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A Comparison of Intrinsic and Extrinsic Motivational Factors as Predictors of Civil Engineering Students' Academic Success*

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Students' academic performance is stymied when there is a lack of motivation to learn. It is hypothesised that intrinsic motivational factors are more prevalent than extrinsic factors in civil engineering students with high academic performance and that motivation does not remain constant throughout a degree. Cognitive theory is utilised with a cross-sectional design to evaluate 148 students enrolled in a three year BSc. Civil Engineering program. Principal component analysis reduced twenty-two positive variables to five factors (Personal, Perfectionist, Parental/Family, Job/Career, and Social Acceptance) contributing towards student's overall motivation. Using ANOVA at a significance level of $p \leq 0.05$, the motivational factors that differed between academic years of study were Perfectionist Motivation and Job/Career Motivation. These differences provide a basis for the further examination of the time-varying nature of motivation. While intrinsic motivational variables were shown to have a more positive effect based on the mean responses, as a factor it was not wholly successful in predicting academic performance, rather extrinsic factor social acceptance accounted for high grade-point averages. Trends indicate motivational factors vary by age, gender, and local versus foreign origin. These result provide a greater understanding of precisely what impulses students are guided by during their studies and provide foundation for focus areas to be explored by educators.

Keywords: motivation; academic performance; cognitive theory; undergraduate student; civil engineering

1. Introduction

Approximately sixty percent of the civil engineering students enrolled in the final year of a Bachelor's of Science (BSc) degree during 2012/2013 academic year failed to complete the program in the prescribed three years. This trend continued in 2013/2014, 2014/2015 academic years. Further, fifteen percent graduated with first class honours. This low throughput raises questions such as: Why isn't a greater number of students graduating with high honours within the requisite time; Is there a lack of motivation or drive in students to succeed; and Are the courses or grading systems too hard or strict? Universities need to promote academic success by making sure that the learning process is strengthened through the accounting of professional and personal development of students in the design of instructions and assessments [1]. It is, therefore, their role to understand the reasons driving students' choices or what factors are responsible for their aspiration towards success [2]. It is believed that motivation can provide the basis for unaccounted success, i.e., when capability cannot differentiate high-achieving students from low-achieving students [3–5].

The Latin root for motivation means to move [6]. The resulting motivational theories have therefore been concerned with both the energisation and direction of behaviour [7]. As an energiser (physical, psychological or social), motivation drives an individual to reach or achieve a goal, fulfil their need, and finally feel satisfied due to the achievement of their aim [8]. It is this need to perform well, which translates into a desire to use knowledge and skills mastered in associated learning activities. Therefore, motivation is believed to be a facilitator of learning and a determinant of academic success [4].

The many motivational theories, which exist, can usually be placed in either of two categories: needs/motive based and cognitive theories. Needs/motive based theories approach motivation by investigating the implicit human necessities, which drive behavioural patterns. They suggest that individuals are motivated by the desire to achieve or maintain the various conditions upon which basic satisfactions reside [9]. Specific to education, need/motive based theories belong to an older pool of research, which attempted to use the need to achieve and the need to avoid failure to explain academic motivation and achievement. As time passed, research showed that these motives merely acted as antecedents to the social-cognitive achievement goals, which then directly influenced academic motivation

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and achievement [10]. Such findings resulted in the recognition that needs/motive based theories and social-cognitive theories were not dichotomous but complementary to each other. Cognitive theories seek to reveal the conscious thought processes, which lead to behaviour. Social-cognitive theories reflect the use of conscious thought making it suited for the education context, i.e., educators can positively influence students' thought processes. Accordingly, current motivational research focuses on using theories, which at least account for social-cognitive constructs as mediators of desired outcomes, such as, motivation [7].

In education, the developed theories have mostly emphasised an individual's perception of him/herself within the social context [11]. The central research themes have been perceived value for and interest in an activity [12, 13]; goals [14]; emotions [15]; achievement motivators for success/failure [16–18]. Despite these proposed research on motivation and interventions suggested by [19] and [20], there is an absence of studies focussing on differences in motivators as an individual develops and the effects of these differences on academic performance. Though advocated by [21] almost a decade ago, studies on directional behaviour which accesses magnitude and dynamic changes in motivators, and reasons supporting these changes has been limited. Further, the literature has been inconclusive in the link between these two facets of 'need for achievement' and 'performance' in engineering education [22].

Establishing a baseline year will allow for comparison between motivational factors and academic performance over time. Three questions are therefore pursued: (1) is there a relationship between motivational factors and high levels of academic success in civil engineering students and, if so (2) does motivation differ at different stages of study within an undergraduate degree program, and where differences exist (3) are they as a result of demographic characteristics of the responding students. The variables having a positive motivational contribution towards success are investigated. From these variables, principal factors accounting for the motivation of all students are extracted. The need exists to determine motivational factors because learning and subsequent academic performance will not happen without motivation or a supportive environment [4]. If student motivation is lacking, the effectiveness of any performance intervention will be reduced. The establishment of variation of motivators by population characteristics, and grade point average (GPA) are also investigated for the derived factors. GPA's are a crucial aspect of undergraduate education because, at this level, education is largely a classroom experience in which grades are the 'bottom line' [23]. Since GPA's are widely accepted and consequential indicators of performance, exploration of its linkage with motivation is critical. These objectives were pursued by considering the stratification of the year group. As noted by [1] the main motivational factors present in a particular year of study may be related to the cognitive character of the student at that particular stage/level of study. Within the civil engineering field, this has not been previously investigated, as such, cognitive theory will, therefore, be applied to determine any possible relation.

Over the past two decades, in the field of education both interventional and motivational studies focussing on the cognitive process have been on the decline [6]. If motivation is not considered as an intervention strategy, it will undermine the effectiveness of any other proposed measure [6]. As differences in motivators have been confirmed between different majors in engineering [16] and as different knowledge set characterises each major, examining what motivates civil engineering students to perform well over a program's timeframe needs to be understood. This analysis will greatly help the engineering education literature address the present challenges of student attrition described by [24]. A further benefit derived from this study involves an understanding of the risk factors that promote individual motivational development. Exploring motivation provides insights into the development of teaching inventories to perfect the forms and methods of instruction, which can help make adjustments in the teaching and learning process. Such intervention would result in a greater understanding of just what impulses the students are guided by and what meanings their learning activity affords.

2. Theoretical framework

All humans are different; it is therefore expected that motivation (source, type and magnitude) is also different among individuals [8]. This inconsistent and varying nature of motivation has resulted in numerous motivational theories combining various types and sources of motivation. These theories include Maslow's Hierarchy of Needs, McClelland's Need to Achieve, Expectancy Theory, Adam's Equity Theory, Achievement Goal Theory, Reinforcement Theory, the Cognitive Theory and many more. Maslow's theory called the 'Hierarchy of Needs' explains that there are at least five sets of goals or basic needs arranged in a hierarchy of pre-potency (physiological, safety, love, esteem, and self-actualisation) [25]. It postulates that when a need is fairly well satisfied, the next pre-potent ('higher') need emerges in turn to dom-

inate the conscious life and to serve as the centre of one's behavioural organisation. Therefore, it suggests that individuals are motivated by the desire to achieve or maintain the various conditions upon which basic satisfactions reside [25]. The degree of satisfaction is goal specific, and the underlying assumption as it pertains to education is that as one changes the goal from bachelors to masters, and ultimately a doctorate, needs are being progressively satisfied from lower levels to higher levels. However, at the micro level for example, while pursuing a bachelor's program, students do not strive to satisfy a need for a lower mark in a course, and then work towards a higher mark in subsequent examinations. At all times high achieving students strive towards the highest achievement level. As a result, [25] theory might not be sufficient to explain possible changes in student motivation which occurs during a program of study.

Others [26] claimed instead that motivation is driven by an innate need to achieve. This concept is supported by the Achievement Goal Theory which provides a framework for understanding students' goals and motivation by highlighting various purposes or reasons and standards of evaluation that a student might have for pursuing particular academic tasks [27]. This theory, however, can elucidate student choices related to persistence in engineering, problem-solving, and the value of tasks encountered in an engineering environment [16]. Goal setting may encourage merely focusing on an outcome without openness to exploration, growth or understanding, and thus inhibits implicit learning [28]. This theory supports the time-varying nature of motivation; however, it has its limitations when goals are unmet. As found by [29] people with unmet goals were more likely to engage in unethical behaviour than people attempting to do their best.

The Reinforcement and Cognitive Evaluation Theories have been two of the key theories within the mainstream of the motivation field [22]. The Reinforcement theory emphasises the relationship between behaviour and its consequences. Cognitive Evaluation theory which builds on the work of [30] expectancy-valence theory of motivation, suggests two motivational subsystems; intrinsic based on situational variables, i.e., when the person feels competent and self-determined. As such, intrinsic motivation would occur when an individual is moved to perform a task due to it being implicitly enjoyable. In contrast, extrinsic motivation is fuelled by external forces such as rewards and recognition and presents itself as a means to an end [31]. Extrinsic motivation is, therefore, the propensity to take part in activities because of the reasons, which do not link to the individual. Traditionally, intrinsic and extrinsic motivational factors have been viewed as mutually exclusive [32]. Both these constructs of intrinsic and extrinsic significantly affect the cognition, learning and hence, there has been unified conclusion that both motivate an individual [22]. However, [4] findings bring to focus the importance of intrinsic factors (i.e., 'Individual attitudes and expectations') towards the achievement of higher performance, which also relates to self-confidence and learning approaches. The extrinsic factors (i.e., 'pulling forces', 'group pressure' and 'learning approach') were shown by [4] to have some motivating effect on students. The simple dichotomy between intrinsic and extrinsic motivation widens the gap in their understanding [33], as there is a focus on one or the other. That is, either on promoting intrinsic motivation through participation and empowerment while minimising the use of extrinsic factors or on using rewards and other extrinsic contingencies to maximise extrinsic motivation while ignoring the importance of intrinsic motivation. Within this context, intrinsic motivation has been linked to adaptive learning and high academic achievement while extrinsic motivation has been correlated to negative emotions, maladaptive coping strategies and poor academic achievement [34]. However, overall, intrinsic motivation has been reported as being more important towards student's educational success because it often leads to genuine and enduring learning and the application of deep learning approaches and study styles associated with academic performance [3]. These arguments lead to the hypotheses:

> *Intrinsic motivational factors are more prevalent than extrinsic motivational factors in civil engineering students with high academic performance levels. (Ho1)*

Research has revealed that motivation since it is based on cognitive processes, can change with time [35]. It is working towards a constant goal, which has both intrinsic and extrinsic value, which causes intrinsic motivation to decrease over time [35]. That is, within the educational contexts where all activities lead to achieving the external rewards of grades and certificates of accomplishments intrinsic motivation should automatically diminish. The trend emerging from studies done on changing motivation is that high quality and quantity motivation decrease while low quantity and poor quality motivation increase as time passes [34, 36]. The quality of motivation identifies both productive and counterproductive behaviours and creates a snapshot of an individual's effectiveness and efficiency towards motivational regulation strategies used while the quantity of motivation addresses the extent of motivational regulation strategies used [37]. These arguments lead to the hypotheses:

The mean scores of students on intrinsic and extrinsic motivational factors are different between each cohorts pursuing the degree. (Ho2)

Differences in low and high achieving students are closely linked to an individual's level of self-regulation [21]. Self-regulation refers to the degree to which students are metacognitively, motivationally, and behaviorally active participants in their learning process [38]. Academic self-regulation according to [39] and [40], involves students who are independent, self-initiated learners with the ability to use a variety of learning strategies (e.g., organising, transforming, note taking) to accomplish specific learning goals. Hence, self-set goals are often more desirable than assigned goals because they automatically engender a higher-level of commitment [4]. Therefore, self-efficacy or personal goals are the most important in determining performance and are found to be correlated with intrinsic motivation [41]. Many share this belief. However, [42] have concluded that self-efficacy is a context-specific construct and rather than generalised performance it addresses student beliefs in their ability to master tasks. Some researchers [43, and 44] believed otherwise and noted that self-efficacy plays a vital role in academic performance, including predicting academic achievement. It is likely that people with a high level of self-efficacy are more prone to set high goals and inevitably perform well [4]. Both self-regulation and self-efficacy are sub-factors of intrinsic motivation as they are related to an individual's cognition. They, therefore, go beyond being key components of motivational construct that influences students' academic task choices [45], but they are significant factors contributing to high academic success.

2.1 Factors affecting motivation

Using cognitive theory to access undergraduate students in Taiwan, [22] concludes that 'individual attitudes and expectation', 'clear direction' and 'reward and recognition' are the most important motivational factors. This finding suggests that effective learning is determined by both intrinsic factors and environmental (extrinsic) factors. For postgraduate students, it was concluded that 'individual attitude and expectation' towards learning created a stronger motivational effect, therefore exhibiting more self-confidence, as they show higher levels of motivation towards learning. In addition, it has been found by [4] that in general the extrinsic factors (i.e., 'pulling forces', 'group pressure' and 'learning approach') may usually have some motivating effect while the intrinsic factors (i.e., 'Individual attitudes and expectations') are dominating.

Motivation in students before the start of an engineering undergraduate degree can also affect the extent of motivation during the degree and henceforth, academic performance. An assessment of Portugal students by [2] sought to correlate the relationship between academic successes in engineering studies and the initial motivational factors present at the time of choosing engineering as a career. All students who mentioned their interest in engineering as the most relevant criterion for their choice of study program seemed to show a more consistently good academic performance [2], hence suggesting that career interest might be a possible indicator for academic success, working as motivational gain as a drive for investment.

A study conducted by [1] in Russia determined that the primary motivational factors present in a particular year of study be related to the cognitive character of the student at that particular stage/level of study. In this study, the motivation of a student pursuing a technical speciality is linked with interests in the professional content of the disciplines and personal feelings and urges about such content [1]. The study concluded that motivation varies throughout an engineering degree, which the previous studies mentioned did not assess. The findings indicated motivation in the first year is in striving towards a rational understanding and professional thinking as compared to the second year, where motivation is in striving to complete rational pictures of the world. Within the third and fourth years of study, motivational factors emerging are self-actualisation and self-realisation respectively.

The importance of demographics on perception to motivation has been established by [46]. With the growing number of female students in engineering, it is critical to examine any gender differences which may exist in student's motivation [47]. In a Danish study by [5], which compared gender and motivation in engineering, intrinsic motivation was found to be a most crucial factor for both female and male students. This study further indicated that in both female and male students, an overlap between their values and the values in engineering education is expected. A comparison of gender and motivation in engineering by [5], revealed intrinsic motivation to be most important for men, while mentors influenced women. They further indicated that in both sexes an overlap between their values and the values in engineering education is expected to play a role. A better understanding of the relationship between demographics and motivators should allow lecturers to motivate students individually rather than using a blanket approach. These arguments lead to the hypotheses:

The mean score for intrinsic and extrinsic motivational factors are different between the explored student's demographic groups. (Ho3)

Whether the motivation is determined before, during, or after the course of study, the literature suggest that intrinsic motivation is a predominant motivational factor present for students learning. Hence, it is the intrinsic motivation of students towards their education that often leads to the genuine and enduring learning and the deep learning approaches and study styles associated with academic success [3]. However, there is no conclusive evidence on motivators towards the high performance of engineering students. The review highlights that some theories of motivation are underlined by the assumption that as time progresses motivation changes from one state to another. Whether or not this is universally applicable within a degree program is still a question which remains unanswered, particularly, with respect to the cognitive theory. The unexplored views emerging from the literature on this changing nature of motivation will, therefore, form the basis for works presented in this paper. The discussed works are limited as most do not link motivational factors to levels of academic performance (specifically grade point averages 'GPA').

3. Method

This study uses a cross-sectional (cohort 1, cohort 2, and cohort 3) design to evaluate the motivation profile of students in a three-year civil engineering BSc program.

3.1 Questionnaire design

The questionnaire used in this study was adopted from the work of [3–5] and [22], this approach increased the criterion validity of the questionnaire used. See Table 1. Comments on the draft questionnaire by two (2) lecturers and three (3) current students within the Civil and Environmental Engineering Department were used to remove ambiguity from and to increase validity in the final survey instrument.

The final questionnaire comprised of two sections. The first is related to academic year of study, gender, country of origin, and GPA range. The second section consists of nine questions seeking to determine why the students chose engineering; and twenty-two (22) motivational attributes. Similar to a study carried out by [5] and [48], a 1–5 scale scoring system was developed. On this scale, 1 represented a strong disagreement and 5 a strong agreement. Cronbach alpha measures the inter-item correlation of scale items. The reliability of the instrument was tested using a measure of 0.7 for Cronbach alpha. The high value of alpha (α = 0.786) attained suggests a high level of data consistency [22, 48].

3.2 Participants and data collection

This study is exempted from the University ethical review board because the researcher's private data, field notes and published materials from the interview are so encoded that there is no likelihood that the identity of the human subjects will be revealed and because no harm or distress is being experienced by the participants. The students were made aware of the purpose of the study and that declining to participating would not adversely affect their marks. If there were concerns outside the purview of the student researcher who administered the survey, the contact of the principal researchers was provided.

A pilot study on the final questionnaire was carried out during Semester 2. The students were contacted during their class time to secure a high response rate and were invited to participate in the survey on a voluntary basis. A total of 148 civil engineering students from a total program size of 170 responded to the survey; 56 from Year 1, 46 from Year 2 and 46 from Year 3. After the removal of all unsuitable variables from the analysis, a case to the number of variables ratio of 10.5:1 guarantee a reliable factor analysis [49] as it exceeded the minimum of 5:1 ratio specified by [50].

3.3 Statistical analysis

3.3.1 Identification of positive motivational variables

The mean response on the (1–5) point scale was determined for each variable. It was assumed that a mean value above 3 was positively motivating. Variables not having a positive effect ($\mu < 3$) were removed from further analyses.

3.3.2 Validation of the motivational constructs by factor analysis

Factor analysis is used to validate and group the motivating variables. In this analysis, the correlation matrix was examined to ensure all variables had a correlation of at least 0.3 as specified by [51]. To justify the measure of sample adequacy for the individual variables, the diagonal of the anti-imaging correlation matrix was reviewed to ensure all values were higher than 0.5, supporting their retention in the analysis [52]. To determine sample adequacy for a group of variables, it was ensured that a Kaiser Meyer Olkin (KMO) value higher than 0.5 existed. A KMO of 0.803 was obtained, which indicated that the pattern of correlation obtained

Table 1. Motivational factors assessed

Category	Questions	a - Law and Chuah (2009)	b - Huang et al. (2009)	c - Kolmos et al. (2013)	d - Alpay et al. (2008)
Why did you choose Engineering?					
intrinsic	I am interested in the field of engineering				
extrinsic	I want to get a good job and/or make money				
intrinsic	I want to be able to design and build things				
extrinsic	This program has a good reputation				
extrinsic	Family/teachers/careers adviser recommended this program				
extrinsic	I want to be like my mother or father				
extrinsic	All my friends chose engineering				
intrinsic	I enjoy learning about new things				
Intrinsic	I want to further my education				
What do you think is driving your desire to complete your degree?					
Reward and Recognition	Studying, learning and achieving something makes my parents/family proud	*		*	*
Clear direction	I am keen to learn about new aspects of my subject and to explore new ideas	*	*		*
Reward and Recognition	Completing this degree will help me get a good, well-paying and respectable job	*		*	*
Clear direction	I get satisfaction from meeting intellectual challenges and pushing my limits	*	*		*
Clear direction	Studying, understanding and learning increases my knowledge and makes me feel accomplished	*	*		*
Punishment	I don't want to disappoint my family for fear of the consequences	*			*
Social or Group Motivation	I enjoy working with my study group/friends and they encourage me	*		*	*
individual aspirations/ goals	I want to be the top student	*	*	*	*
Punishment	I want to do well to avoid mistakes (Losing scholarship, sponsorship, failing etc.)	*			*
individual attitude	I want to accomplish my own learning goals	*	*	*	*
Punishment	If I don't do well I will be humiliated	*			
Social or Group Motivation	All my friends are doing well so I need to do well also	*		*	*
individual aspirations/ goals	I want to make a difference or contribution to engineering in the world	*	*	*	*
Group or Social Pressure/ Competition	I want to outperform my classmates and friends	*		*	*
Individual aspirations/ goals	I want to get good grades and graduate with high honours	*	*	*	*
Reward and Recognition	I just want to get a degree at the end of the day	*			*
Parental or Mentor	I want to be like my mother or father			*	
individual attitude	I don't want to let myself down	*	*	*	*
individual attitude	I want to prove something to myself	*	*	*	*
individual aspirations/ goals	I believe that what I am learning now will be beneficial to my future job	*	*	*	*
Parental or Mentor	The lecturers are informative, encouraging and good role models			*	
Parental or Mentor	My parents/guardians/family encourage me			*	

was relatively compact and hence factor analysis should give distinct and reliable results [52]. For the Barlett's test of sphericity, a significance value of 0.000 was obtained therefore indicating that the correlation matrix is not an identity matrix. These values are sufficient to justify the applicability of the Factor Analysis method to the sample [53].

Principal component analysis is a least-squares method, and outliers can severely influence the model [54]. The lower bound and upper bound of the factor scores were determined with a modification of 2.2 as suggest by [55], and factor analysis was repeated excluding the outliers. Subsequently, through the examination of the communality matrix, the removal of the outliers did not affect the final solution, and hence all results were retained

for further analysis. The screed plot, which is a plot of the eigenvalue on a bi-coordinate plane, was inspected to confirm the number of factors to be included [56].

3.3.3 Independent sample T-Test and ANOVA

Independent sample T-tests were used to compare the positive motivating factor groups, obtained from the Factor Analysis, with gender [Male and Female]; and country of origin [Local (Trinidad and Tobago Students) and Foreign (Other Caribbean countries including International students)]. The null hypothesis that the means for the groups equal, versus the alternative hypothesis that the means were not equal (2-tail) or that the mean for one of the groups is larger than the mean for the other group (1-tail) was tested. The null hypothesis was rejected if $p \leq 0.05$. If $p > 0.05$ there is not enough evidence to conclude that the means are the same for the groups.

Similarly, for a group containing more than two categories one-way ANOVA's was used to compare the motivating factor with academic level (Year 1 vs Year 2 vs Year 3) age ($\leq$18, 19–20, 21–22, 23–24, >24), and academic performance (High GPA $\geq$ 3.0, Intermediate GPA 1.50–2.99, and Low GPA $\leq$ 1.49). Academic performance was also compared with Gender and Country of Origin.

4. Results and discussion

4.1 Current motivation

Respondents' demographic data are shown in Table 2. The majority of students were from Trinidad and Tobago 64.2%, whereas 35.8% were foreign students. Motivation in students prior to the start of an engineering undergraduate degree can also affect the extent of motivation during the course of the degree and might be a possible indicator of academic performance [2]. Fig. 1 identifies the reasons why students choose engineering.

When the students were asked what they thought were currently driving their desire to complete their degree? the highest rated responses both with means

Table 2. Demographic details of respondents

Age	**%**	**Academic Level**	**%**	**Country**	**%**
<=18	3.4	Year 1	37.8	Trinidad	64.2
19–20	43.2	Year 2	31.1	International*	35.8
21–22	34.5	Year 3	31.1		
23–24	7.4	**Gender**	**%**	**GPA**	**%**
>24	11.5	Male	64.2	GPA > 3.0	27.6
Responses	**148**	Female	35.8	GPA < 3.0	72.4

* Barbados, Jamaica, St. Lucia, Grenada, St. Vincent, Dominica, St. Kitts, Belize, Nigeria, Kenya, and India.

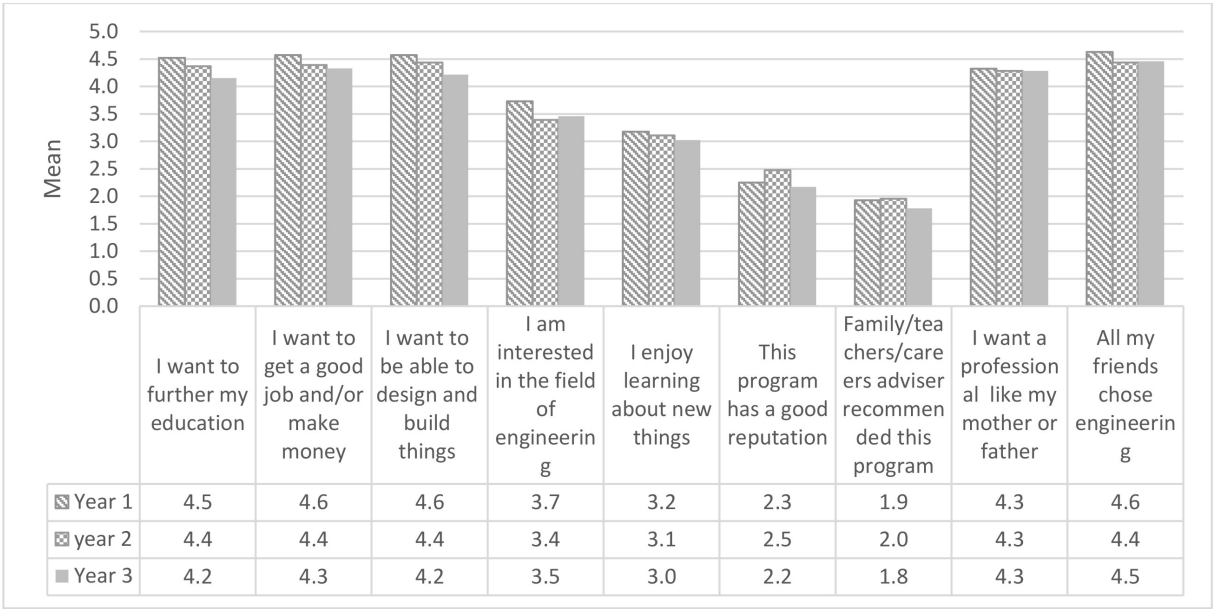

Fig. 1. Why students choose engineering.

of 4.32 were the two intrinsic variables:—Clear Direction (Studying, understanding and learning increases my knowledge and makes me feel accomplished) and Individual Attitude (I don't want to let myself down). Attitude is regarded as the intensity of negative or positive effect for or against a psychological object [57]. Affective dispositions are powerful predictors of students' subsequent behaviour [58]. It has been shown that there is a positive relationship between students' attitudes towards learning and their academic achievement [59]. Students who have negative attitudes towards educational activities are found to exhibit challenging behaviour including anti-social and off-task behaviour [60].

Table 3 shows the means response for all the positive motivational variables in descending order. It is also important to note that all the amotivating factors ($\alpha < 3$) are all extrinsic. Since motivation and encouragement from lecturers was seen as amotivational, faculty members wishing to motivate their classes should challenge the students to appeal to their urge to succeed and to prove something to themselves, provide connections to real-world applications for those students motivated by the useable content of the course, and increase compassion toward students which could inevitably change their attitude towards lecturers.

4.2 Positive motivational variables

It is imperative to determine what variables are currently motivating students; because it is either one or a combination of these positive motivating variables which will inevitably encourage students to learn and succeed academically. It is believed that some degree of intrinsic motivation is prevalent in all students because it is an individual's own decision, will or acceptance to understand, learn or retain information, as knowledge cannot be forced upon an individual. This explanation could be the reason why the intrinsic motivational variables were found to be most important to the engineering students. The subgroup of intrinsic motivation found to be highly motivating was the individual's self-attitude, and one's clear direction or understanding of what one wants to accomplish. Extrinsic variable categorised as reward or recognition was the third most important, as it is expected that most people want to get a good job to be able to support themselves financially. It is important to note that all the variables thought to not contribute towards learning motivation were extrinsic. It is the involvement of parents and their interaction with students which draws the importance of parental motivation to student's performance [61]. Simply striving to be like one's parent was the motivational variable with the lowest rating. This rating possibly indicates that most of the students currently pursuing civil or environmental engineering do not have parents within the field of engineering. Nonetheless, parental encouragement was the 4th most important positive motivational variable, as parents would want their children to explore a field or career into which they perceived to be rewarding. Parental involvement through encouragement benefits students learning and academic success [62]. This is because parental involvement affects attendance, sense of well-being, student attitude, educational

Table 3. Motivational variables and their perceived importance

Positive Variable	**Mean Response**
Studying, understanding and learning increases my knowledge and makes me feel accomplished	4.32
I don't want to let myself down	4.32
Completing this degree will help me get a good, well-paying and respectable job	4.25
I am keen to learn about new aspects of my subject and to explore new ideas	4.24
My parents/guardians/family encourage me	4.23
I want to accomplish my own learning goals	4.21
I want to get good grades and graduate with high honours	4.20
Studying, learning and achieving something makes my parents/family proud	4.18
I want to make a difference or contribution to engineering in the world	4.17
I get satisfaction from meeting intellectual challenges and pushing my limits	4.10
I believe that what I am learning now will be beneficial to my future job	4.05
I want to prove something to myself	3.99
I don't want to disappoint my family	3.95
I want to do well to avoid mistakes (Losing scholarship, sponsorship, failing etc.)	3.78
I enjoy working with my study group/friends and they encourage me	3.55
I want to be the top student	3.30
I just want to get a degree at the end of the day	3.23
Amotivational Variable	**Mean Response**
The lecturers are informative, encouraging and good role models	2.95
All my friends are doing well so I need to do well also	2.91
If I don't do well I will be humiliated	2.91
I want to outperform my classmates and friends	2.79
I want to be like my mother or father	2.44

Table 4. Factor Analysis—(Verimax Rotated Component Matrix)

	Principal Component				
Variables	**1**	**2**	**3**	**4**	**5**
I get satisfaction from meeting intellectual challenges and pushing my limits	0.797				
Studying, understanding and learning increases my knowledge and makes me feel accomplished	0.787				
I am keen to learn about new aspects of my subject and to explore new ideas	0.691				
I want to make a difference or contribution to engineering in the world	0.659				
I want to be the top student		0.803			
I want to get good grades and graduate with high honours		0.746			
I want to do well to avoid mistakes (losing scholarship, sponsorship, failing etc.		0.705			
My parents/guardians/family encourage me			0.747		
Studying, learning and achieving something makes my parents/family proud			0.738		
I don't want to disappoint my family			0.611		
Completing this degree will help me to get a good, well-paying and respectable job				0.770	
I believe that what I am learning will now be beneficial to my future job				0.677	
I just want to get a degree at the end of the day					0.755
I enjoy working with my study group/ friends and they encourage me					0.718

aspirations, homework readiness, time spent on homework, favourable attitudes toward school and grades [62].

4.3 Factor analysis grouping

The five confirmed factors containing an Eigenvalue greater than 1, accounted for 66.5% of the variance in the solution, satisfying [63] criteria. Table 4 illustrates the derived solution from the factor analysis.

Factor 1 ''Personal Motivation' comprised of four (4) contributory intrinsic motivational variables. This intrinsic factor included variables supporting an individual's clear understanding of his aspirations, satisfaction, accomplishments and also personal feelings towards making a valuable contribution to engineering.

Factor 2 'Perfectionist Motivation', categorised by three (3) extrinsic motivation variables. These variables indicate an individual's desire to be the best, on top or to be idolised. This type of motivation falls under the heading of reward or recognition motivation. This motivation encompasses variables including an individual's desire to be the top student and to get good grades or graduate with high honours. Another extrinsic motivational subgroup called 'punishment motivation' includes the variable doing well to avoid mistakes. This punishment variable provides support to the perfectionist title, as it is evident that a perfectionist would do everything he could to avoid making errors, which inevitably involves negative consequences.

Factor 3, also a group of extrinsic factors, is titled 'Parental or Family motivation'. Under this factor, there is a direct encouragement by parents/family, recognition or kudos from parents/family towards the student's achievements and also student motivation to avoid parental/family disappointment and inevitably motivation of the student is centred around and driven by the family.

Factor 4 contains two (2) variables grouped into Job/Career Motivation. This extrinsic factor includes the variable indicating 'motivation to succeed and learn to obtain a well-paying and/or respectable job', which is categorised by the subgroup of extrinsic motivation called reward and recognition. The other variable in Factor 4 displays motivation to a job/career by indicating the perceived importance of learning and understanding as it will be beneficial and applicable to a future job, which is classified as motivation due to a future reward.

Factor 5 called 'Social Acceptance Motivation' is also an extrinsic factor. The variable stating 'I just want to get a degree at the end of the day' does not specify the class of degree (as previous variables did) but indicates that any class of degree will suffice. This variable can be associated with the fact that in modern society, being educated at the tertiary level is becoming the norm and especially in Trinidad and Tobago due to the increase in government assistance which provides free tertiary education to citizens. This universal tertiary education programme, Government Assisted Tertiary Education (GATE), resulted in employers recruiting individuals with minimum tertiary level education. Without this level of education, the 'eligibility' to be part of society therefore significantly decreases. The other variable indicates the enjoyment of encouragement due to friends or a study group. This variable demonstrates the need to be accepted by a group of people to be motivated and shows the importance of social acceptance toward motivation.

4.4 Motivational factors and academic performance (GPA Levels)

To determine which motivational factors produce high levels of academic success within students, a one-way ANOVA was carried out and concluded

that Factor 5 'Social Acceptance Motivation' was the only motivational factor in which there was a difference in average response towards the extent of motivation between students' with various GPA performance levels (P = 0.047). LSD Post HOC tests showed that there was statistical significance (p = 0.014) between the average response of students performing at a high GPA and students performing at a low GPA. The LSD Post HOC test also showed differences between students performing at a low GPA and those performing at an intermediate GPA with respect to motivational Factor 5 (p = 0.024). This finding means that respondents within the three GPA levels (1 = Low GPA < 1.49, 2 = Intermediate GPA 1.50–2.99, 3 = High GPA 3.00–4.20) did not equally agree to the extent of motivation by Social Acceptance. This difference between high performing students and low performing students could be because students who tend to excel academically are usually individuals who enjoy studying and working on their own to fully understand and further their knowledge without the influence or possible distractions which may result from a group or friends. Additionally, in their determination for academic success, high achieving students would not accept just a degree, but a degree of a high quality. This discourse could lead to the reason why the mean for low GPA students was greater than that for high GPA students. With regards to the intermediate GPA and the low GPA students, the same explanation could be feasible. However, to a greater extent, the low GPA students would agree to motivation by this factor. This explanation is substantiated by the value of the means difference. Between high and low GPA students the mean difference was 0.9138 and between intermediate and low GPA students the mean difference was 0.7888, which means that low GPA students agree to motivation by factor 5 to a greater extent than intermediate and high GPA students.

4.5 Motivational factors and academic level

A comparison of the three academic year groups on the motivation factors using homogeneity of variances and the ANOVA indicates significance for Factor 2 'Perfectionist Motivation' (p = 0.00) and Factor 4 'Job/Career Motivation' (p = 0.007). This finding means that null hypothesis is rejected and that there is sufficient evidence to claim that the extent of motivation by Factor 2 and 4 differs among academic levels. LSD Post Hoc tests to determine reasons for the observed significant values indicate that for Factor 2 'Perfectionism Motivation' there was statistical significance (p = 0.00) between Level 1 and Level 3 students; also between level 2 and level 3 students (p = 0.001). For Factor 4, there is a statistical significance (p = 0.028) between level 1 and level 2 students.

Motivation changes through the course of one's study [1]. This study was neither continuous nor progressive, however, it assessed the current motivation of various students at their respective levels. It is understandable as a new student first enters university, especially straight after the completion of a secondary education program his/her main aim is to learn and to try to be the best, mostly unaware of the challenges that lie ahead. As a student progresses through his academic career, the workload and expectations become more burdensome, and many students lose their inner drive of perfectionism, and their focus leans ultimately to the completion of their degree. This validates why the mean difference between level 3 and level 1 (0.827) is greater than the mean difference between level 3 and level 2 (0.669), simply because most level 2 and even more level 3 students have lost their drive to be the best (with the exception of the few) as compared with new year 1 students.

Differences observed between level 1 and level 2 students on Factor 4—Job/Career Motivation possibly originates because level 2 students are closer to reaching their goal of completion than level 1 students. At the time the survey was taken Level 2 students are on average one year away from graduating and pursuing their chosen career paths. Both Factors 2 and 4 are extrinsic factors, which imply that external factors contributing to motivation are not the same, and thus motivation changes as a result of a change in the surrounding environment. Intrinsic motivation, on the other hand, showed no significant change, which implies that personal motivation is present at the start of the degree and is carried through until the end.

4.6 Motivational trends

4.6.1 Age

Leven's homogeneity of variance test produced $p \leq 0.022$ for Factor 1 'Personal Motivation', and $p \leq 0.014$ for Factor 4 'Job/Career Motivation' when the motivational factors were compared to the five age group categories. Significance ($p \leq 0.05$) for the ANOVA supported the rejection of the null hypothesis. This result means that there was sufficient statistical evidence to claim that the extent of motivation by Factor 1 and Factor 4 differs among age groups. LSD Post HOC tests indicated there was statistical significance (p = 0.030) between age group '>24' and group '21–22' for Factor 1 and statistical significance (p = 0.015) between group '>24' and group '19–20' for Factor 4. The extent of Personal Motivation differed within the age group

21–22 and >24. This difference could be simply due to maturity. Older or more mature students usually have a specific idea of what they want to accomplish in life as compared to younger students. This sense of direction in older students could lead to a greater agreement of motivation by Factor 1. Regarding differences noted for Factor 4, usually, students older than 24 either are working part-time while completing their undergraduate degree or completing their degree to return to their original job with higher qualifications. Thus, the older students already have an expectation of what impact their current studies will have on their careers as opposed to younger students who are striving to obtain a job. Also, some of the older students being in higher years of study are at a different cognitive level, and as a result, their study mindset would be different. As a student age, the strength of achievement motives (excellence and demonstration of mastery compared to others) and openness to experience decline, and the strength of motives related to promoting positive affect and protecting self-concept increases [64]. Using [64] explanation, older individuals are less threatened by a failure in a course, partly because academic achievement plays a smaller role in their lives, compared with individuals who are in the early part of their development. Therefore, for older students, who are top achievers, higher levels of performance are less likely to be associated with the rewards of grades.

4.6.2 Gender

There was a significant difference between the mean response for males (–0.1311) and females (0.2227) on motivational Factor 1 'Personal Motivation'. The Levene's significant value ($p = 0.65$) supported the assumption of equal variances, the corresponding significance value ($p = 0.041$) from the T-test for equality of means indicated the rejection of the null hypothesis. It was therefore concluded that there is a statistically significant difference between the mean extent of motivation by Factor 1 between male and female students. Women are thought to be more extrinsically motivated than men, as females appear to tend to attribute academic achievement outcomes to external factors more than males do [5]. According to [65], males have a very high estimate of their abilities and attribute their success primarily to ability and effort, but attribute failure as a result of external factors. It is likely that the in/visibility paradox has described by [66] has a major bearing on the motivational gender dynamics operating in engineering school cultures. This culture defines the various ways students interact routinely in the classroom setting: styles of greeting, humour, social circles, topics of conversation etc., which shape who is seen as 'belonging' or not [66]. Engineering school and workplace cultures are gendered, and gendering, in many subtle ways, with the result that women are more likely than men to be marginalised in engineering schools and workplaces [67]. Females face the paradox of needing to fit into to a culture that is in many ways masculine, but at the same time 'not lose their femininity'.

4.6.3 Origin

When compared with the origin of the population a significance value of $P = 0.393$ for the Levene's test for equality of variances was obtained for Factor 3 'Parental/Mentor Motivation'. A resulting significance of $p = 0.026$ for the T-test for equality of means was obtained. It was therefore concluded that there is a statistically significant difference between the mean extent of motivation for Local (mean = –0.1394) and Foreign students (mean = 0.2564) when compared on Factor 3. Parental behaviour is different among different populations, and as parents express different values and behaviours students' motivation is affected differently [68]. Parental involvement in student's education has been linked not only to higher achievement but also to increased academic motivation [61]. Foreign students, being away from their family and home, could receive less direct communication from their family. Most local students live with their families and communication between student and parent or family is easier. Notwithstanding this interaction, students of different cultural background engage in school differently as the educational values of their culture are reinforced by their families [61]. Higher parental expectations coupled with a strong sense of obligation to family and a feeling of duty to excel academically contribute to increased student motivation, particularly for foreign students [69]. To confirm this effect, the GPA was compared for local and foreign students. When comparing GPA categories and origin, a value of $p = 0.01$ was attained for the homogeneity of variance test. Multiple comparisons from LSD Post HOC tests indicate that there is statistical significance ($p = 0.043$) between local and foreign students for the students who are currently performing at High and Intermediate GPA levels. A possible reason for this significance is that foreign students may value their studies and complete their degree in a timely manner than a local student because foreign students are either on a scholarship or paying for their tuition fees, while the university fees for the local students are covered by government funding (GATE). It is understood that maintaining high academic performance is necessary to retain a scholarship. It is of low probability to acquire a low GPA (<1.49) without having failed a course, and failing a course prolongs one's stay at

the university automatically, which ultimately increases tuition fees, accommodation fees and other expenditures which local students usually are not obliged to pay. As [70] explains, the hard logic which is automatic and unconscious, and shaped by evolution provides a continuous assessment of the main problems that a student must resolve to survive or perform exceptionally well: How are things going? Is there a threat or a major opportunity affecting the quality of one's degree? Situations are continually being evaluated cognitively as good or bad, requiring escape or permitting approach. The inherited neural mechanisms that evolved to provide ongoing assessments of threat level have not been turned off [70]. For the average student, real emergencies do not emerge frequently, and most situations do not call for an immediate reaction. However, in the environment in which humans evolved this was far from the case, and students have retained this system from that time. As explained, when it comes to the performance questions mentioned above, the questions are perhaps less urgent for a local than for a foreign student. Therefore, foreign students perform at a certain academic level as a result of their more disciplined character, due to financial constraints, and their innate nature, thus accounting for the significance between students with high and intermediate GPAs. The impact of origin on GPA could be the reason for the lack of significance between gender and GPA, as students' performance is dependent on where they come from rather than their gender.

5. Implications and recommendations

The extrinsic factor 'social acceptance' was the only factor to vary within each GPA category. Social support from peers and teachers can serve as a significant role to improved performance as students are learning to be more self-regulative. Feedback is the most common form of social support. Research indicates that effective feedback includes information about what students need to improve, what they did well [71], and steps they can take to enhance their work [72]. Progress feedback assists students in raising their academic achievement [73] and can promote student motivation [74] and self-regulation. Students who received feedback from their teachers were more likely to be engaged in task and use self-regulated learning strategies to improve their tests scores [71].

Highest-achieving students' analyse situations to identify strategies that work for them, seek new approaches and adapt previously used approaches to learning, monitor their performance, and apply new strategies if they are not satisfied with their performance [75]. It is with these practices in mind that effective systems for helping these high achieving students improve their performance can be built [76]. A lecturer or peer can offer assistance to support self-directed learning. In the process, the student is assisted to master a task or concept that they were incapable of grasping independently, thereby allowing the student to complete much of the task unassisted. Such intervention will build a learning culture as described by [77]. This involvement is important as some high achievers may lack awareness of the full array of learning strategies available to them. By utilising directed discussions to point out alternative strategies that may be more effective lecturers can help students learn and incorporate these skills. For example, a lecturer may ask students to describe how they learned a new concept or accomplished a task, then ask what decisions led to the chosen approach. Continuous iterative practice until the student is comfortable with applying new strategies to his or her learning would help high achievers develop these critical-thinking skills, mainly, through an emphasis on strategies used rather than assignment solutions to questions. It is importance to help students learn what is most important and how this importance is measured [76]. Understanding why design class is relevant to their professional future, for instance, helps students motivate themselves to not only "work harder" but to explore and apply new learning strategies to attain competence in that class. In the design of civil engineering programs courses should be encouraged which fosters collaboration between students, industry mentors, and lecturers such that students are guided to help define their goals, monitor their progress and build skills that will help the students achieve. Encouraging self-monitoring and self-teaching to foster achievement and independence in high-achieving students are frequently mentioned in the literature [76, 78]. Additionally, professors teaching upper level or more demanding courses should use different context-specific methods to instil a positive sense of efficacy in their students to enhance personal motivation, since personal motivation was the most potent motivational factor and the lecturers were considered to be amotivators. Lecturers of introductory-level classes can provide first-year students with other successful peer role models to enhance their personal beliefs to excel in their courses and enhance their job/career and perfectionist motivation. Further improvements can be made by using a wide variety of student work, illustrations, "scripts," and a complete assessment interview to demonstrate and evaluate other students' use of strategies. These examples of past projects, allows current students to observe their peers' successes

and encourages them to see that they too can succeed.

6. Conclusions

Students at the acceptance threshold have the ability and sufficient academic background to begin pursuing and completing an undergraduate engineering degree within the requisite time. When capability cannot differentiate high-achieving students from low-achieving ones, the literature suggests motivation can provide the basis for unaccounted success. As such, this study arose from the questions of what motivational factor(s) encourages students to do well, whether these factor(s) were different among years of study, and can demographics explain any differences which may occur? The cognitive theory was used as the basis for the identification of positive motivational variables. A cross-sectional study design, from years one to three, was used to evaluate student motivation in a BSc Civil Engineering program. Findings revealed intrinsic variables were the main motivators. Since, autonomy, choice, and control foster intrinsic motivation, instructions and assessments should be designed with this in mind, and also considering the extent to which these are afforded to students.

Factor analysis produced five motivational factors contributing towards learning in students at all academic levels; these are personal, perfectionist, parental/family, job/carer, and social acceptance. Hence, confirming both intrinsic and extrinsic motivational methods should be used by faculty members in classroom setting.

Motivation before entry into the program was not considered, however, trending analysis using ANOVA and T-Test indicated a difference in perspectives on job and career motivation among the student age ranges, as older students had a greater sense of awareness of their future compared to younger students. Also, differences in personal motivation between male and female students showed that males were more intrinsicly motivated while females rely more on external sources. Additionally, parental/family motivation varied between local and foreign students.

The motivational factors that varied between cohorts were job/career and perfectionist motivation, thus, suggesting that motivation was not the same and was subject to change due to external sources and the cognitive character of the individual progressing through the degree. While this work is cross-sectional, it is likely to infer that the differences noted among the year groups support the continuation of a longitudinal study as a student develops from entry to exiting the programme.

While these differences noted were trending, they did not contribute towards students making the honours roll or not. There was no motivational factor inclusive to students with a high GPA causing them to excel. That is, it is difficult to neatly align student motivation with academic performance, which shows that intrinsic motivation may not be the separator or deciding factor between students with high and low GPA's within the civil department. The extrinsic factor 'social acceptance' was the only factor to vary within each GPA category of students. This finding on social and academic goals has highlighted the importance of considering how the pursuit of multiple goals is coordinated and enacted within the classroom. It is not understood how student's pursuit may be regulated towards multiple goals and the different strategies that may be used to achieve social and academic goals simultaneously. Further work in this area must be encouraged.

Additionally, professors teaching upper level or more demanding courses should use different context-specific methods to instil a positive sense of efficacy in their students to enhance personal motivation, since personal motivation was the strongest motivational factor and the lecturers were considered to be amotivators. The findings from this motivational study can give insights into the development of teaching inventories and perfect the forms and methods of instruction, which can help make adjustments in the teaching and learning process. This would result in a greater understanding of precisely what impulses the students are guided by, what meanings their learning activity affords and finally promoting an increased number of true professionals who can help advance society.

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