

AC 2007-1605: PRELIMINARY RESULTS OF A LONGITUDINAL STUDY INTO THE ACADEMIC SUCCESS OF STUDENTS IN TECHNOLOGY-FOCUSED VS. HUMANITIES PROGRAMS

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Preliminary Results of a Longitudinal Study into the Academic Success of Students in Technology-Focused vs. Humanities Programs

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Abstract

Attrition rates in junior years of technology-focused programs are much higher than in humanities. As well, in recent years technology-focused programs have been experiencing drops in enrollment, and difficulties in attracting qualified candidates, while admissions to other programs seem unaffected. Such trends are worrying and thus we, as educators, need to improve efforts to better understand our students that would in turn allow the university to better plan and tailor their student success, retention and recruitment programs. This paper reports on the background and initial hypotheses as well as on the first survey results of a new longitudinal study which is intended to provide insight into retention issues, including an investigation of a “filtering effect” of the traditional instruction that the authors hypothesize is taking place and is partly responsible for high dropout rates, as well as for the reduced diversity of the student body as they progress through the technology-focused versus humanities programs. The study will also provide recommendations to improve student engagement and success.

Introduction

High attrition rates and feelings of alienation are the flip side of student success and satisfaction. They are much higher in junior years of technology-focused programs than in humanities. At the authors’ university, up to 30% of engineering students drop out at the end of their first year, a percentage typical when compared with other technology-focused programs. High attrition rates are a disservice to students and parents, as well as to universities and funding bodies (i.e. government), because they cost money, affect planning process and reduce diversity of the student body. Moreover, in recent years all technology-focused programs have been experiencing drops in enrollment, and difficulties in attracting qualified candidates, while admissions to other programs seem unaffected. Such trends are worrying at a time when the very well-being of post-industrial society and of environment depends so much on technology. High attrition rates and drops in enrollments in technology-focused programs have been linked to two contributing factors. The first is globalization of the economy with a host of implications for the job prospects (e.g. outsourcing, “race to the bottom” in labor market, etc.) that impact potential students’ perceptions of the desirability of certain career choices. While this factor is completely outside of

the academic purview, the second contributing factor, quality of student undergraduate experience, is an area where action can be taken. While some students withdraw because of poor performance, others choose to leave for many different reasons. There is evidence that students do not engage with content, that instructional strategies are not addressing their learning needs, and a perception that in order to succeed, they have to conform to certain acceptable learning strategies. Improving quality of undergraduate education steadily gains prominence across the whole North American university system, and efforts are made to assess educational experiences of undergraduates, for example through US-based National Survey of Student Engagement¹, that includes many Canadian universities. With many students reporting feeling disengaged and alienated, the Survey gave Canadian schools mostly poor marks². The educators need to improve efforts to better understand students' learning that would in turn allow the university to better plan and tailor their student success, retention and recruitment programs. As Felder, a pre-eminent engineering educator, states, "The more thoroughly instructors understand the differences, the better chance they have of meeting the diverse learning needs of all of their students"³. Considering the negative impact of high attrition rates and student disengagement, an investigation aiming to improve student success and engagement in technology-focused programs meets a societal need.

The authors have recently embarked on a multi-year investigation into retention issues, learning differences and depth of learning that aims to a) build a student-learning model that captures such variables as differences between the two cohorts of students (i.e. from technology-focused and humanities programs), instructional strategies, and learning outcomes (i.e. academic success, their sense of personal fulfillment in the program and their perceptions of instructional methods), b) analyze correlations between the model variables and outcomes, and c) formulate some recommendations to improve the learning outcomes. Individual differences that will be considered are students' learning styles, emotional competency as they progress through their four-year programs, and their response to instructional delivery methods. The project will also include development and testing of some assessment tools. The study will follow a cohort of students through their undergraduate education at the authors' home university from their entry into the first year in Fall 2006 to their graduation in Spring 2010. The authors currently hold national level government funding for the first three years of the project.

Study Design and Hypotheses

Teaching and learning are dynamic endeavors and many factors, dependent on learners, instructors, and subject domain, affect learning outcomes. The outcomes can be defined both in cognitive domain, where academic achievement and retention can measure student success, and in affective domain, where surveys and focus groups can assess student satisfaction and perceptions of instructional strategies. According to Felder, three categories of individual differences have implications for teaching and learning: learning styles, approaches to learning and intellectual development levels³. Thus the long-term goal of this project is to investigate why the defined outcomes of the learning process (i.e. student success, satisfaction and engagement) are significantly different in technology-focused programs when compared with humanities, and

to formulate recommendations. The authors want to develop a better understanding of student learning styles, maturity levels (emotional competency) as they progress through the four-year program, their response to instructional delivery methods, and their perceptions of the effectiveness of those strategies. Factors affecting the learning outcomes can be grouped into attributes associated with learners and attributes associated with the learning environment. The first group includes such individual differences as students' backgrounds, prior knowledge and experience, their age, gender, ethnic background, motivation, computer skills, personality types, cognitive and learning styles, academic ability, etc. The second category includes instructors' expertise, motivation, teaching style and choice of instructional strategies, some of which may be subject-specific. The study will focus on those factors that may help explain differences between the two student cohorts, in technology-focused programs and in humanities.

The study will collect data from a broad cross-section of students in the two cohorts, while following them through the four years of their programs. The authors hypothesize that a wider gap between learning preferences and instructional styles exists in technology-focused programs than in humanities, which in turn contributes to differences in outcomes. A model will be built that relates student differences and instructional strategies to outcomes (student success, satisfaction and opinions), the hypothesis will be tested, and recommendations to improve the outcomes will be formulated. The authors set out three specific and attainable objectives for the study:

- To assess the learning styles of the two cohorts of students (i.e. technology-focused and humanities) by administering an existing and validated instrument, Index of Learning Styles (ILS) Questionnaire⁴ and to identify patterns;
- To assess the emotional maturity of the two cohorts by administering an existing and validated instrument, Emotional Competency (EC) Questionnaire^{5,6} and the Study Process (SP) Questionnaire⁷ and to identify patterns;
- To develop and test unbiased Instructional Quality Questionnaires (IQQ) that will be used in the subsequent investigations.

This paper deals with preliminary results obtained from the analysis of the first administered survey, and is limited to learning styles only. Thus, for the reasons of brevity, a detailed description of planned investigations of Emotional Maturity and of Instructional Styles is not included.

Investigation of Learning Styles

Learning style represents a manner in which learners consistently respond to and process information in a learning environment, and is defined by bipolar dimensions. While the concept of the learning style is not universally accepted, particularly among psychologists, models of learning styles that have been defined paint a consistent picture of learner's differences and proved to be effective tools in tailoring instruction so that learner's needs are met³. Several

psychometric tools for different learning models have been used in educational research. To assemble a learning preferences profile for each year of the student body they will investigate, the authors decided to adopt the model developed in 1988 by Richard Felder, an engineering professor at North Carolina State University, with help of psychologist Linda Silverman that focuses on aspects of learning styles particularly significant in engineering education^{3, 8}. The model currently has four bipolar dimensions describing Perception (*Sensing-Intuitive*), Input (*Visual-Verbal*), Processing (*Active-Reflective*) and Understanding (*Sequential-Global*) of information, with scores in the range of 6-7 indicating a balanced learning style with mild preference either way, scores in the range of 8-9, indicating a moderate preference, and scores in the range of 10-11 indicating strong preference for a particular mode of learning. In 1991, the psychometric assessment instrument, Felder-Soloman Index of Learning Styles, was developed⁴. The ILS is simple, non-ambiguous and in public domain. The web-based, 44-item, self-scoring version of the questionnaire gets approximately 100,000 hits per year and has been translated into several languages. Since its inception The ILS has gone through several iterations and many validation studies^{10, 11, 12}. Felder stresses that to be effective as a learner and problem solver, the learner needs to develop cognitive flexibility along each dimension, and suggests a multi-style approach to instruction that supports learner's preferences at some times, while challenging them at other times^{3, 8}. Such approach benefits from incorporation of active, collaborative, student-centered learning strategies that have also been pointed out as most effective in a seminal paper⁹ by Chickering and Gamson. The multi-style approach was also used by the second author in a research study showing that implementing hypermedia and online support in an engineering course resulted in an increased student achievement and satisfaction^{13, 14}. Those gains were attributed to creating a more engaging environment where an expanded range of learning styles was supported.

While the ILS has been widely used to assess learning styles of engineering students³, the literature review identified only one study of business students¹⁵, one study of arts students³, and none provided more than anecdotal speculation regarding possible gender and cultural differences in learning preferences, although both areas were identified by Felder as worthy of further investigations³. In their current investigation, the authors thus have a unique opportunity to make a worthwhile contribution to the existing research on the ILS based on their access to student populations not previously included in any studies (i.e. arts students, women and students of diverse cultural backgrounds).

The study will also include an investigation of a possible "filtering effect", whereby diversity of the student body (as expressed by their learning styles) is reduced as they progress through the program, that the authors speculate is taking place. The percentage of visual learners among engineering students is much higher than among the general population. Between 70% and a staggering 95% of engineering students are reported to be visual learners^{3, 12}, compared with 60% of high school students¹⁶. A majority of engineering students also prefer active learning, where they process information through physical activity, discussion, group work and meaningful projects relating to the "real world." Yet there is a mismatch between these preferences and traditional engineering instruction that is still overwhelmingly verbal, theoretical and lecture based³. This mismatch is believed to contribute to high attrition rates, poor academic performance, disillusionment that some students experience within a program, and negative

perceptions about careers in engineering. The authors hypothesize that similar patterns are at work across all technology-focused programs. Literature review also reveals differences in distributions of learning styles among students and faculty^{17, 18, 19}. Styles of senior/graduate students and the faculty are more aligned, while those of the lower level students' are more divergent. Some suggest that the learning styles undergo transitions¹⁸. However, this theory is untested, and a longitudinal study is necessary to confirm if the shift within the same cohort actually took place. Others show high correlation of the learning style assessments over time^{10, 11}. Thus, a more compelling possibility for the differences is that the style of teaching prevalent in the field, adversely affects students with learning styles not supported by it. This would create a "filtering effect" of traditional learning environments, where learner differences are not acknowledged. It is thus asserted that students whose learning styles are consistently not supported, have more problems remaining in their programs and drop out at higher rates. Such "filtering" would reduce diversity of styles among the graduates, urgently needed by technology-focused professions.

Indeed, while engineering students on our campuses are now more ethnically diverse than ever, participation of women in engineering in North America, after a couple of decades of progress, has stalled around 20% and in fact has started to decline. Similarly, most creative, thinking-outside-the-box prospective students are turned off by traditional approaches to education and a silo mentality that permeates the field. Engineering, already perceived by the society at large as myopic and lacking in awareness of its societal impact, desperately needs to attract and retain the diversity of personalities, styles, gender and thought, and to cultivate holistic integration, environmental consciousness, and collaborative, interdisciplinary, leadership and communication skills, all attributes not typically appreciated within content-overloaded engineering curriculum. Currently, successful students seem to be those more resembling their professors, and while this may make them good candidates to survive the rigors of a graduate program (and become academics themselves), their skill set may not be the best match for a successful practitioner. And yet, only a small fraction of the undergraduate body will continue on into graduate school. Thus, the possible "filtering effect" warrants a serious investigation that will be provided in this study. If its existence is confirmed, it would provide useful insights into retention issues.

Methods

The research protocol for the study was approved by the Ryerson Research Ethics Board. Student participation is voluntary, and all participating students are asked to sign an informed consent letter. The students are not exposed to any risks or reprisals for refusal to participate in the study. Volunteers for this study are drawn from three distinct student bodies on campus: engineering, business and general humanities programs. Students for the experimental cohort (technology-focused programs) were recruited from Engineering, and Information Technology (IT) Management programs. Students for the control cohort (humanities) were recruited from BA programs in Faculty of Arts at Ryerson, such as Criminal Justice and Arts and Contemporary Studies. The study will track the students from entry into their first year in Fall 2006 to their graduation in Spring 2010. Four different questionnaires will be administered to the participants

at different points of their program, and Focus Groups (FG) will be held with a smaller group of students on a yearly basis and taped for later assessment.

The first round of surveys, completed in September 2006, had more than 600 volunteers complete the ILS Questionnaire, the EC Questionnaire and the SP Questionnaire. At the time of writing, the encoded data base included 217 entries. For this paper, the authors focused on the preliminary analysis of the ILS part of the surveys collected, with the analysis of correlations between individual learning style, emotional maturity and academic success and between individual learning style, emotional maturity and personal fulfillment to follow in future reports.

Results and Discussion: Gender vs. Program Differences in Learning Styles Distributions

At the time of writing, the available data included ILS responses from 105 Technology-Focused (TF) cohort and 112 responses from the Humanities-Focused (HF) cohort. The former included 20 engineering students and 85 Information Technology Management students. For the purposes of this paper, the authors decided not to distinguish between these two groups because of a relatively low number of engineering students (20 out of 400) entered into the data base by the time of writing. This distinction will be elaborated on in later reports. There were 119 ILS responses from male students and 97 ILS responses from female students. The distribution of genders among the TF cohort was 83.8% male vs. 16.2% female, compared with an opposite trend among the HF cohort (27.9% male vs. 72.1% female). It is restating the obvious that these two distributions are statistically significantly different (Chi-Square statistic for ordinal data was $\chi^2 = 255.451$, $p = 0.0001^{**}$), as it is a well-known fact that any technology-focused cohort of students is predominantly male. As an aside, the 16.2% share of women in the TF cohort is an accurate reflection of an overall participation of women in technology focused programs at Ryerson, which is also 16%. That number has historically been somewhat lower than the national average of women in technology-focused programs, which in Canada currently remains stalled at approximately 20%. Table 1 and Table 2 show, respectively, bimodal distributions of learning styles between programs and between genders.

Table 1: Demographic Data – Differences in Bimodal Distributions by Program

TF	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Number	59	46	63	42	95	10	65	40
%	56.2%	43.8%	60.0%	40.0%	90.5%	10.5%	61.9%	38.1%
HF	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Number	63	49	28	84	79	33	36	76
%	56.3%	43.8%	25%	75%	70.5%	29.5%	32.1%	67.9%
χ^2 for program differences	$\chi^2 = 0.001$ $p = 0.990$		$\chi^2 = 57.167$ $p = 0.0001^{**}$		$\chi^2 = 51.683$ $p = 0.0001^{**}$		$\chi^2 = 42.067$ $p = 0.0001^{**}$	

** Significant at .01 level (2 tailed)

Table 2: Demographic Data – Differences in Bimodal Distributions by Gender

Male	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Number	65	54	57	62	104	15	61	58
%	54.6%	45.4%	52.1%	47.9%	87.4%	12.6%	51.3%	48.7%
Female	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Number	57	40	34	63	70	27	39	58
%	58.8%	41.2%	35.1%	64.9%	72.2%	27.8%	40.2%	59.8%
χ^2 for gender differences	$\chi^2=0.671$ p=0.413		$\chi^2=6.416$ p=0.011**		$\chi^2=20.424$ p=0.0001**		$\chi^2=4.744$ p=0.029*	

** Significant at .01 level (2 tailed)

* Significant at .05 level (2 tailed)

As Table 1 shows, the participating TF students were overwhelmingly Visual learners (95%). They were also predominantly Active (56%), Sensing (60%) and Sequential (62%). This is consistent with previous research that shows the vast majority of students in technology-focused programs, are visual learners who achieve more subject-related understanding from pictures, diagrams or demonstrations^{3, 13, 14, 15}. Their numbers are much higher than in the general population¹⁶. The 95% of TF students who were Visual learners is consistent with various studies quoted by Felder³ where that percentage varied from 70% to 95%. The roughly 60%-40% split in favor of Active and Sensing modalities is also very consistent with the literature^{3, 13, 14, 15} and supports the model construct that assumes that students in technology-focused programs show preference for active learning in a context of real-life applications, where they can engage with the subject in a meaningful way and to process information through physical activity, discussion or group work^{3, 12}. Finally, the 60%-40% split in favor of the Sequential way of organizing knowledge is also consistent with the theoretical construct of the model that showing that engineering students tend to prefer an orderly progression through topics and subjects without questioning underlying connections and with performing tasks with only a partial understanding of the subject. The construct also acknowledges the reality of traditional styles of instruction in engineering departments that reinforces these tendencies through an over-reliance on sequential lectures and rarely demands of students a more holistic approach to understanding^{3, 12}.

As Table 1 shows, the participating HF students were also predominantly strongly or moderately Visual learners (70.5%), which is consistent with a documented shift over the last half a century in North America in information intake preferences among the general population from mostly text-based to visually-oriented, attributed to an explosion of visual media and computers¹⁶. However, the percentage of those students who were Verbal learners is much higher among the HF cohort than among the TF cohort (29.5% vs. 10.5%, respectively), and the difference is statistically significant, as shown in Table 1. The differences between the two cohorts are even more striking, and statistically significant, for Processing and Understanding dimensions, where HF students were predominantly Intuitive (64.9%) and Global (67.9%). Larger percentages of Verbal learners and the predominance of Intuitive and Global learners seem to be consistent with the nature of humanities programs that emphasize research and assimilation of large quantities of assigned readings, development of communication skills and a holistic approach to

understanding of the domain. At the same time there is less room for practical experimentation so favored by Sensing learners.

The bimodal distributions found in the HF cohort are not consistent with the only study of humanities students found in the literature review³. In that study of 235 humanities students in Belo Horizonte, Brazil, they were mostly Verbal learners (61%), while only 29.5% of the HF students in the current study were. The Brazilian study also showed that Sensing and Sequential learners accounted for 62% each, compared with only 25% and 32.1%, respectively, of the HF cohort in the current study. One possible explanation for the inconsistency may be that specifics of the single quoted study cannot be generalized. For example, we do not know whether the general population in Brazil is predominantly Visual, as it is in North America. Similarly, since there seems to be a self-selection component in choosing a program of study, perhaps there are cultural components to the Brazilian humanities curriculum that affect the distributions. It is also entirely possible that it is the HF students in the current study at Ryerson who are a distinct population, where learning preferences cannot be generalized. Perhaps the cultural component is at play here as well, given that so many students at Ryerson are either international students or recent immigrants. In either case, further investigation of the ILS scales in context of the humanities programs is warranted.

In both cohorts in the current study an almost identical percentage of students are Active learners (56.2% in the TF cohort vs. 56.3% in the HF cohort) and the Active and Reflective preferences are the most balanced. Unlike the Input dimension, where the vast majority of all students are moderately or strongly Visual (the mean Visual score for the TF cohort was 8.39 out of 11 vs. 6.98 for the HF cohort), the mean scores for the Active mode of learning were much lower (6.30 for the TF cohort vs. 5.96 for the HF cohort), indicating a prevalence of a balanced learning style, with only a slight preference for Active learning. This is consistent with the very mechanism of how learning takes place, best elucidated by Kolb²⁰ who introduced the concept of “experiential learning cycle”. All learners need to experience and experiment, but also to reflect and analyze and thus tertiary level learners are expected to have developed a degree of cognitive flexibility that allows them to be Active learners at some times, and Reflective at other times.

This balancing act required for effective learning informs the main theme espoused by Felder, that the most effective way to meet the learners’ needs is to combine traditional lectures with more active and collaborative strategies³. This theme is also supported by research on best educational practices showing that student engagement through active and collaborative learning activities results in improved learning outcomes⁹. However, while there is some evidence that instructors in humanities have been quicker to adopt instructional strategies more conducive to student engagement, teaching in technology-focused programs is still predominantly traditional^{3, 19}. The mismatch between the way technology-focused programs are taught and the learning preferences of their students, identified by Felder³ and confirmed by one of the authors’ previous work^{13, 14, 19} is one of the overarching concerns of the authors’ research, and one that they hope to address with recommendations stemming from this project.

In summary, Table 1 shows evidence of certain self-selection mechanisms, where the programs

tend to attract populations with different learning preferences, consistent with the nature of the programs. However, it has also been suggested that the differences in learning preferences between programs may be linked to a larger proportion of enrolled female students. Van Zwanenberg, in his study¹⁵ of business vs. engineering students at the University of Newcastle, UK, found significant differences between these two populations in bimodal distributions on all dimensions, and speculated that it may be connected to the fact that there were many more females among business students than among engineering students, but did not provide detailed gender distributions between the two cohorts. Because studies using the ILS questionnaire tend to focus on engineering students, which traditionally are overwhelmingly male, the literature review did not find any other examples of gender differences analysis in learning preferences. The current study represents thus a unique opportunity to study these. As Table 2 shows, both male and female populations show similar preference for Active mode of learning (58.8% of females vs. 54.6% of males). However, there are significant differences on other dimensions. More male learners are Sensing (52.1%) and Sequential (51.3%), and more female learners are Intuitive (64.9%) and Global (59.8%). Both male and female students are overwhelmingly Visual learners, but the differentiation between the two genders is the strongest in this dimension, with a significantly larger proportion of Verbal learners among female students (27.8% vs. 12.6% among males).

As Table 1 and Table 2 show, the statistically significant differences in bimodal distributions between male and female populations on Perception, Input and Understanding dimensions are very similar to those between the two cohorts (TF vs. HF). However, since the HF cohort is overwhelmingly female and the TF cohort is overwhelmingly male, the question remains whether these differences are gender or program-based. A look at gender distributions within the programs, provided in Table 3 and Table 4 may help answer that question. Out of eight possible comparisons to be made (i.e. male vs. female distributions on four dimensions within the two cohorts), there are no statistically significant differences in five. There is a statistically significant difference within the TF cohort on Active-Reflective dimension, with significantly more TF female students with an Active learning preference (76.5% vs. 52.3% among males). There is also a statistically significant difference within the TF cohort on Sensing-Intuitive dimension, with significantly more TF female students with a Sensing learning preference (70.6% vs. 58.0% among males). Finally there is also a statistically significant difference within the HF cohort on Sequential-Global dimension, with significantly more HF male students with a Global learning preference (80.6% vs. 63.8% among females). However, the samples of female TF and male HF populations were small (n = 17 and 31, respectively), reducing the impact of such differences on the overall cohorts. In summary, based on the analysis of the present sample, it would seem that gender has much less effect on the learning style preferences than the choice of a program of study. However, this area warrants further investigation.

Table 3: Demographic Data - Bimodal Distributions by Gender among TF Cohort

TF Male	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Number	46	42	51	37	80	8	55	33
%	52.3%	47.7%	58.0%	42.0%	90.9%	9.1%	62.5%	37.5%
TF Fem	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global

Number	13	4	12	5	15	2	10	7
%	76.5%	23.5%	70.6%	29.4%	88.2%	11.8%	58.8%	41.2%
χ^2 for gender differences	$\chi^2 = 28.637$ $p = 0.0001^{**}$		$\chi^2 = 6.765$ $p = 0.009^{**}$		$\chi^2 = 0.606$ $p = 0.436$		$\chi^2 = 0.491$ $p = 0.483$	

** Significant at .01 level (2 tailed)

* Significant at .05 level (2 tailed)

Table 4: Demographic Data - Bimodal Distributions by Gender among HF Cohort

HF Male	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Number	19	12	6	25	24	7	6	25
%	61.3%	38.7%	19.4%	80.6%	77.4%	22.6%	19.4%	80.6%
HF Fem	Active	Reflective	Sensing	Intuitive	Visual	Verbal	Sequential	Global
Number	44	36	22	58	55	25	29	51
%	55.0%	45.0%	27.5%	72.5%	68.8%	31.3%	36.3%	63.8%
χ^2 for gender differences	$\chi^2 = 1.334$ $p = 0.248$		$\chi^2 = 3.400$ $p = 0.065$		$\chi^2 = 3.439$ $p = 0.064$		$\chi^2 = 14.630$ $p = 0.0001^{**}$	

** Significant at .01 level (2 tailed)

* Significant at .05 level (2 tailed)

Summary and Future Directions

In this paper the authors outlined the design for their multi-year research project investigating the intersection of learning preferences, emotional maturity and academic achievement. Due to the early stage of the project, the paper provides only the analysis of the learning styles part of the surveys collected in Fall 2006, with a particular focus on gender vs. choice of program differences between the two cohorts in the study. However, even at this early stage of the study, the results are promising. The scope of the study will afford the authors to create a large database from a diverse student body, including those outside their own engineering programs and thus to test the Felder Learning Model for variables rarely previously seen in literature, i.e. gender, choice of future career and cultural background.

Furthermore, future reports will focus on the Emotional Competency (EC) and Study Process (SP) Questionnaires that measure basic emotional and social competencies, and depth of learning, respectively. The EC Questionnaire has been primarily used with psychology students, and has never been tested among students in a technology-focused program. Thus, applying these instruments to cohorts that have not been traditionally tested with them, and resulting analysis, will constitute a unique aspect of the study. A detailed analysis of correlations between individual learning style, emotional maturity and learning outcomes will also follow. The authors hope to gain enough insight and better understanding of the students to a) formulate some recommendations for improving student success rates, and b) inform the future direction of their research, in which they are planning to identify effective instructional practices.

What motivates this direction is that the authors feel the responsibility for the students' succeeding in engineering undergraduate programs is not theirs alone, and that more needs to be

done beyond providing counseling and academic remedial programs. Thus, while the current proposed study will help the authors learn more about the engineering student population and thus provide useful insights on how to improve student success rates, the study that will look at the instructional side of the coin will allow them to make specific informed recommendations with regards to the engineering classroom practice. A unique aspect of this part of the study is that the authors will solicit input from the students, through focus groups, as to which teaching methods they appreciate and which teaching delivery style they feel benefits them. A more qualitative measurement tool will be developed, and tested, within this project to elicit student feedback as to the effectiveness of current teaching strategies, an instructional quality questionnaire (IQQ). This input will inform the future research of correlations between different learning styles and specific teaching methods in order to identify effective instructional design, looking at it principally from the student's perspective.

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