students' writing and presentations can tell us about and the actual capabilities.

Conclusion

We see positive growth trends in students' self-efficacy for communication across engineering programs at four universities. Understanding students' self-efficacy for various types of communication is important if we are to provide them with opportunities within the curriculum to develop those skills. We find that by identifying sub-skills in each of the four communication types, we are able to see more clearly where students find their areas of strength, and where they feel they need more instruction or experience. Students in two of the four universities rated their confidence across communication skills higher than in the other schools, and in both of these universities, there are partnerships between engineering faculty and communications specialists who collaborate on curricular design and who co-teach these skills.

References

[1] ABET Engineering Accreditation Commission. (2005). *Criteria for accrediting engineering programs.* Baltimore, MD: ABET, Inc.

[2] National Academy of Engineering. (2004-2005). *The engineer of 2020: Visions of engineering in the new century.* Washington, DC: The National Academies Press.

[3] Sageev, P. & Romanowski, C. (2001). A message from recent graduates in the workplace: Results of a survey on technical communication skills. *Journal of Engineering Education, 90*(4), 685-693.

[4] Organization for Economic Co-operation and Development. (2005). *Definition and Selection of Competencies (DeSeCo) Project.* Retrieved from http://www.oecd.org/education/skills-beyond-school/41529556.pdf

[5] Williams, J. (2002). The engineering portfolio: Communication, reflection, and student learning outcomes assessment. *International Journal of Engineering Education, 18*(2), 199–207.

[6] Boiarsky, C. (2004). Teaching engineering students to communicate effectively: A metacognitive approach. *International Journal of Engineering Education, 20* (2), 251–60.

[7] Gömleksi˙ z, M. N. (2007). Effectiveness of cooperative learning (jigsaw II) method in teaching English as a foreign language to engineering students (Case of Firat University, Turkey). *European Journal of Engineering Education*, *32*(5), 613-625.

[8] Paretti, M. C., & Burgoyne, C. B. (2005). Integrating engineering and communication: A study of capstone design courses. In Web proceedings, ASEE/IEEE Frontiers in Education Conference. Retrieved from http://fie.engrng.pitt.edu/fie2005/papers/1205.pdf, pp. F4D.23–F4D.28. L

[9] Leander, K., & Paul, P. (2004). Speaking and writing: How talk and text interact in situated practices. In C. Bazerman and P. Prior (Eds.), *What writing does and how it does it: An introduction to analyzing texts and textual practices*. Mahew, NJ: Lawrence Erlbaum.

[10] Bandura, A. (1977). Self-efficacy: towards a unifying theory of behavioral change. *American Psychologist, 33,* 344-358.
[11] Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall.
[12] Bandura, A. (2006). Guide for constructing self-efficacy measures. In F. Pajares & T. Urdan (Eds.), *Self-Efficacy beliefs of adolescents.* Charlotte, NC: Information Age Publishing.
[13] Kear, M. (2000). Concept analysis of self-efficacy. *Graduate Research in Nursing*. Retrieved from http://graduateresearch.com/Kear.htm
[14] Pajares, F., Hartley, J., & Valiante, G. (2001). Response format in writing self-efficacy assessment: Greater discrimination increases prediction. *Measurement and Evaluation in Counseling and Development*, *33*, 214-221.
[15] Ausubel, D. (1960). The use of advanced organizers in the learning and retention of meaningful verbal material. *Journal of Educational Psychology, 51*(5), 267-272.