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THE POTENTIAL BENEFITS OF NURTURING NATURE TO RESOLVE OVEREMPHASIZED STEM EDUCATION IN THE INDIAN EDUCATION SYSTEM

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Abstract

This study investigates STEM education in India in context of the nature-nurture debate. Discussed are the benefits of nurturing unique talents, rather than forcing subject choices and how the Indian education system has produced engineers who, due to societal biases, have been unable to acquire jobs. In an effort to validate the advantage of nurturing unique talents, a survey was conducted and the driving factors for specific professions identified. Three groups were included: high school students, professionals in non-engineering fields, professional engineers or engineering students. Each group was asked questions on their job/major and the role their family played in influencing choices. Results revealed that 90.6% of students had parents who wanted them to pursue STEM subjects for job security and due to societal pressure. Less than 10.7% confirmed that their parents urged them to pursue the Humanities. Of the professional engineers, 73.5% stated their calling didn't lie in engineering and therefore planned on switching fields. Further case studies support that there exists a bias towards STEM education in India and that allowing students to nurture their unique nature might have benefits to both individuals and society.

Keywords
Nature, Nurture, Indian Education, STEM, Job Satisfaction

1. Introduction

The Indian education system is a complex mixture of ancient traditions, religion, political imbalances, and cultural diversity. For many years, rather than following fixed academic curricula, knowledge was passed down from generation to generation, to preserve a particular set of beliefs or style of living. The traditional approach, which was a combination of subjects that dealt with day-to-day rituals, social interactions, and practical skills, had equal weight given to the Sciences, Arts, and Commerce, and multiple skill sets were crucial in times of war and political conquest. It was an all encompassing, holistic system of education that took shape as a learning-for-living pedagogy. Over time, however, India observed a gradual shift from this pedagogy to a more rigid system of curricula that categorised education into specific "streams." The three dominant streams recognised today are Commerce, Science (known as STEM in many parts of the world), and Arts/Humanities. In making the system very rigid by creating specific streams at a high school level, students are required to make decisions based on "futuristic goals" that they might not have any idea of at such a young age. For many students, more exposure and time is required to discover themselves before making crucial academic choices. However, owing to the absence of this time, students inevitably choose the "safer" option that they believe lies in the field of Science. These rapid decisions allow for little time in developing and understanding one's unique nature or innate passions. The rigid classification is of great significance in Indian society as it determines, to a large extent, the kind of career that a student will gravitate towards; and more importantly it labels students at a young age, limiting their intellectual curiosities in the classroom and conditioning them to think rather one dimensionally in many cases--it doesn't allow for a multidisciplinary approach that could be gained from not having to make certain decisions at high school level. The demarcation of streams also pressurises both students and parents in many cases as the requirement to make the "right" decision for the "right" future is imperative, considering that many may come from unstable socio-economic backgrounds where opportunities are scarce and circumstances are not always favourable. Recent research has shown a gravitation, across the country, towards STEM subjects (AICTE, 2014), regardless of interest levels in the stream. This paper sees an urgency in addressing this fact as data gathered from government sources provides evidence for it having a significant impact on the state of the country's "engineers" in particular.

1.1 Impact of the British Rule on the Education System

The British Rule, 1858-1947, had significant consequences on the education system in the country. The current system is heavily based on the methods of teaching established by the British legacy (Chauhan, 2004). The East India Company showed no regard for the ancient philosophical pedagogies that existed prior to their arrival. They even dismissed many regional languages and demanded the use of English—a foreign tongue to the native Indians—for most official purposes. The Company merely cared about getting Indians to carry out trade and administrative tasks as efficiently as possible for them. The overall development of people's natural interests was neglected and as a result, a system that was strongly based on theoretical rote learning developed. Students were encouraged to memorise facts and theories whether or not they made any sense. And since it was compulsory for them to do so in order to get jobs and earn a decent livelihood under the British Rule, they did not really have an opportunity to pursue a passion that was outside the group of subjects considered "important" by the British. By the time the British left the country in 1947, there remained disorganised and restructured education, political, and administrative systems that would take many years for the Indians to put back in order, if at all they could (Brown, 2010). The ancient systems prior to their rule were long forgotten. In a fierce attempt to catch up with the rest of the world and develop the newly established economy, students were encouraged to pursue careers in the Sciences. A strong market for technological advancement developed and becoming an "engineer" was the popular trend. Unfortunately, most of this rapid development took place in the same old system of education left by the British. In fact, most of the technologies India adopted were those that had been used by the British for several years and were now outdated. Even as the number of engineering colleges increased in the country and the number of engineers went up, there were no attempts to come up with new, indigenous technology (Tripathi, 1996). This put India at a disadvantage to other countries like Japan who, following colonialism, immediately started to create their own technologies to facilitate economic and industrial development.

While there were many indigenous reformers over the years, the system today still remains strongly rooted in the framework established by the British. As a consequence, in a somewhat Anglicised system of syllabi, there remain many unexplored areas of academic disciplines. One such reformer, Krishnamurti, strongly disregarded the system of education left by the British (Rajagopal, 1958). He saw no value in rote learning information from a few core subjects and insisted on the need for a more holistic education where every student had the capacity to discover their own passion via interacting with nature. Later, a similar stance was taken by Tagore (2015) who developed an intense dislike of conventional Western education as

it was contradictory to the values and beliefs of Indian cultures and philosophies. These reformers tried to rekindle certain values and methods that took shape in the ancient Indian education system. For the engineering industry especially, developments in areas such as textile manufacturing, chemical engineering, glass manufacturing, and light engineering all used methods and technologies that were left behind by the British (Tripathi, 1996). This fact had an impact on the mentality of creativity and ingeniousness in the field of engineering. It helps explain why they saw a certain sense of urgency in addressing such issues in fields such as engineering; they envisioned a time when STEM education in India, in trying to help the country catch up with other industrial powers as a result of its delayed development in coming up with ingenious techniques in certain fields, would generate a reputation of being "secure for job opportunities" and in turn cause people to neglect their innate interests or passions/natural inclinations for "safer" opportunities. These remarks by some very prominent figures in Indian history also highlight the general attitude towards the education system in the country that prevailed throughout and long after the British Rule. Over the years, reformers like Tagore and Gandhi tried to bring about changes in the system of education (Bhattacharya, 2008). For instance, Tagore's establishment of the Santiniketan schools (Pal, 2016) aimed at revolutionising the education system by fusing the best pedagogies from both Western and ancient Indian systems. Their actions to bring about changes that resonated with the traditional system of education in India prior to the British Rule are indicative of the severe impact British education had on the progress of the country. Lord Macaulay of the British empire wrote in his Minute, "We must at present do our best to form a class of persons, Indian in blood and colour, but English in taste, in opinions, in morals, and in intellect" (Chand, 2007). The British clearly saw much potential in their own pedagogies being used to cater to the "needs" of the Indian colony and envisioned a land that would strongly complement the educational practices of their own. As a result, the holistic approach to learning that prevailed in ancient India was lost to a system that emphasised the need for division of academics in specific disciplines for efficient administration under the British Rule. Today we observe this classification of subjects in a much more organised manner under different syllabi and, and society continues to succumb to its consequences by narrowing the means by which students can be part of an interdisciplinary system that allows them to discover and possibly pursue their unique nature. The education system in this paper and many of the societal biases referred to are direct implications of the altered history that severely impacted India's development of an educational system.

1.2 Current Situation in India

According to a national employability report (Aspiringminds, 2016), around 97% of graduating engineers try and seek jobs in either core or software engineering. Yet, only 3% have adequate skills for employment in the software sector and only 7% have the ability to handle core engineering tasks. A large percentage of students from science and engineering are able to perform well in classroom scenarios, irrespective of their passions or natural inclinations towards the subject. However, they find it challenging when it comes to using these skills obtained from the classroom in a real life scenario. Studies by researchers have revealed that passion can play a huge role in contributing to performance at work (Ho, 2011). This suggests that the absence of *nature* for the skill set could be a limiting factor when it comes to working in a professional environment or even acquiring certain kinds of jobs. Many of these unemployable candidates often find themselves using the Social Sciences and Commerce-related areas as backup fields for pursuing careers. It certainly is ironic that people do not see much scope in the Social Sciences in a country where there are numerous societal problems yet to be solved (Dhupdale, 2014). While many might argue that the answers to the various societal issues lie in Science, it is important to understand that a large portion of India's Scientific market is dominated by multinational companies (Das, 2017). The companies see the Indian economy as one with a lot of potential and cheap labour costs at the same time. While these companies might benefit Indian society by providing job opportunities for the masses and improving the infrastructure in certain areas, the revenue earned and research obtained does not always remain in India to facilitate much progress (Aggarwal, 2000). Moreover, there is no useful purpose in trying to use Scientific progress to help a country without really understanding the various social factors contributing to the societal turmoil; and in view of the topic of this paper, there appears to be no significant benefit in engaging in a field that one has no natural inclination towards. The results of doing so, in many cases, can often manifest as mediocrity and dissatisfaction in that respective field, therefore having no significant impact on the societal areas desperate for improvement. Looking at the population at large, the number of unemployable engineers has been increasing over the years: while 2016 saw 52% of the engineering graduate population incapable of performing skills of a certain level and therefore acquiring jobs, 2017 saw this number go up to over 60% (IUCEE ITF Team, 2017). This data highlights the fact that the problem discussed in this paper (students pursuing STEM education without really having any natural inclination towards it) is one that appears to be adopting greater social relevance as we look ahead into the future with every passing generation of students and therefore requires urgent addressal before its consequences potentially create severe employability issues and various economic drawbacks.

There are also the other obvious concerns arising from the trend of nurturing absent natures that need to be dealt with cautiously. With high levels of competition for places at esteemed universities in the country, there have been several reports of students risking their health--and even attempting suicide--as a result of the growing pressure from parents and academic institutions (Deb et al. 2015, Sharma, 2014), showing a deep sense of urgency in addressing this matter as it is clearly having a severe impact on society.

2. Literature Review

2.1 The Nature-Nurture Debate

The nature-nurture debate sets the stage for discussing whether one's abilities in a particular academic field are determined by genes, the environment, or both. In trying to gather why students choose a particular stream or set of subjects, it is important to understand the degree by which both the social environment and genetic makeup of the individuals influence their decisions. The nature-nurture debate has been going on for several years and research from around the world has revealed that the two are closely intertwined. Angoff (1988) argues that it is of greater importance to question whether intelligence can be "changed" rather than whether it is determined by nature or nurture. He claims that both nature and nurture play an equally important role in contributing towards "intelligence" and that it is pointless to investigate this basic fact any further. In his study about the difference in aptitude levels between "White and Black" social groups, Angoff demonstrates how "aptitude" can be improved over a period of time within each group if certain educational requirements are provided for. From his work, we gather that one of the most efficient ways to observe an individual perform to the best of their abilities is by a combination of recognising certain abilities present at the time of birth (nature) and then nurturing these abilities with the help of certain educational resources. Angoff's work is of significance to this study as it clarifies that *nurturing* an individual's unique *nature* is indeed beneficial to a certain extent when it comes to achieving the maximum potential from one's intelligence or aptitude.

With nature and nurture appearing as overused words with very vague interpretations in certain contexts, many have dug deeper into the subject and tried to examine the definitions and dominance (in certain cases) of each. As for "nature," some have attempted to describe the two main forms that this word adopts in day-to-day conversation. These include talent and gift. Gagne (2004) notes that talent is a branch of giftedness. According to him, "a gift may or may not be present at the time of birth. If the gift is allowed to develop properly under certain conditions, the talent development process, then the gift is expressed as expertise in a particular

field." Similarly, Barbot et al. (2015) make a clear distinction between talent and potential. According to them, potential may be present at the time of birth and talent is the ability to practice and express this potential in different ways. Focusing on specific examples wherein these theories about "talents" or "gifts" could manifest, academic performance of students has been a popular area of research for many scholars. Rimfeld *et al.* (2016) argue that a person's DNA has a major role to play in determining the kind of subjects they pursue and their academic achievement in those respective subjects. While others would like to disagree and believe that academic performance is a result of both genetics and environmental factors that contribute towards determining the success of an individual in a particular subject, and that environmental factors such as hard-work and teaching resources can trump genetic factors, studies such as these have indicated otherwise. In light of this paper, these particular studies are significant in highlighting the fact that pursuing a field that is in sync with one's nature (or genetic makeup) is more likely to yield better results in terms of performance in that respective field.

Apart from education, another key area wherein patterns of nature-nurture influences have been observed is Criminology. Levitt (2013) talks about the roles of nature and nurture in the context of aggressive and antisocial behavior. She claims that genetic factors often trump environmental factors when it comes to determining the actions of criminals. The findings of this research have lead many sociologists to worry about specific cases wherein families coming from poor economic backgrounds, and thus observing trends of crime as a means to obtain financial support, could see the "criminology" trait pass on for generations and eventually manifest in the phenotype of a significant chunk of the population. The implications of this have been extended to examining how this genetically oriented trait could impact educational choices in certain underdeveloped countries. While there has been no proof of the same gene playing a role in both criminology and educational choices, the possibility still remains for the time being.

As discussed in this paper and other related studies, society's inability to recognise a gift at the right point of time and then develop this gift into potential or a visible expertise in a specific field has given multinational organisations a difficult task in selecting the right kind of employees with the right "talent" or "expertise" for a specific job. Dries (2013), talks about the struggle companies face when it comes to finding "talented individuals." In her argument about the 'talent management phenomenon,' she talks about the psychological impacts (under different circumstances) of telling people that they are talented versus telling them nothing at all, and then explores their performance in the company. She tries to explore whether or not non-talented individuals in a particular field display any improvements in performance when they are made to believe they are talented (nurturing a false nature) and whether talented individuals in the same

field perform better than the non-talented individuals even when they are not told anything about their abilities. The results of this study quickly bring about questions on the differences between trying to nurture a set of skills that might not necessarily be a part of a person's "gift" or "talent" and nurturing a set of skills that *are* a constituent of a person's "gift" or "talent." Some of these questions are discussed later on in this paper.

2.2 Indian Education System

With much importance being given to exploring the meaning of giftedness, recent works in India have focused on highlighting the methods of providing a gifted education in order to recognise unique gifts in various individuals. Roy (2017) talks about the Indian government's struggle to provide a suitable education to facilitate the development of the pool of talent that it recognises amongst its citizens, stressing on the need to identify the roles of nature and nurture under various political, economic, and cultural circumstances. Her findings showcase the fact that the Indian Education System could benefit from the emergence of a formula to best guide and allow for the natural development of every individual's unique gifts, and also a change in the traditional mindset that pushes students onto an educational path that is easily catered to by the already existing academic resources.

As discussed earlier, Science education in India has been influenced by several external sources, including the arrival and departure of the British. Joy (2017) explains that STEM education in Indian classrooms adopted different forms during historic, colonial, and post-colonial periods. The Nehruvian project, which aimed at creating a modern, independent India, played a crucial role in paving the way for rapid Scientific research and, as a consequence, significant economic progress. A race began with other economic powers and very soon India found itself ahead of other economic giants like China and Japan. This created a unique mentality--one that made choosing STEM education a need rather than a want. According to Chunawala and Natarajan (2010), parents and teachers play a very crucial role in deciding what kinds of courses students pick at both school and college level. Many students are conditioned to believe that the only way they can help contribute towards the progress of the country is by pursuing Science. As a result of this mentoring from a young age, the number of students wanting to pursue STEM subjects in college increases rapidly. Moreover, the government plays a key role by providing special incentives such as scholarships for those pursuing STEM subjects in particular:

> "Even though the studies indicate that there is no decline in interest in the section of students who wish to pursue science, the government continues to promote science

education through introduction of various beneficial schemes for schools and students and scholarship." (Chunawala and Natarajan, 2010)

These governmental incentives play a vital role in conditioning the minds of the youth by making them believe that the rewards surrounding STEM subjects are a result of their superior role in society to other streams such as the Humanities and Commerce. The findings of Chunawala and Natarajan (2010) are of extreme significance in justifying, to a certain extent, the trends observed in the surveys conducted in this study. They also suggest that the propaganda surrounding STEM education could prove to be a major factor in preventing students from even bothering to discover their unique nature before making decisions about the careers they want to pursue.

2.3 Recent studies in Nature-Nurture

While most people today agree that nature and nurture are strongly interconnected in most concepts, some of the latest research has involved discovering ways whereby certain elements from both nature and nurture can be harnessed by individuals in making day-to-day decisions. Understanding that nature and nurture, although strictly related, can each play a more dominating role than the other, depending on the situation and setting, has become an important agenda for businesses and institutions around the world. Kontoyianni *et al*. (2013) focus on using different "instruments" to identify levels of "mathematical giftedness." They argue that IQ tests are not the most efficient way to measure mathematical ability and therefore, in their study, consider aspects of personality such as persistency, resiliency, and dedication while measuring the performance of their students in various mathematical activities. Advances such as these are proving to be huge in the way employers choose their employees. Liao and Lee (2009) discuss how human behaviour plays a crucial role in maximising organisational success and effectiveness, irrespective of technological development. They focus on pointing out how every personality contributes towards the success or failure of an organisation in a different way. These studies are of significance to this paper as they suggest that better performance results can be observed in a workforce wherein the individuals are committed to their profession not just through their technical skills, but also through their emotions; and if we see the culmination of emotions and technical expertise in achieving a particular task in a particular field, we are likely to consider this a product of *nurtured nature* more than anything else.

Other recent endeavours have involved comparing humans to machines in order to achieve a greater understanding of the relationship between nature and nurture. Meinecke (2013), through comparing natural speech development in human beings to speech development using technology, argues that "innateness" is the "amnestic" part of nurture and that nurture is the

"amnestic" part of nature. Bartelt and Dennis (2014) talk about how both nature and nurture play an equally important role in determining human behaviour with "communication tools." He examines both terms in the context of "genre rules," highlighting how the understanding human beings have of certain online communication tools develops over time.

Going beyond the biological and education-related aspects of nature and nurture, some researchers have explored this topic in the context of policy making. Bang Nes (2015) argues that the understanding of the different ways in which nature and nurture interact could prove to be extremely beneficial in making more informed policy decisions. She examines the influence of behavioural genetic studies on public health care policies and claims that society could benefit to a large extent by placing these behavioural studies in an environmental context, thereby bringing to light the interactions between nature and nurture. These scholars' work about the necessity for understanding of an individual's unique nature before allowing the influences of nurture to interfere and cause other social complications is what needs to be investigated in the community, especially in the context of Indian education system described in the paper.

3. Sample and Instruments

In order to examine whether biases towards Engineering and Science exist at different levels of a person's educational/professional career, three target groups were selected: high school students (aged 15 to 18) in India, professionals in non-engineering fields (aged 24 to 60), and professional engineers/engineering students at college level (aged 19 to 60). Each group received a questionnaire with questions focusing on why they chose to enter a particular academic/professional field, the roles their parents had in influencing their decisions to go into that particular field, their satisfaction with their respective jobs, and whether or not their respective professions/areas of study are something they are truly passionate about. High school students were asked about a "mixed stream," which comprises of subjects from the Sciences, Commerce, and Humanities. The professionals in non-engineering fields and professional engineers/engineering students were not asked about this mixed stream as it a relatively modern feature of only certain international syllabi in India. The aim of this stream is to allow undecided students to have greater options. The total number of people surveyed in the group targeting high school students was 81; for professionals in various fields, it was 105; and for professional engineers/engineering college students, it was 92. As the study aims at specifically exploring the impact of engineering in the Indian education system, each of the three target groups were asked whether or not they had been urged to pursue core engineering subjects, namely Physics,

Chemistry, Biology, and Mathematics, over any other academic disciplines such as the Humanities and Commerce during their school/college years.

Responses were obtained via Typeform, an online questionnaire service. All responses were anonymous for all the groups involved. For the group targeting high school students, the survey was sent to 16 different schools across the city of Bangalore, India, and then to multiple schools in the cities of Mumbai, Delhi, and Chennai. The results were then compared with data from government websites on the number of Engineering, Humanities, and Commerce students in the country. For the group targeting professionals in various fields, the questionnaire was sent out via the same online platform, Typeform, to people in multinational companies, schools and colleges, restaurants, theatrical academies, and different business ventures. Self-employed people were also included. For the group specifically targeting professional engineers and engineering students, the same online platform was again used to reach out to engineers in both local and multinational companies. Some of these multinational companies include the following: Cisco, IBM, Accenture, and Dell.

With regards to the case studies used in this paper, the individuals were interviewed in person and the content shared by them was recorded electronically by the interviewer. The names used in this paper have been changed for the sake of protection of identity.

4. Results

4.1 High School Students

The results from the category targeting high school students revealed that 61.3% of the surveyed students' parents wanted them to pursue STEM subjects over Commerce and the Humanities. The remaining 38.7% were equally distributed between Commerce (12.9%), Humanities (11.5%), and a "mixed" stream (14.3%) involving a combination of Science, Commerce, and the Humanities (see Figure 1). The percentages of students who actually went on to pursue the subjects are as follows: Science (72.3%), Commerce (10.2%), Humanities (5.3%), and Mixed (12.2%). In reply to the objective question on whether they had been urged to pursue STEM subjects over the Humanities and Commerce, 70.8% replied "yes" while 29.2% replied "no." In response to the objective question on why their parents had persuaded them to pursue STEM subjects, 54.7% of the students chose "job security in the future," 39.9% chose "societal pressure/status," and 5.1% chose "lucrative career ahead" (see Figure 2). Apart from objective questions such as these, the questionnaire also included some subjective questions such as, "If you have ever been urged to pursue STEM subjects over any other fields, please put down a few points sharing your experiences." In response to this question, most of the answers included

comments such as: “I was told to take engineering so that I could easily obtain a job”, “Teachers advised me to choose science because I was smart enough and my grades were excellent. They considered humanities to be secondary, in comparison with medicine or engineering”, “One of the elders in my extended family thought pursuing engineering would mean job security and a high societal status. He did not pay any attention to personal interests and passion”, “I was told taking science is a safer option.”

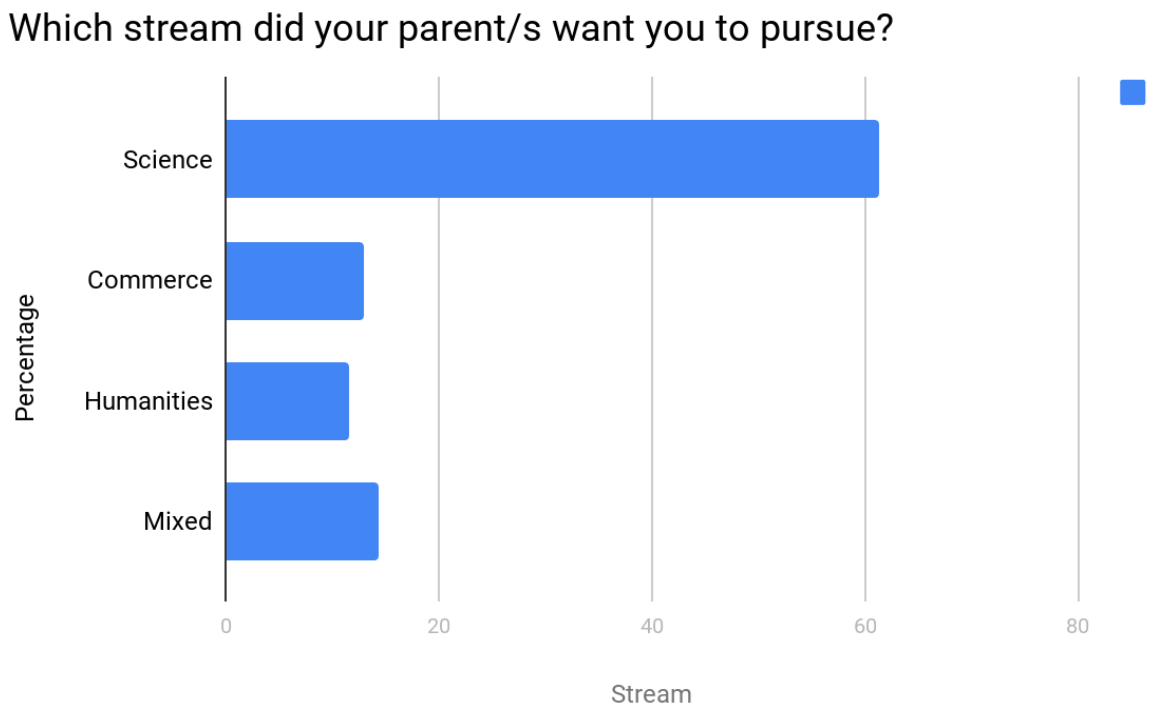

Figure 1: *Parental Preferences in Subject Choices (high school students)*

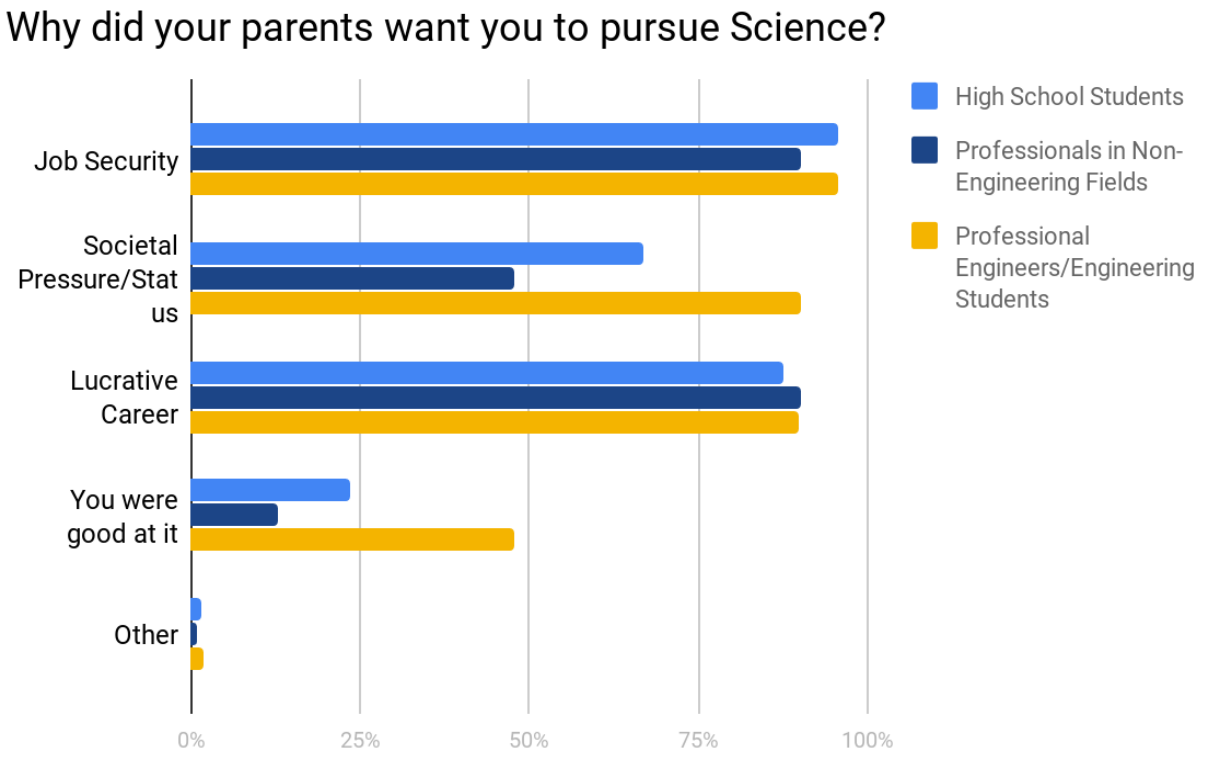

Figure 2: *Reasons for Parental Preferences in Science (from all groups: high school students, professionals in non-engineering fields, and professional engineers)*

4.2 Professionals in Various Non-Engineering Fields

The results from the group targeting professionals in various fields revealed that 63.7% of parents of those surveyed wanted their children to pursue Science in College. However, only 30.5% of these people actually went on to pursue studies in core Sciences in college, while 40% of the remaining pursued Commerce and 20% of the remaining pursued something in the Humanities. In response to the question, "Have you ever been urged to pick Science over another field?," 81% of the people answered "Yes." For the question, "Which field/s were you in before (if you were not always in your current field?," 50.8% of the people chose Science while the remaining 49.2% were equally distributed between Commerce, Humanities, and "other." Following this question, in response to the next question, " Why did you switch fields (if at all)?," 71.3% of the people claimed that they were "not passionate about it" while 15.8% chose "not lucrative enough" and the remaining 12.9% chose "other" reasons. As mentioned earlier, while 63.7% of the people answered that their parents wanted them to pursue Science in college, the whole of the remaining 36.3% answered that their parents wanted them to pursue a degree in Commerce. Interestingly, 0% of the people stated that their parents wanted them to pursue a college degree in the field of Humanities (see Figure 3).

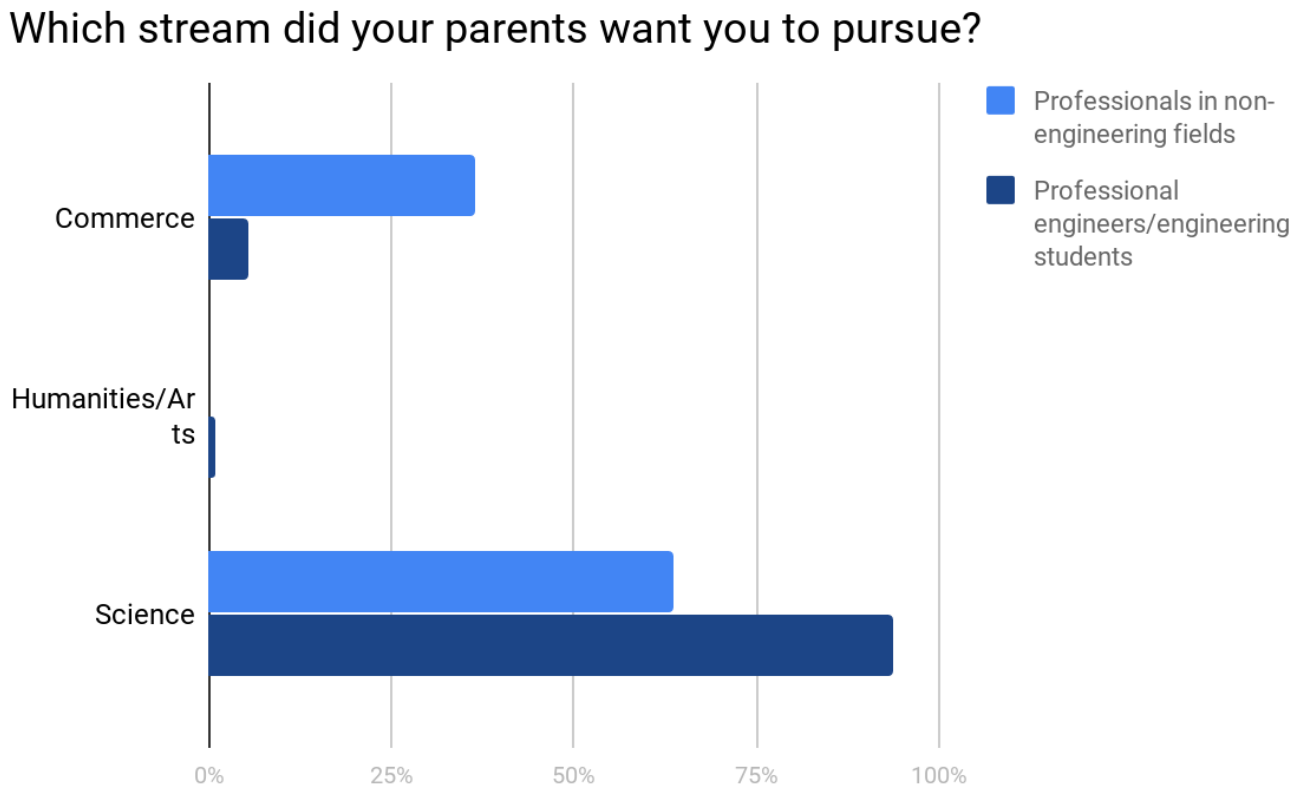

Figure 3: *Parental Preferences in Subject Choices (professionals in non-engineering fields and professional engineers/engineering students)*

For questions relating to job satisfaction, 93.4% of the people reported that the greatest satisfaction was found in a job when it was something they were passionate about. Of these, 72.1% reported that greater satisfaction was found when the job matched their personality type. Only 7.8% reported that a "good salary" or other "financial benefits" made an occupation satisfactory. When asked to rate their current job satisfaction on a scale of 1 to 10, with 10 being "extremely satisfied" and 1 being "extremely unsatisfied," the average rating for all those surveyed was 8.1.

4.3 Professional Engineers and Engineering Students in College

The results from the group targeting professional engineers and engineering students in college revealed that 93.8% of the parents of those interviewed wanted their children to pursue STEM subjects in college (see Figure 3). Out of these, 91.5% actually went on to pursue STEM subjects and eventually procure a job in the field of engineering. In response to the question, "Why did you choose to become an engineer?," 89.3% chose "job security" and 84.5% chose "societal status" (see Figure 4). When asked, "Do you plan on switching fields in the future?," 73.5% answered "Yes." Following this question, in response to "Why do you plan on switching fields (if at all)?," 87.8% answered "Not passionate about what I am currently doing." When

asked to rate their job satisfaction on a scale of 1 to 10, with 1 being "extremely unsatisfied" and 10 being "extremely satisfied," the average rating received was 5.3.

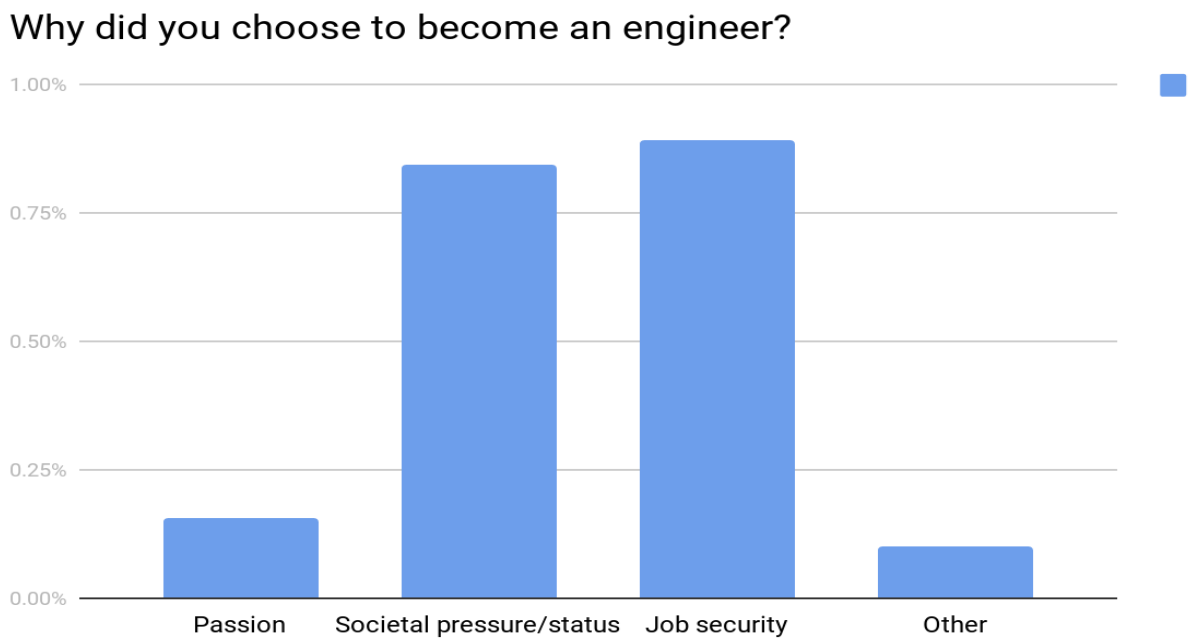

Figure 4: *Reasons for Becoming an Engineer (professional engineers and engineering students)*

In response to the subjective questions such as "Did you feel pressured to become an engineer from a young age?," the general responses included comments such as these: "My parents always told me that becoming an engineer would give me plenty of job opportunities later on in life", "I really was not given much of a choice to pursue areas of study outside the STEM subjects as my parents found it worthless to study subjects in the Arts or Commerce", "My father was an engineer and so was my elder brother and many of my cousins. It was therefore assumed that I would follow in their footsteps and so I never thought too much about what I really wanted to do."

5. Discussion

5.1. Existence of External Pressure to choose Science and Engineering

As shown in the works of other scholars (see Literature Review), Indian society takes pride in establishing the belief that students pursuing STEM subjects are generally smarter or more intelligent than students in other academic disciplines. As a result, students tend to hide or disregard their abilities in other areas of study and generally feel pressured towards developing a strong liking for the STEM subjects--whether or not these subjects are in sync with their unique nature. The fact that 73% all the people in all categories claimed that they had an external pressure--their parents in particular--to pursue STEM subjects over the Humanities and

Commerce highlights that a vast majority of engineers and engineering students in the country are being encouraged on to a path that is not necessarily something they are passionate about or something that is built on the foundation of their unique nature. The subjective answers relating to personal experiences in being urged to pursue STEM subjects and core Sciences over other academic disciplines are also key in highlighting the fact that many of the biases towards the core Science subjects are embedded in the culture of the country. They are simply being passed down from generation to generation in the form of a complicated, single narrative that only talks about the glamour of being in the field of Science. For example, one student stated that her parents and grandparents believed that she was "smart enough to pursue Science" and that she would do "much better in life" if she pursued a career in this field. We learn from these remarks that such preconceived notions about Science are clearly not the students' own perceptions about the field, rather a mixture of prejudices that are revealed to them in the household from a young age.

The fact that 0% of the people in the group of professionals in various non-engineering fields and a negligible amount (0.9%) of the people in the group of professional engineers/engineering students confirmed that their parents had urged them to pursue studies/careers in the field of Humanities suggests that there are probably some social, economic, and political reasons behind the Humanities being given a rather inferior position in Indian society. It certainly is ironic that this is the case in a country that has one of the most diverse societies in the world, with a rich culture and heritage that spans back thousands of years. With several flawed societal practices, poverty, hunger, and various other social and political issues, one would expect the youth of the country to be greatly inspired to pursue careers and ventures in the Humanities. Considering the vast scope for improvement in this area and numerous career opportunities that could be created, it seems counterintuitive that the Humanities would be treated as less important than the Sciences.

Under the option of "mixed stream" for the high school students, it was observed that students chose this stream due to two main reasons: undecided on their future plans for college and parental pressure to keep the Sciences going for as long as possible. Some subjective answers such as "My main interest is in the Humanities. I'm not really interested in the Sciences, but I had to keep them going because of my parents. I'm currently struggling to keep up with my class in these subjects," reveal that for many students, there really is no purpose in them pursuing certain subjects when they are not passionate about them. The bias towards STEM education and parental expectations force them to study certain concepts that are not necessarily in sync with their nature and this could lead to their poor performance in that area. Instead, if this pressure

and bias did not exist, students could benefit in many ways by pursuing subjects that they are interested in and have a natural inclination towards.

As shown in the results section, while many of the high school students and professionals in non-engineering fields didn't actually pursue STEM subjects even though their parents wanted them to, many of the professional engineers (see Results) chose to become engineers solely because of parental pressure and other societal reasons. The impact of this fact is seen in the vast number of professional engineers who plan of switching fields at some point in the future (see Results). This impact is discussed in more detail in the Case Studies section. The "impact" also refers to the large number of engineers who are unemployable or do not have adequate skills in acquire certain jobs in the professional world (see Introduction).

5.2 Overall Job Satisfaction due to the External Pressure

To observe the impacts of such external pressure, job satisfaction was asked; if the study could examine the various reasons for finding immense satisfaction with their work by succeeding and contributing to society in a meaningful manner, then it can show the importance of following individuals' own passion and natural talent rather than what the current education system desires. For professionals in engineering and non-engineering groups, the questions about the reasons for job satisfaction, the reasons for an individual's decision to change careers at some point in time, and the reasons for an individual to choose a particular career in the first place were asked. The results to these questions revealed that most 73.5% of the engineers surveyed (see Results) would certainly change their career paths at some point in their lives as they were doing something that they were not truly passionate about--or something that wasn't in sync with their unique nature. These results reveal a high possibility that an individual will at some point in their lives most definitely fall back on their passions in order to continue feeling satisfied with their contributions to society and contribute in the most productive way possible for longer durations of time in the field that they gravitate towards. Based on these findings from the personal experiences they had to share about their job satisfaction, this study is able to conclude, to a fair degree of certainty, that nurturing nature is a valid means for the creation of a society where individuals contribute in a manner that is more productive and meaningful than if they nurtured a set of skills that they had no significant interests in or natural inclination towards.

As for the 71.3% of professionals in various non-engineering fields who changed careers at some point as a result of not being passionate about their respective fields (see Results), we again observe passion as the dominating reason for an individual's commitment to a field for longer durations. In this group of people surveyed, we see a relatively average higher job satisfaction rating of 8.1 (see Results). This value is probably an indicator that shows a majority

of the individuals surveyed in this group (71.3%) had changed their respective fields at some point in time to pursue something that they were more passionate about.

5.3 Nurturing Nature as a Possible Solution

With modern society promoting the idea of choosing jobs and career paths based on personality type rather than just interest level, the survey asked whether the members of the targeted groups found any resemblance between their personality type and skill sets of their current profession. Not surprisingly, those who stated that they planned on changing careers at some point in their lives revealed, in the subjective answers dealing with personality types, that their personality traits did not seem to be aligned with the skill sets and emotional demands of their current jobs. They also stated that their natural abilities lay in a different field and that moving to that particular field would possibly allow them to perform tasks in a more "efficient and enjoyable manner." These findings take us back to the subject of job satisfaction, and possibly job productivity, increasing with greater focus being given towards pursuing studies, careers, and jobs in fields synchronised with the unique nature of the individual. In this context, as highlighted by the results of the personality type questions, nature also refers to the personality of the individual. As stated by many scholars (see Literature Review), many companies around the world pay special attention to personality types in determining whether or not a candidate is apt for a particular role, irrespective of their technical knowledge in the respective field. Discussed later in the Case Studies section of this paper are examples of people having superior technical knowledge in a particular field, yet having troubles procuring jobs of their desired standards as a result of their overall personalities not being in sync with their skill sets.

The results from the survey targeting professional engineers and engineering students at a college level revealed that a majority of professional engineers (see Results) working in top positions at multinational companies and earning generous wages were keen on switching careers at some point in the future. This information is of extreme significance as it highlights the fact that many Indian engineers find that the perks and benefits of their jobs aren't strong enough to outweigh their lack of passion and talent for what they do. But on closer inspection, this fact begs the following question: why is engineering considered to be an elite field in India with extreme job security, and why would people dedicate so much time in trying to get into it when they know that they are ultimately going to settle for something else--in most cases this something else being their true passion.

5.4 Case Studies

The following case studies have been included to give examples of people who were pushed into the field of Science and Engineering, but switched to entirely different fields upon realising that their passions and interests did not lie in the field their parents had pressured them to pursue. By covering factors such as personality types, societal biases, and familial pressures, these case studies aid in supporting the argument of this paper: that nurturing nature is beneficial. The names used have been changed for the sake of protection of identity.

Case Study 1: From Mechanical Engineering to Play Writing

Simon grew up in a home where his father was the first generation in the family to attend school. Having graduated with a Bachelors in Commerce from a small college in northern India, Simon's father was the owner of a local convenience store. From the age of six, Simon was encouraged by his family members to "study for a couple of hours everyday" and pay special attention to "PCM" (the popular acronym in India for Physics, Chemistry, and Mathematics). Simon recalls having spent very little time studying subjects like History, Economics, and Sociology, as his family often told him that "the Arts are for those who cannot understand Science. They will not get you anywhere successful in life." At social gatherings, Simon was often praised among extended family members and friends for "studying Science." His ears were usually filled with remarks about what a "safe choice" he had made and how he would one day "become an engineer and make the family proud." At a tender age and with limited exposure to the world around him, Simon says that he grew up with the belief that "engineering" was his ultimate destination. After spending long hours solving "hundreds of problems in Physics and Math," Simon finally cracked the entrance exam and received a scholarship at the esteemed university, IIT Kanpur. He says, "I still remember seeing the tears of joy in my parents' eyes on learning that I had attained a scholarship at one of the most competitive colleges in the country." Simon describes the "shock" he felt on entering the college as one of the most pressuring moments in his entire life. He found the people around him to be much like "robots with no actual clue as to why they were there doing whatever they were doing." As the next couple of years went by, Simon often found himself questioning his own reasons for being where he was. He was "desperate to find a purpose" to his life.

Four years after being admitted to the prestigious university, Simon finally graduated with a degree in Mechanical Engineering. He remembers feeling "very lost" at first, with no ideas on what he wanted to do next. His parents persuaded him to take a job as soon as he could and so at the age of 25, Simon found himself working at a car-manufacturing firm. He spent the next three years of his life at the same firm, dedicating all his knowledge to designing specific

engine components. But as time went by, there came a point where Simon no longer enjoyed what he was doing. He did not feel "a sense of passion and joy to wake up every morning and get to work." He gradually found himself spending a fair amount of time learning about the culture of his city and the social problems that he felt were "never addressed by anybody."

Much to his family's disappointment, at the age of 30, Simon quit his job to work with a small group of graduate students in creating a play that addressed the subject of gender equality.

> "On hearing that I had quit my job to get involved in theatre, the first thing my father told me was that my life was over and that I will soon be living on the streets." (Simon, 2016)

Despite the lack of support from home, Simon went on to pursue his passion: writing. Although his first play on gender equality was no major hit, Simon realised that he had finally discovered himself through the process--he had recognised the purpose in his life and developed a burning desire to keep going at it. It was a feeling he had "never felt before." Today, Simon is a full time writer and has written several plays and other theatrical productions that he believes will gradually create a big impact on society. He loves what he does and could not see himself doing "anything else in the world right now."

Simon's case study is of great relevance to this paper as it gives us a perfect example of someone who was given the incorrect nurturing as a child--that too for STEM education--and eventually realised that their nature lay elsewhere. Through this study we get a clear picture of the societal factors that contributed in guiding Simon on the path to engineering and many of these factors, such as familial and societal pressure, social biases, and job security, are reflected in the results of the surveys conducted as part of this study.

Case Study 2: From Software Engineering to College Counselling

Right from the age of seven, Percy was told that he had to follow in the footsteps of his cousin brother and become a software engineer when he grew up. With his parents taking a loan to buy him a computer at the age of ten, Percy knew that his family's desires were serious and that he could not let them down. Everytime a neighbour or a friend or anyone known to Percy's family secured a job as a software engineer or any other engineer, he was reminded of the pressure surrounding him and the urgency to get into a "well-reputed college," from where he could easily procure a job at a "high-paying company."

On graduating from a top ranked college in India, Percy was sent to the United States (where his cousin happened to be working) to acquire a job as a software engineer. He remembers the "rush" with which decisions were made for him about his future plans. It was not long before Percy's cousin was able to put Percy in touch with a few "influential contacts" and

help him acquire a job at a firm specialising in software development. Much to his surprise, however, Simon found himself carrying out "very basic" tasks that did not require much "technical knowledge" in the field:

> "I believe I was overqualified for the job I was doing. I had a spent four years of my life studying the details of software building and now I was spending a large portion of my time performing administrative tasks that any kid right of high school could have done. I was getting bored and could not believe that my friends in India who graduated along with me with the same degree were performing tasks that were way more complex and technically oriented." (Percy, 2017)

Percy later learned that his "inabilities to present solutions to syntactic problems in an efficient manner and analyse data critically" were some of the reasons stopping him from moving ahead in his career. With no interests to continue doing what he was doing, Percy returned to India in the hope of pursuing something that was of more value to him. He soon took up a job at a software development firm in his native city, hoping to discover himself again. Although the work was indeed more "intellectually stimulating" for Percy, he soon got "exhausted and bored" of his field. He developed a strong feeling that his personality leaned more towards interacting with people rather than "crunching numbers and data the whole day." At the age of twenty nine, much to the "horror" of his entire family, Percy quit his job as a software engineer. On careful reflection about his journey so far, Percy realised that what he really wanted to do was help students prepare for college and "avoid making the same mistakes" that he had made. He started working with a few students by helping them prepare for exams and make decisions about colleges based on their interests--he was determined to not let them get "pressured into pursuing Science."

Percy's case study is another example of the nurturing of an absent nature in an individual as a result of societal biases, societal pressures, familial pressures, and preconceived notions about things like "job security." We can gather very clearly from his study the fact that many students in India are barely given an opportunity to explore their innate interests before society's prejudices force them towards pursuing STEM subjects in school or college, and eventually a career in the field of Science/engineering.

6. Conclusion

This paper explores the impact of STEM education in context of the Indian education system and aims at proving that Indian society could benefit to a certain extent if students were to discover and nurture skills or abilities that are a constituent of their unique nature or genetic makeup. In order to prove this hypothesis, surveys were conducted involving three groups of

people: high school students, professional engineers and engineering students in college, and professionals in various non-engineering fields. The data collected from the three surveys revealed that there exists a strong bias in Indian society towards STEM subjects over the Humanities and Commerce. 90.6% of the students interviewed stated that their parents wanted them to pursue STEM subjects merely for the sake of job security and societal status. Meanwhile, around 73.5% of the professional engineers surveyed stated that their interests did not really lie in engineering and therefore planned on switching fields at some point in the future. Using data from the surveys conducted as well as data from governmental sources and other scholars in the field, this paper questions the reasons behind students believing that STEM subjects hold a higher place in Indian society than subjects falling under the Arts and Commerce. Also discussed are some of the historical factors that contributed to the formation of the current education system in the country and the factors (both social and economic) that drive people towards pursuing careers in the field of Science as opposed to other fields. Based on data collected from the surveys conducted and other governmental sources, this paper concludes, with a fair degree of certainty, that Indian society could benefit to a certain extent if greater importance was given towards identifying and nurturing the unique nature of every individual as opposed to forcing them to pursue studies or careers in fields that they might not have any interests in or natural inclination towards.

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