

A Study of the Relationship Between Educational Background, Psychological Factors, and Soft Skills Among Bioengineering Students

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Abstract– The aim of this study was to investigate the impact of educational factors on students' psychological factors, including locus of control and need for achievement, as well as their soft skills self-perception. A regression analysis was conducted for each independent variable, and the results showed that there is no correlation between locus of control and the development of soft skills. However, the type of sport students practiced and their residence during university had a significant effect on their need for achievement. Additionally, certain educational factors, such as the type of school attended before college, as well as the student's residence during high school and university, and the type of sport practiced, had a significant impact on students' self-assessment of their soft skills. These findings suggest that understanding the impact of educational factors on students' need for achievement and soft skills could help promote entrepreneurship among students from different educational backgrounds.

Keywords-- educational factors, locus of control, bioengineering students, soft skills, innovative education, entrepreneurship.

I. INTRODUCTION

Higher education institutions provide a structured learning environment that fosters intellectual growth and development. These intellectual competencies prepare students to navigate complex challenges and make informed decisions in their personal and professional lives. In addition to intellectual competencies, higher education institutions focus on equipping students with practical skills that are relevant to the workforce and the evolving needs of society. This includes developing communication skills, teamwork and collaboration abilities, technological literacy, entrepreneurship and other domain-specific skills [1][2],[3]. However, universities and industries have discovered that although students generally have academic proficiency, they often lack essential soft skills that play a significant role in job success [4].

Therefore, studies are needed to seek understanding how educational factors and personality affect students achievement of soft skills. Studies indicate that certain personality traits, such

as the need for achievement and locus of control, have a positive correlation with individuals

entrepreneurship interest and success [2],[3]. Theories such as locus of control and McClelland's motivational theory provide frameworks for understanding their individuals' beliefs, motivations, and behaviors, and how these factors influence achievement, success, and personal fulfillment. Both theories will be described in more detail.

A. Locus of Control

Rotter's locus of control theory is a personality theory that proposes how individuals develop a belief system that influences their behavior. According to this theory, people's belief system is based on their perception of the relationship between their actions and the outcomes of those actions [5]. Control beliefs refer to the subjective representation of one's own abilities to control or modify important facts in life. These beliefs shape the basis for behavior, as they constitute the previous step for planning and executing actions aimed at a goal, while also determining the resulting affective reactions, causing emotional states of pride or shame. Within control beliefs, those related to the location of the domain and those related to the effectiveness of exercising it can be distinguished.

According to this theory, when an individual believes they lack the ability to modify a significant aspect of their environment or predict future events, they may lose the motivation and determination to change other aspects of the environment that are within their control. This can result in ineffective cognitive and behavioral performance, as well as the emergence of signs of helplessness, depression, and hopelessness [6].

This theory focused on the concept of "locus of control," which refers to an individual's perception of the underlying causes of events in their life. It can be classified as either internal or external. People with an internal locus of control believe that they have control over their life outcomes, while those with an external locus of control believe that external factors such as luck, fate, or other people's actions determine their outcomes[7]. Several research has shown that those with an internal locus of control are better students, less dependent, less anxious, better able to cope with different stresses and problems in life, have higher self-efficacy, and exhibit better social adjustment[7].

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B. McClelland's motivational theory

The McClelland motivational theory proposes that human behavior is driven by three basic needs: the need for achievement, the need for affiliation, and the need for power [8]. According to the theory, these needs are learned through socialization and are shaped by early life experiences. Individuals can have varying degrees of each need, and their behavior is often driven by the dominant need. Individuals with a high need for achievement strive for success and challenges, driven by recognition. Is the desire to accomplish difficult tasks and to attain personal goals. Individuals with a high need for achievement are often self-motivated, goal-oriented, and strive for success. Those with a high need for affiliation, desire social interaction and to be liked by others, they are driven by belongingness, is the desire to establish and maintain social relationships. Lastly, individuals with a high need for power seek control and influence over others and are driven by their ability to make an impact. Individuals with a high need for power are often assertive, competitive, and enjoy being in positions of authority. According to the theory, individuals have one dominant motivational need that shapes their behavior and decision-making[9].

Generally, hard skills, also called technical skills, are measurable and are usually taught in schools. While they refer to the knowledge that a person possesses, soft skills are focused on capabilities, and they are not easily measurable. Soft skills are generally categorized into personal attributes, interpersonal skills, problem-solving, and decision-making skills, and they are typically developed through experience. Research has shown that both hard and soft skills are important for job success, and individuals who possess both types of skills tend to perform better [10]. However, developing soft skills is challenging as they are less measurable and vary greatly among individuals based on their personality and background.

As a leading university in Latin America, Tecnológico de Monterrey has the objective of developing human capital, as it acknowledges its vital role in economic growth. Thus, this research aims to identify the key factors that impact the locus of control of college students, intrinsic motivation, and soft skills from an educational perspective, with focus on factors that can be influenced by universities. Personal aspects such as family or religion are excluded from this study, as they are beyond the control of universities.

II. METHODOLOGY

A. Participants and data collection

The study consisted of 40 students who were currently enrolled in a bioengineering course, students were in either bioengineering or food science program at “Tecnológico de Monterrey”. Participants were given a survey that included questions about their backgrounds, such as whether they previously studied in a private or public school, whether they were foreigners in their formative years, whether they have played any sport and what kind of sports, whether they have

work experience and for how long, and whether they have been involved in a cultural activity or any other academic association (Table I).

In addition, participants completed a second survey focused on the Rotter's Locus of control scale [5], and a third survey for McClelland's theory based test from MacKenzie [11], and a soft skills test where students were asked to rank how they feel towards each soft skill (communication, critical thinking, lifelong learning, ethics, teamwork, entrepreneurship, and leadership). The study utilized a questionnaire developed by Ngoo to measure participants' attitudes towards their soft skills [12].

The Rotter's Locus of control scale was graded based on a score of 12 or more points considered as internal. For the McClelland's Motivational test, achievers were selected if the points for achievement were at least 2 points higher than affiliation or power. For the soft skills test, an average of all responses in each skill was calculated, and if the average was more than 3, it was considered as high. For the type of school and residence, if the student had experienced both, then public and foreigners were selected for them.

B. Data Analysis

The data collected from the survey was analyzed using binary logistic regression in Minitab. The dependent variable was the score on Rotter's Locus of control scale, McClelland's Motivational test, and the soft skills test, while the independent variables were the responses to the background questions. The purpose of the analysis was to identify any significant relationships between the independent variables and the soft skills scores.

C. Ethics and limitations

The study was approved by the university's ethics committee, and all participants provided informed consent before completing the survey. Confidentiality was ensured by removing any identifying information from the data. This study was limited by the small sample size of only 40 participants from two programs and one university, which may limit the generalizability of the results. In addition, the survey relied on self-reported data, which may introduce biases or inaccuracies in the results.

III. RESULTS

The aim of this study was to examine whether certain educational factors affect students' locus of control, need of achievement, and soft skills. A regression analysis was performed, using all independent variables together (Table I), and each dependent variable was tested separately. The results are presented in Tables II and III.

Table II displays the results for locus of control, achievers, and the combination of locus of control and achievers. None of the tested educational factors significantly affected locus of control, neither the combination of internal locus of control nor achievers. Specifically, for need of achievement, which is a

motivation factor known to impact entrepreneurship and management success, it was found that the students' residence in university had a significant effect (pvalue < 0.05). Specifically, students who were in their home city were more likely to be achievers than those who were foreigners. In addition, the type of sport practiced by students had an impact on their need of achievement. Those participants who practiced individual sports tended to have achievement as their motivation.

Table III presents the results for all soft skills. Out of 80 possible comparisons, 10 were found to be significant. The following educational factors had a significant effect on soft skills. It was noticed that the student's residence during high school affected their self-assessment in communication skills, with foreigners ranking themselves higher than home city students. In addition, the type of sport practiced by students also impacted their self-assessment in teamwork skills. Those who practiced team sports graded themselves higher than those who practiced individual sports. The type

of school attended by students before college had an impact on their self-assessment in critical thinking skills. Those who attended public schools rated themselves higher than those who attended private schools.

The student's residence during high school also affected their self-assessment in critical thinking skills, with foreigners rating themselves higher than home city students. Cultural activities had a positive impact on lifelong learning skills, with students who participated in cultural activities rating themselves higher in this area. The type of school attended by students before college had an impact on their self-assessment in professional ethics and moral skills, with those who attended public schools rating themselves higher than those who attended private schools. Finally, the student's residence during university had a significant effect on their selfassessment in teamwork skills, with foreigners rating themselves higher than home city students.

TABLE I
INFLUENCING FACTORS (INDEPENDENT VARIABLES) EVALUATED IN THIS STUDY.

<i>(independent variables Influencing factor)</i>		<i>Factor levels</i>
<i>Consideration</i>		
<i>Type of school</i>	Private or public school	Attending a private or public school can potentially increase an individual's sense of control over their education and opportunities. Private schools may have more resources to offer extracurricular activities and programs that promote soft skill development and often have higher academic standards and scholarships that influence in students' motivation to achieve goals. Public schools are typically more structured and regulated by external factors such as state standards, government regulations, and budget constraints, which may lead to a greater external locus of control, as students may feel that their lives are more controlled by external factors. They also tend to be underfunded and understaffed, which can lead to a lack of individualized attention that decreases motivation.
<i>Residence status</i>	Foreign or home cities	Being a foreign student can potentially increase an individual's sense of control over their lives, while also presenting challenges that may require adaptability and resilience. It may also offer opportunities for developing soft skills such as communication, cultural awareness, and empathy, and since usually foreigners leave their home cities seeking for a better education, it can potentially motivate them to succeed academically and professionally.
<i>Non-academic activities enrollment</i>	Sports, culture activities, or clubs	Participating in non-academic activities such as sports, cultural activities, or clubs can potentially increase an individual's sense of control over their personal interests and passions, while also offering opportunities for developing soft skills such as communication, leadership, and problem-solving. These activities can also provide motivation to achieve goals and a sense of purpose or belonging.
<i>Work Experience</i>	Yes or No	Having work experience can potentially increase an individual's sense of control over their career goals and opportunities, while also requiring skills such as communication, teamwork, and adaptability. Work experience can also provide motivation and financial independence.

TABLE II
LOCUS OF CONTROL AND NEED OF ACHIEVEMENT RESPONSES COUNT

Influencing factors	Factor levels	LOC			Achievers			Internal and Achiever		
		Internal	External	α	Yes	No	α	Yes	No	α
Type of School	Private	24	9	0.794	22	11	0.341	16	17	0.996
	Public	4	3		2	5		4	3	
High School	Home city	20	12	0.936	23	9	0.226	15	17	0.131
	Foreign city	8	0		1	7		5	3	
University	Home city	7	6	0.261	12	1	0.018*	7	6	0.349
	Foreign city	21	6		12	15		13	14	
Sports	More than 5 years	8	4	0.156	6	6	0.251	4	8	0.183
	Less than 5 years	20	8		18	10		16	12	
Type of sport	Individual	13	7	0.144	14	6	0.076**	9	11	0.325
	In teams	15	5		10	10		11	9	
Clubs	Yes	18	10	0.115	15	13	0.192	14	14	0.44
	No	10	2		9	3		6	6	
Cultural activities	Yes	15	5	0.92	11	9	0.11	12	8	0.281
	No	13	7		13	7		8	12	
Work experience	Yes	25	11	0.968	24	12	0.192	17	19	0.971
	No	3	1		0	4		3	1	

All results are the total number of participants. a Indicate significance level : * < 0.05 and ** < 0.1.

TABLE III
SOFT SKILLS RESPONSES COUNT

Influencing factor	Factor levels	Communication			Critical Thinking			Entrepreneurship			Ethics and moral		
		High skills	Low skills	α	High skills	Low skills	α	High skills	Low skills	α	High skills	Low skills	α
Type of School	Private	9	24	0.267	10	23	0.031*	5	28	0.965	10	23	0.05*
	Public	2	5		5	2		0	7		6	1	
High School	Home city	7	25	0.096**	10	22	0.081**	3	29	0.489	14	18	0.538
	Foreign city	4	4		5	3		2	6		2	6	
University	Home city	1	12	0.16	5	8	0.95	0	13	0.952	5	8	0.514
	Foreign city	10	17		10	17		5	22		11	16	
Sports	More than 5 years	3	9	0.548	5	7	0.392	2	10	0.672	2	10	0.191
	Less than 5 years	8	20		10	18		3	25		14	14	
Type of sport	Individual	3	17	0.066**	9	11	0.469	3	17	0.784	8	12	0.847
	In teams	8	12		6	14		2	18		8	12	
Clubs	Yes	9	19	0.979	12	16	0.601	4	24	0.798	14	14	0.315
	No	2	10		3	9		1	11		2	10	
Cultural activities	Yes	9	11	0.632	8	12	0.883	4	16	0.568	11	9	0.377
	No	2	18		7	13		1	19		5	15	
Work experience	Yes	10	26	0.184	13	23	0.935	5	31	0.938	15	21	0.971
	No	1	3		2	2		0	4		1	3	

Influencing factor	Factor levels	Leadership			Lifelong learning			Team Work		
		High skills	Low skills	α	High skills	Low skills	α	High skills	Low skills	α
Type of School	Private	14	19	0.957	15	18	0.16	21	12	0.181
	Public	4	3		5	2		5	2	
High School	Home city	13	19	0.959	17	15	0.462	20	12	0.496
	Foreign city	5	3		3	5		6	2	
University	Home city	2	11	0.955	7	6	0.434	5	8	0.1**
	Foreign city	16	11		13	14		21	6	
Sports	More than 5 years	7	5	0.327	7	5	0.111	9	3	0.295
	Less than 5 years	11	17		13	15		17	11	
Type of sport	Individual	10	10	0.318	11	9	0.256	14	6	0.165
	In teams	8	12		9	11		12	8	
Clubs	Yes	16	12	0.132	14	14	0.268	21	7	0.187
	No	2	10		6	6		5	7	
Cultural activities	Yes	12	8	0.96	12	8	0.069**	16	4	0.396
	No	6	14		8	12		10	10	
Work experience	Yes	16	20	0.738	17	19	0.97	24	12	0.165
	No	2	2		3	1		2	2	

All results are the total number of participants. a Indicate significance level : * < 0.05 and ** < 0.1.

IV. DISCUSSION

Numerous articles have investigated the factors that influence locus of control, motivational needs, and soft skills. However, this is the first study that focused on educational factors to promote entrepreneurship in universities.

A. Factors affecting locus of control.

In a study conducted by Serin, various factors such as gender, income level, and residence were examined in relation to locus of control (LOC) [13]. The results indicated that male students had higher levels of internal control ($t= 4.890, p<.001$), students with higher income levels demonstrated greater internal control compared to those with low- and medium-income levels ($F= 5.171, p<.01$), and students residing with their families had higher levels of internal control than those living in dormitories or houses ($F= 8.175, p<.001$). However, the present research suggests that none of the studied factors significantly affected LOC, which could be since most university students have medium to high income levels. It would be interesting to include this factor in the study to determine if the population is restricted.

According to Fejgin, there is a positive correlation between participating in competitive sports and having internal LOC [14]. However, this study analyzed whether the sport was practiced individually or in teams, a factor that has not been previously examined in relation to predicting LOC. In this case, there was no statistically significant relationship between the two. Although work experience has not been compared to locus of control in university students, this study found no relationship between them.

B. Factors affecting need of achievement.

Karaman et al. conducted a study to examine factors affecting local and international students and found that U.S. students reported higher levels of achievement motivation than international students [15]. However, the current study focuses on foreign students, who are from the same country (Mexico) but reside in a foreign city. Thus, any cultural differences that might impact achievement motivation between international and local students should not be relevant. Being a foreign student can have varying effects on motivation depending on the individual. Some may find the challenge of studying in a new environment motivating, while others may struggle to adapt to a new culture and experience decreased motivation. In this case, foreign students were found to have lower levels of achievement motivation, which may be due to the high standards of a prestigious university like Tec de Monterrey, where it may be challenging for some students to meet expectations.

Dunleavy [16] examined the relationship between practicing sports and the need for achievement in American college students and found that a high need for achievement is associated with participation in competitive and individual

sports, which supports the finding of this article that individual sports are linked to a greater need for achievement.

C. Factors affecting soft skills self-perception.

Abdul et al. conducted a study comparing the soft skills of Malaysian university students from private and public schools [17]. They found that students from public schools scored higher in all seven skills, which was attributed to the compulsory activities and non-academic activities that Malaysian students must attend, whereas in private schools, these activities are not mandatory. Syed also conducted a study on this topic and found that students from public schools rated their abilities higher in all seven categories of soft skills compared to those from private schools [18]. However, the results of this article showed that students from public schools rated themselves with high skills in only 2 out of 7 skills. This may be since the population studied is biased, as people who are currently in a private university but were previously in a public school may have received scholarships for excelling in certain skills such as leadership, sports, and intellectual abilities.

There have been no studies on the relationship between foreign students and their development or perception of soft skills, but in this study, foreigners rated their soft skills higher than locals in 2 out of the 7 soft skills. This may be due to the challenges that foreign students face when moving to another country and becoming independent.

Ihsan Sari conducted a study on the relation between soft skills and the type of sports students practice and found that none of the soft skills were significantly affected by the type of sport [19]. However, in this article, there was a significant correlation between students who practiced team sports and perceived higher communication skills. This can be attributed to the fact that communication is fundamental for success when working in teams.

Additionally, Shcheglova reported that being involved in extracurricular activities positively correlates with the development of soft skills [20]. In this case, being involved in cultural activities such as artistic activities influence students' perception of lifelong learning, as they provide ongoing opportunities for individuals to learn and explore new ideas. Many cultural activities, such as attending concerts, museums, or theatre performances, can be enjoyed throughout an individual's lifetime.

Finally, work experience was not found to be significantly correlated with any of the dependent variables in this study, possibly because the participants' work experiences were limited since they are still students.

D. Limitations of the research

The study was conducted on students from a private university, Tecnológico de Monterrey, which limits the population that the findings can be applied to. Students in distinguished private schools have resources that others may

not, so the results can only be generalized to those who attend recognized private universities. The soft skills test used in the study was based on self-evaluation, which may not accurately reflect the students' actual skills. It would be beneficial to have an external evaluation to measure the true impact on soft skills. Due to the small sample size, there is a possibility of response bias, so a larger sample is needed for a more representative sample of the university population, which could help in further developing the model.

V. CONCLUSION

Educational factors, such as the type of school attended before college, as well as the student's residence during high school and university, and the type of sport practiced, had a significant impact on students' self-assessment of their soft skills. Based on the findings, author considered that there are some approaches that universities take to enhance internal locus of control, need for achievement, and high soft skills among their students and consequently enhance their entrepreneurship:

- Encourage participation in competitive and individual sports: Participating in sports can promote internal locus of control and the need for achievement, particularly for those involved in competitive and individual sports. Universities can encourage students to participate in sports and provide opportunities for them to do so.
- Offer cultural activities and extracurricular opportunities: Being involved in cultural activities and extracurricular opportunities can positively influence the development of soft skills, such as communication and lifelong learning. Universities can offer a range of activities and opportunities for students to participate in, such as attending concerts, museums, or theatre performances.
- Provide support for foreign students: Universities can offer support for foreign students to help them adapt to their new environment and overcome any challenges they may face. This can help foreign students maintain high levels of achievement motivation and develop high soft skills, such as adaptability and cross-cultural communication.
- Emphasize the importance of extracurricular activities: Studies suggest that students from public schools tend to score higher in soft skills due to mandatory extracurricular activities.
- Encouraging Collaborative Learning: University administrators and instructors can consider incorporating more collaborative learning activities into the curriculum to promote teamwork and enhance achievement motivation. For instance, group projects, case studies, and problem-based learning activities can provide opportunities for students to work together, share knowledge and skills, and accomplish common goals, which may foster a sense of accountability and motivation to succeed.

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