An Exploration of the Conative Domain among Engineering Students

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Abstract: *Concerns about student retention, demotivation and lack of confidence in engineering courses has been discussed over the past 15 years. This study suggests the need of exploration study on conative domain to prepare students for future challenges in engineering study. One promising line of research is to promote a deeper understanding of the concept of conative domain, to explain the confusion between the idea of conation as motivation and resilience, and to discuss several researches on conation in educational contexts.*

This paper is part of an ongoing PhD research project that aims to explore conative domain among engineering students. It reviews existing literature in this topic and presents preliminary findings from surveys and interviews. The results from surveys showed students were less confident of their own technical skills and have a lower level of self-esteem compared to employers' perception. Results from lecturers' interviews showed students' attitudes and interest were the major obstacle that affects their willingness in exploring engineering skills.

Introduction

Several researchers have discussed concerns about student retention, demotivation and lack of confidence in engineering courses over the past 15 years (Marra, Rodgers, Shen, & Bogue, 2009; Matusovich et.al, 2008; Seymour, 1995). In 1995, undergraduate students taking science, mathematic and engineering courses (SME) in the United States decided to dropout and changed to other courses because of a lack of interest and motivation in SME (Seymour, 1995). Similarly, higher cases of non-completion in higher education were found at several universities in Malaysia (Sapuan, 2008) and Australia (Maslen, 1999). The greater concern in engineering field is when the number of students dropping out from engineering programs increases from year to year (Baillie, 2000). The problems are clear but there is no clear answer.

Most of the solutions in higher education have normally focused on evaluating students' cognitive, affective, and psychomotor domains, neglecting another important domain, the conative domain. Some previous psychologists referred to conation as *will* or *desire*. However, confusion has existed with the concept of conation since it was proposed by Bain in 1868 (Gerdes & Stromwall, 2008). To rectify this situation, the overall conation concept has been intensely explored by Riggs & Gholar in 2009. Research on the conative domain in educational contexts has attracted more researchers in this century; this suggests the importance of conative research to explain variations in student performance (Reeves, 2006; Riggs & Gholar, 2009; Snow & Jackson, 1994).

Concerns for effective solutions for students dropping out of engineering courses have shed light on the importance of research in the conative domain. Thus, one promising line of research is to promote a deeper understanding of the concept of conative domain, to explain the confusion between the idea of conation as motivation and resilience, and to discuss several researches on conation in educational

contexts. The second promising line of research is to discuss preliminary findings from surveys and interviews among engineering students in Malaysia. This paper will conclude with the significance of future study of the conative domain among engineering students and an outline for further research.

Literature Review

The Concept of Conation

The concept and impact of conation to a person's life is not new. Conation is a term that has been used by classical psychologists to refer to willingness, desire or a "striving towards" (McDougall, 1926, p128) achieving goals. Conation creates changes from within. In a critical situation, conation is such strength from within that can help a person 'recover from a blow' (McDougall, 1926). Gerdes & Stromwall (2008) stresses that conation occurs when a person with any degree of motivation or goal orientation strives to achieve their goals.

Riggs & Gholar (2009) highlighted six attributes in the fundamental framework of conation that are belief, courage, energy, commitment, conviction, and change. Prior to the date, (Barron, 1969) discussed these same attributes when describing a creative personality. Belief corresponds to willingness towards goal realisation. Both factors, belief and willingness, are relational factors that tend to promote or inhibit one's desire to strive (Riggs & Gholar, 2009). Indeed, the stronger the belief or willingness, the greater the determination to realise the goals.

Several reasons why research into conation less getting enough attention among researcher is that conation is often intertwined with the cognitive (intelligence) and affective (personality) domains (Snow & Jackson, 1994). In fact, the cognitive, affective and conative domains are closely interconnected and interdependent (Riggs & Gholar, 2009). The term 'conation' is also sometimes misused among researchers because the concept overlaps with other terminology (eg. intrinsic motivation). In order to understand the differences, it is important to view the conation concept in relation to other dimensions, such as motivation and resilience. Both factors are entirely different concepts but closely related to the conative domain.

The Relationship between Resilience, Motivation and Conation

The strength of an individual's conation depends on internal and external factors that influence a person's life. Both factors are known as intrinsic and extrinsic motivation factors. Conation and intrinsic motivation share the same learning domain that is the conative domain while extrinsic motivation is connected to affective domain (Riggs & Gholar, 2009).

Intrinsic Motivation : Intrinsic motivation (e.g., interest and desire) influences from inside a person (Ryan & Deci, 2000). A person with high levels of intrinsic motivation shows the desire to do any task even those thought to be impossible. Intrinsic motivation has attracted attention from many social psychologists who have explored how it affects a person's behaviour (McDougall, 1926; Spielberger & Starr, 1994). In learning contexts, it is difficult to know whether students are intrinsically motivated to learn as they need to follow a specific curriculum. Students do not have the chance to decide what they want to learn. In this situation, students need external factors that can encourage them to get through the learning process.

Extrinsic Motivation: Extrinsic motivation refers to motivation that influences a person from outside (e.g., reward and award). The effects of extrinsic motivation on a person's interest have been extensively debated over the years (Bandura & Schunk, 1981; Riggs & Gholar, 2009; Ryan & Deci, 2000). Riggs & Gholar (2009) states that intrinsic motivation is a neutral reaction without the presence of extrinsic motivation and the extrinsic rewards can have negative influence on intrinsic motivation. This study argues with Riggs views, thus, beliefs that some of intrinsic motivation factors are raised from the existence of extrinsic motivation factors. For example, an assignment deadline acts as an external force to make students commit to accomplish the assignment within the timeframe. Commitment that students put on the assignment is one of the conation attributes to engage students with the assignment given. The deadline, an external force, is not seen causing a negative impact to students attributes; thus, it is created positive attitudes such as effort and self-discipline as well as time management skill that will be invaluable in a work setting.

Resilience: Resilience is a specific attribute that supports an individual to recover from an adverse event (Allen, Murray, & Simmons, 2005). Riggs & Gholar (2009) relates resilience with conative intelligence (CI), the ability to persist, pursue, strive and commit to a goal. To be persistent or strive towards the end, an individual needs to have sources of resilience that are beliefs, skills and supports (Allen et al., 2005). For example, in a learning situation, when students face learning difficulties or fail in an examination, their performance is affected, emotionally, mentally and physically; they can be overcome that challenge through their belief in their abilities and through support from family and friends.

Research on Conation in Education

In the last decades, researchers in education have explored the importance of the conative domain to complement the other domains: cognitive, affective and psychomotor. Reeves (2006) suggests that higher education needs to produce graduate students that not only have affective capacity (to value, appreciate and care), cognitive capacity (to think, problem solve and create), psychomotor (to apply physical skills) but also the conative capacity (to act, decide and commit).

Students that possess cognitive ability, affective value and psychomotor behaviour act differently corresponding to their desire, will, effort, energy, commitment and self-determination (Reeves, 2006). In addition, each student has various perceptions, orientation and approaches to learning; therefore, they act differently to achieve their learning goals (Vermetten, Lodewijks, & Vermunt, 2001; Zimmerman, Bandura, & Martinez-Pons, 1992). The ways they act also depends on the level of striving they put on that action (McDougall, 1926). Indeed, they act dissimilarly because of their conative differences.

In order to explore individual learning differences, Snow & Jackson (1994) suggests a provisional taxonomy (model) of the conative domains. The model focuses on the conative domain that links with personality (affective) and intelligence (cognitive). The conative domain has two main categories that are motivation and volition. Several factors of individual differences in learning are located under both categories such as achievement orientation (eg. fear of failure), self-regulation (eg. control of effort and action), transitional interest and styles (eg. intrinsic motivation, learning approach), self-directed construct (eg. self-esteem, self-efficacy) and other-directed constructs (eg. beliefs, perception). The study contributes to the understanding of conative processes; however, it is less clear how some of the individual differences such as self-efficacy and learning orientation relate to the conative domain. Furthermore, self-efficacy has been widely explored in Social Cognitive Career Theory (Lent et al., 2008; Smith, 2002) and learning orientation has been shown to correlate with personality (affective) (Duff, Boyle, Dunleavy, & Ferguson, 2004a).

McFarquhar (2006) explores nurses' perception of the factors leading to success on their multiple attempts on examination. Findings from the students' conative experiences show that several factors had affected students during the several trials. These factors are goal achievement and accomplishment, striving that enables success, internal meaningful act (making personal decision), external meaningful acts (praying, reading, attending classes) and supports from family, friends, and institution. Researchers who follow this study tended to misunderstand conation, assuming that the factors listed are conative factors. In fact, most of the factors listed are motivation factors that force the conation process to occur (as discussed in the previous section).

Preliminary Study

In order to begin to explore the above issues, a preliminary study has been conducted to investigate critical factors that influenced technical skills mastery among mechanical engineering students at Merlimau Polytechnic, Malaysia (Paimin, 2006). One-third of undergraduate degree students in engineering program at Malaysian universities are diploma recipients from polytechnic engineering program. A set of questionnaire was distributed to 47 final year students and 18 employers who were chosen from several industries to which the students were attached for industrial training. The results are displayed graphically in Figure 1 numerically in Appendix A.

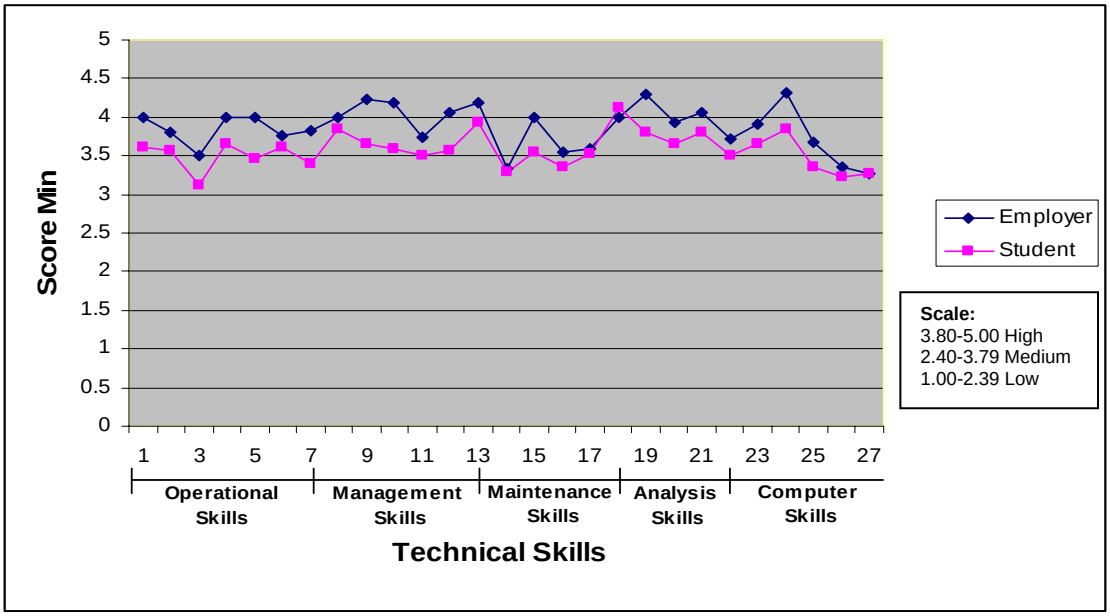

Figure 1: Students and Employers Perception on Student Technical Skills

The study focused on identifying the level of student technical skill: operational, management, maintenance, analysis and computer skills based on employers and students perception. The largest gaps between both perceptions were on writing work report (item 9) and technical report (item 10). Although students were exposed to report writing skills during their learning processes, the new exposure to real working environments with various types of writing reports and a wide use of English language to report job tasks may reduced the students self belief in their report writing skills. They had a similar, low perception on several job tasks such as their ability to operate machines (maintenance), applied knowledge in CNC (*Computer Numerical Control*) programming and use of other software in programming (e.g: C++).

The overall results showed that employers have higher perception of students' technical skills compared to student's perception of their own technical skills. It may be concluded that students are less confident of their own technical skills and have a lower level of self-esteem based on their performance in technical skills.

The researcher also interviewed several lecturers to get their opinion on students performance related to technical skills. Findings from lecturers' interviews showed they believed that students' attitudes and interest were the major obstacle among other factors, thus, affects their willingness in exploring engineering skills.

> *"....students were less initiative to develop their self efficacy, they are too dependent to all input and notes that lecturer gives in class."* **[R3T3-16/08 (SK2:S5)]**

> *"There is no other factor than student attitude. No matter whether they have prior experiences or not, mastery technical skills closely related to their awareness of improving and developing their own skills".* **[R4T4-16/08(SK2:S5)]**

Students' attitudes are critical, according to the lecturer interviews. Students need more encouragement and motivation to raise their awareness to the importance of developing knowledge and skills during the teaching and learning process. Students need learning activities that can increase their intrinsic motivation. One mechanism is to use learning activities that relate to their future careers (Kember, 2000). The more support and encouragement from lecturers and faculty, the better chances they have to help students achieve their academic goals.

This result has confirmed the importance of research on student conative domain, thus, lead to the further exploration study that will be conducted among undergraduate engineering students at several universities in Malaysia and Australia.

Future Research

In the light of the above literature and preliminary study, further research is being conducted to identify students' conative profiles that will explore the conative styles of engineering students. Since little study has explored the internal and external factors that affect conative domain among students, the future study will explore the other possible factors that influence conative capacity among engineering students.

The other focus of this research is to support Snow & Jackson (1994)'s conative model by examine several individual learning differences and their relationship to conation domain. The three factors to be considered are learning orientation, self-efficacy and career motivation. The first factor, learning orientation is considered with concerning that it is correlated with student interest and intrinsic motivation (Entwistle & Ramsden, 1982; Snow & Jackson, 1994). Learning orientation can affect students' learning in terms of how they react and respond to a learning environment (Duff, 2004b; Duff & McKinstry, 2007). The second factor, self-efficacy refers to a person's beliefs, expectation or ability to accomplish a task (Bandura & Schunk, 1981), therefore, has one of the attributes described in the fundamental framework of conation (Riggs & Gholar, 2009). The last factor, career motivation, are closely relate to a person's behaviour and interest that can builds individual's resilience and insight (London, 1983).

Conclusion

The literatures and findings discussed in this proposal is therefore suggests that engineering education for the future should emphasise research on conative domain to prepare students for future challenges in engineering study. Such research is important to solve the issues of retention, demotivation and drop out from engineering courses. Engineering education also should focus on designing learning activities and instructional instruments that can foster student conative capacity. The further exploration study is expected to assist engineering faculty members in understanding how conation contributes to student academic performance.

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Appendix A: Questionnaire Items

Table 1 : Students and employers perception on student technical skills.

No	Questionnaire Item	Score Min		
		Student (S) Perception	Employer(E) Perception	df (E)-(S)
	Operational skills			
1	Discharge of duties related work operation	3.62	4.00	0.38
2	Conventional machine	3.57	3.80	0.23
3	CNC Machine	3.13	3.50	0.37
4	Handling tools and other equipment	3.66	4.00	0.34
5	Determine suitable tools for machine operation	3.47	4.00	0.53
6	Test equipment	3.62	3.77	0.15
7	Quality Control	3.40	3.82	0.42
	Management skills			
8	Tasks planning	3.85	4.00	0.15
9	Write work report	3.66	4.24	0.58
10	Write technical report	3.60	4.18	0.58
11	Control inventory	3.51	3.75	0.24
12	Assess working environment	3.57	4.06	0.49
13	Implement technical work when needed	3.94	4.18	0.24
	Maintenance Skills			
14	Machine maintenance	3.30	3.33	0.03
15	Tools maintenance	3.55	4.00	0.45
16	Troubleshooting	3.36	3.54	0.18
17	Suggest alternative to avoid tools damages	3.53	3.60	0.07
18	Safety practice	4.13	4.00	-0.13
	Analysis Skills			
19	Data interpretation (measurement)	3.81	4.29	0.48
20	Data interpretation (chart, graph)	3.66	3.93	0.27
21	Documentation	3.81	4.06	0.25
22	Prescribe quality product	3.51	3.71	0.20
23	Analyse product defect	3.66	3.92	0.26
	Computer Skills			
24	Computer application (Ms Word, Excel etc)	3.85	4.31	0.46
25	CAD/CAM program	3.36	3.67	0.31
26	CNC(Computer Numerical Control) programming	3.23	3.36	0.13
27	Other programming software (e.g: C++)	3.26	3.27	0.01