

**Undergraduate STEM degrees for International Student in the
U.S: Analyses and Strategies for Recruitment**

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Table of contents

Abstract	1
Introduction	2
History of STEM programs	4
Globalization	5
Internationalization of higher education	8
Major programs/colleges that focus on STEM degrees in the United States	13
STEM Higher Educational institution comparison	14
- Two Ivy Leagues	
- Two Private	
- Two Public	
Educational and Professional accessibility	17
Strategy	18
References	19

Abstract

In this project, STEM education in the U.S and other parts of the world was analyzed.

There has been an increasing number of international students studying STEM programs but not at the undergraduate level, with the exception of China and other countries. To understand what shapes the destination of students to a specific program various factors were taken into consideration: Financing, Language barrier, culture, and standardized testing.

Introduction

Each year thousands of students travel to the United States to pursue higher education. According to the Institute of International Education, approximately 880,000 international students (individuals who have obtained permission to study in the U.S in the form of F-1 and J-1 visas) are studying in the U.S. during the year of 2015. The statistics show the countries students originated from as well as the level of education that they hope to attain. There are about 44% of international students in the U.S. studying in the Science, Technology, Engineering, and Mathematics program (STEM) at the undergraduate and graduate level (1). The funding (Assistantships, fellowships, and Scholarships) for graduate STEM programs often allows qualified candidates financial assistance to be able to receive their education abroad, specifically in the U.S. However, most of the undergraduate STEM programs select students who are qualified educationally, and if able to cover the education and living expenses students can enroll(2).

International students face different barriers – Financial, Language, Educational System, and the Admission Standardized Testing, when they study abroad, especially in the U.S. In order to get admitted to an undergraduate or graduate program. Non-native speakers of English, or a candidate who did not complete their previous degree in an English taught accredited program are generally required to take an English proficiency test. For instance, the Test of English as a Foreign Language (TOEFL) is intended to measure the ability to read, write, and communicate information in English (3). When a student is

accepted by a university the student receives an acceptance letter along with the I-20 form (4) which is an eligibility form to study at the university. The student has to go through a process of applying for the permission to study in the U.S known as the VISA by proving to the U.S embassy the ability to afford the educational and living expenses during the completion of the specific degree and the unintentionality for illegal migration. There are many different types of visas but we will only be focusing on F types as they are crafted for educational and exchange purposes. Generally, most of the students come to the U.S with an F-1 visa. For example, students coming to the U.S from Morocco will need to apply for the F-1 visa, and if they have any dependents (spouse, children), they will need to go through the F-2 visa (5).

We might think that because English is an official language and used for instruction for higher educational programs in 54 countries*1, a large number of the students from these countries will designate the U.S as a place to pursue their education. However, the statistics from the Institute of International Education (6) show that students from China, India, and Saudi Arabia make up the majority of international students in the U.S, and has recently increased over the last few years. In contrast, the population of international students from other countries has barely changed or decreased compared to China and India. Students coming to the US from Germany, France, and Spain has decreased over the past years. For European students, education across Europe can be either at little or no cost as a result of the European Union policies (7). Research, and the quality of education across Europe had also been notable internationally. Potentially for this matter, European students chose to stay in Europe.

There are many factors that shape the destination of a person seeking an education abroad. The United States of America has contributed in the innovation of STEM programs such as, Medicine, Astronomy, and Technology while providing favorable conditions of education. Therefore, many students wish attend U.S higher educational institutions. Yet, they are many obstacles, such as the tuition and fees that need to be lowered to make opportunities reachable by all educationally qualified candidates. Some countries and organizations have sought to create partnerships by making the admission process easier, and scholarships to make the educational experience affordable. For example, Saudi Arabia created a scholarship – SACM, allowing Saudi students who have met the education qualifications to study abroad with full scholarship, including a stipend for room, boards, tutoring, and for spouse and children (8).

History of STEM

The emphasis on the scientific fields has not started until the mid-20th century in the United States of America (USA) (9). The scientific fields that include mathematics, general science, engineering and technology are referred to as the acronym, STEM. An important event that happened in the in 1957 where Russia sent the first Satellite – Sputnik to the space. Russia and the USA had strained relations at that time period. Therefore, motivation for the USA to expand the scientific fields to be competitive with the rest of the world. President Dwight D. Eisenhower took the initiative to promote educational changes to inspire the American community in STEM. His work and President John F. Kennedy’s policies had successfully stimulated the growth of these

programs. The USA not only sent a satellite to space but sent astronauts to discover unexplored planets but innovated, cured diseases, and made food available despite of the drought. The educational policies changes by these two honorable presidents have sparked evolution in post high school education as we are going to compare few higher educational institutions who specialize and excel in STEM. The U.S government funded and supported these programs with millions of dollars that range from grants, fellowships, and loans. To help expand these programs there were strategies that were put into place to help support the program's growth, and increasing federal investments (9). Specifically, the President has called on the nation to develop, recruit, and retain 100,000 excellent STEM teachers over the next 10 years": "He also has asked colleges and universities to graduate an additional 1 million students with STEM majors".

One of the strategies that has mainly helped the success of STEM programs in the U.S was the recruitment of talented individuals from all over the world, however, it carries advantages and disadvantages. The spur of the quality of the U.S education has not only made it valuable and recognized nationally and internationally.

Since the origin of the STEM movement there has been an increased push for providing the resources and support to grow an interest in a student's future education path both in the country and abroad. The USA has not been highly ranked for math, science, engineering, and technology. It projected there will be a high need for people in these fields of occupation to be competitive with the rest of the world.

The need of scientists in the future is increasing not only because we need to seek innovation for pleasure. Future scholars, thinkers and engineers will gather, and share their perspectives on global warming, and pollution – hoping to find a solution for it.

Nowadays, many U.S universities make up the majority of the best ranked universities in the world (10). A top ranked university is not only supposed to be focusing on one field of study, rather it should have a focused vision on many fields of study while promoting research, quality teaching, infrastructure, extracurricular activities and grants (11).

Globalization

To not confuse globalization, the exchange of goods and ideas, with colonization. In Colonialization one dominant party forces the exchange of goods upon the recessive one while ignoring and destroying the norms and morals. But globalization has freed the exchange of goods and ideas between different countries within manageable limits, therefore, allowing the internationalization of education. (12)

Migration is an important component of globalization as it shows the movement of populations to different locations with improved living condition and seeking better job opportunities. For instance (13). Potential workforce candidates are attracted to the opportunity of being employed in the U.S. and gaining citizenship because of the equal opportunity, resources and benefits. However, there are potential issues that can arise. The abundance of resources would not result in any restriction, but due to its limitations each country regulated its policies about the flow of individuals. The U.S Department of Immigration has set requirements in order to offer the permission to study in the U.S while promoting many benefits to the visitors. Most of the individuals who apply to a university fall under the category of an F visa. Depending on the length of the potential program they are going to be placed at, the ambassador of the U.S embassy at that specific country reviews the applicant's eligibility and qualification in terms of the

financing, and the unintentionality of illegal migration. The F visa regulates the rights and law for the immigrants in the U.S with the purpose of studying only, and reduces the risk of having large international student body in the U.S who cannot afford the schooling and living expenses.

- **Financing of the program:** Applying to a university is not a short process. Universities require few financial forms to be filled from international students after their acceptance. Affidavit Support form is one of the important letters that shows how much a student is supported by his family/guardian, and it also has to be supported by another letter and its translation if needed of the guardian's bank statement. The Affidavit Support Form goes along with the electronic reporting system -- Student and Exchange Visitor Information System (SEVIS) (14). The University would not only estimate the cost of courses to be taken but it will also estimate other expenses – living, transportation, books, activities, and miscellaneous. The expenses can be supported by either the applicant himself, or by a guardian. Scholarships/grants from either the university or other parties can also fulfill the Affidavit support form. In the case of not meeting the financial requirements the university will not be able to send offer the I-20 – letter of enrolment which will therefore result in the rejection of the visa. An applicant who is not meeting the requirement is potentially to be seen. Not to have his education choice a priority.

Moreover, International student who, after getting admitted, during their course of study and couldn't afford the schooling anymore don't have much flexibility to stay in their program. These instances happen due to either the inability of the guardian/sponsor to pay the tuition, or due to the fraudulent financial documents. If caught providing

fraudulent documents, the student has to be reported to the embassy (15). In the case of only insufficient funds, the student is able to transfer to another institution in the U.S that can be affordable, to go back to his country and come back later on when funds are available.

- **Unintentionality of illegal immigration** is a critical aspect that all international students have to take careful consideration in. It is similar to a job interview. If your first impression shows your interest on becoming a good student while not planning on staying illegally after the expiration of the visa, and the unintentional of illegal off campus employment, , , the visa will most likely be awarded.

Rather than the financing and the legitimacy of the stay, there are still many factors that the ambassador takes into consideration before making any decision.

Yet, we can see that globalization has given the 19th, 20th, and 21st centuries a new recipe for policies, resulting in a new flavor of unexpected advantages, but also some inconveniences. With the flow of ideas through continents, education has become more internationalized.

Each country has an educational system that it is either crafted by its scholars, inspired by other educational systems, or adopted from the colonializing country. With the study of international education we could for instance, compare the Norwegian educational system with the Malaysian one for the purpose of developing a new effective resilient system. International education also carries many ethical and societal aspects where it teaches us how to coexist with others who share different aspects; beliefs and physical look rather than discouraging and humiliating them.

Globalization has led to the promotion and expansion of the idea of the brain drain, which

is bringing people together for the purpose of expanding ideas and growing the science field. Not controlling the flow of capable individuals to other parts of the world might cause serious political instability and impeding the growth of countries. Those who wish to come to the U.S for the purpose of working fall under another visa category, H-1B visa. Each year, the H-1B visa quota is release (16) as it shows that International workers are needed but with limits. Which makes sense using a biological analogy. When a cellular environment has more nutriments, more products are going to be produced. However, when it is too high or too low the environment will shut down. Importing high skilled labor, brain drain, has been very important for the U.S's development in the scientific fields (17) However, the drain might be either a gain or a waste where talented migrants might face unemployment (18), and the exodus of talent whom emigrated. For this fact, we ought to sometimes see brain drain negatively.

With having access to information overseas is the major factor of the internationalization of the educational system in the U.S. and will help further expand college STEM programs.

Migration of Ideas -- HISTORY OF SCIENCE

Nowadays, the U.S has become one of the most influential and leading countries in the scientific and technology fields by offering the largest supply of engineers and scientists in the world. Three centuries ago, the Muslim world had shined its rise in the scientific fields. However, the gleam did not last long and as a result a lag has occurred while the European world amazed the world with its discoveries. Aaron Segal's work about "Why does the Muslim World Lag in Science" analyzed the issue and proposed

some hypothesis that might have impeded the scientific discoveries of the Muslim world (19). Learning from the failure of the Muslim world help understand how societies have an ongoing development. The hypothesis of the religion being the major factor of this decline was refuted. The major factor was found to be the rejection of ideas from the European market. The Muslim world in the 18th century was only open to the Middle East and North Africa while Europeans were rising with new discoveries. The European fast pace has left the Muslim world behind, inverting the image from translating discoveries from Arabic to translating them to Arabic. We can consider that the lack of globalization being one of the factors of the “not openness” to the outside world. Segal said that “Algeria, Morocco, and Tunisia each operates its own modest version of French-style centralized research policies but their lack of linkages to the private sector or ability to diffuse results limits their productivity, “. Other countries like Sudan lack their talents who immigrated to the Arab Gulf Countries. Natural disasters, political instability play a major factor in reducing international students in the U.S.

Major Population of International Students in the United States:

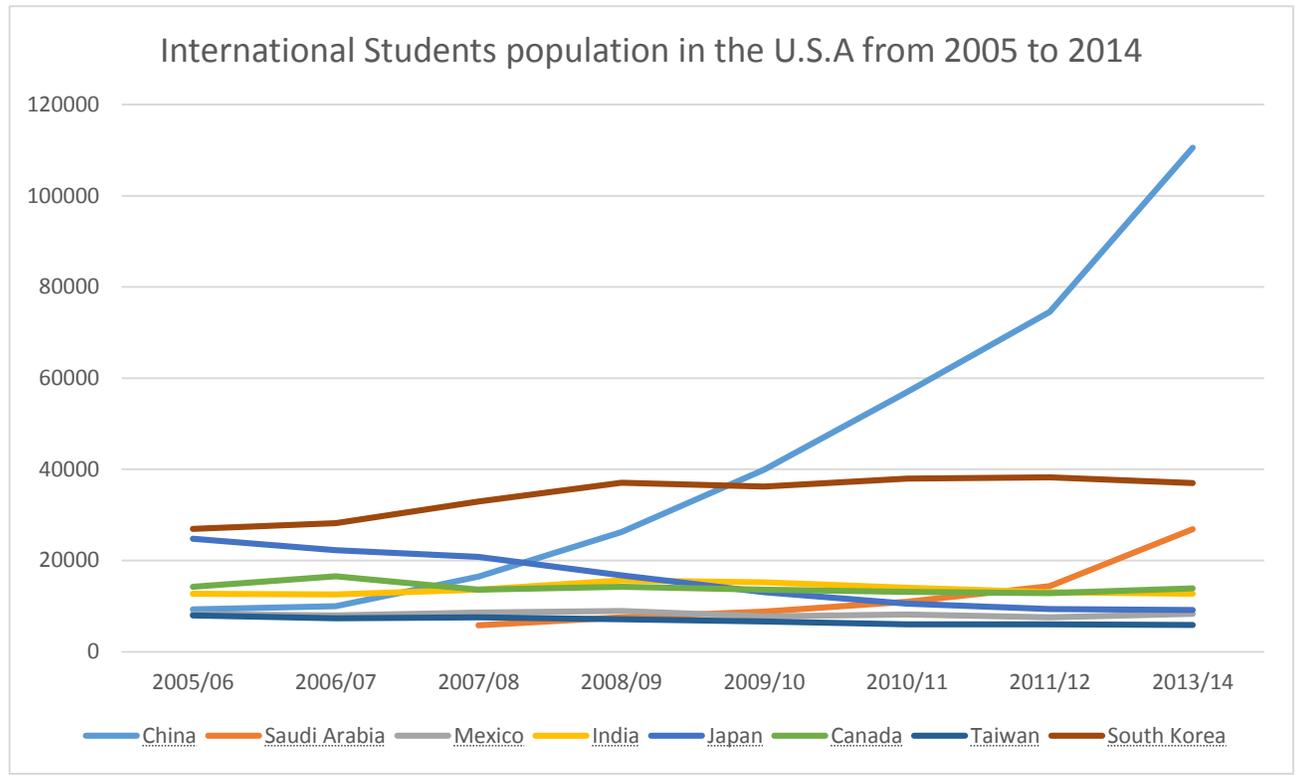


Figure 1: The population of international students in the U.S.A from 2005 to 2014.

Source: Institute of International Education, *Open Doors Report(1)*

China along with India and Saudi Arabia make up the majority of the undergraduate international student's population in the United States. However, at the undergraduate level, India is excluded from the list of top international students in the U.S. The number of international students from India from the year of 2005 to 2014 has decreased by 0.39%. On the other hand, the Chinese student's population has increased by about 1,088% over the same time span. Undergraduate students coming from Taiwan,

Japan, and Canada knew a decreased from 2005 to 2014. While the number has almost stayed the same for Mexico. The only exceptions who knew a miraculous increase were China, Saudi Arabia, and South Korea.

Although a decreased number was seen in undergraduate students coming from India, Indian students seeking a graduate degree has increase. This could be explained by disinterest of Indian students choosing UK due to the change of the visa rules. Thus, making them choose the U.S for many reasons such as the eligibility to work after graduation.

From an article from the Wall Street Journal about “ Why Indian Student Number in the U.S are on rise after three year decline” was more general rather than comparing the population fluctuation at each level of study. The decline and the rise of the Indian student population in the U.S. seems to be monitored by the financing aspect since the Graduate Indian population has rose but not the undergraduate. Most of the STEM graduate programs do offer grants, scholarships and assistantships to international students. (20)

Using a little basics of physics knowledge; everyone’s accessibility to education is located at the center of gravity – as every single individual is bound to the ground through gravity. However, other acting forces might interrupt the movement of the individual to the center of education. For instance, a low value of the financing will not favor reaching the center of education. Moreover, Political forces are ambiguous, strong, and unexpected. The Arab spring grabbed many of our attention. It debuted in 2011. Interestingly, it interfered with decline of Indian students going to the U.S, but not Saudi

Arabian students. There are many possible interpretations. Language and culture potentially shape the point of view we adopt, and so we have to be careful at how recruiting international students.

Fields of study that international student from Morocco opt for

From a survey conducted by an educational institution located in Morocco, Learning Group Academy only found that 50 out of 600 students chose to pursue an undergraduate STEM degree in the U.S. for the past 7 years.

The Moroccan educational system at the High school level – or called as Lyceé focuses on orienting good students towards the scientific according to another survey taking by high school students. Students although the overwhelming coursework of the many scientific courses to be taken, and the three mandatory languages, the Moroccan systems allows students flexibility after achieving their Baccalaureate – similar to a high school diploma.

Education in the United State is considered to be a prestige. And not everyone can afford it. The Survey has also showed that the majority of the undergrad Moroccan students fall under the higher financial class. If so, is the financing the major drive for Moroccan students to study an undergrad program in the U.S and why financially do advantaged students opt for a business degree rather than a scientific one?

The following interpretation are mere hypotheses as they are subject to be refutable. Students wish after their graduation to take over or invest what their family is leaving for them. The second hypothesis is that Moroccan students who want to purse a scientific

field rather want to go to Europe than the USA due to the low cost.

Interestingly, Morocco is a developing country. The biggest solar power plant in the world was turned on the Moroccan Sahara, and is projected to be ready by 2020. The projects' leaders have partnered and engaged with few U.S higher institutions, Worcester Polytechnic Institute (WPI), Vanderbilt University, and Texas University for the development of the project. This could be a great start for the recruitment of Moroccan students for undergrad STEM programs in credible universities. (21)

The University model in the U.S

With the internationalization concept, students meet global thinkers who are their professors, mentors, and classmates to bounce learn and bounce their ideas in universities. There are a wide range of educational centers that international students can attain their STEM degrees at the public, private and ivy universities. Some examples of each are Brown, Cornell, Illinois Institute of Technology, California Institute of Technology, Colorado School of Mines, and Virginia Tech University. The major differences are the financial responsibility to attend these universities and opportunity to attain an occupation in the US afterwards. Each of these programs can be compared and contrasted based on student's needs. Students' major need are the quality of education, research, financing, inclusivity, and jobs opportunities after graduation. The following information is separated based on the sector of educational centers are considered as, either public, private or ivy.

Major schools with STEM

The prestige and the elitism the Ivy League institutions have not only gained national recognition, but they are also ranked top worldwide. Historically, most of the Ivy League institutions were founded before the American Revolution, making them Colonial colleges with the exception of Cornell (22).

Brown and Cornell University were chosen in this analysis not because of their geographical location – although all Ivy are located in the northeast of the US, but due to STEM programs they offer and the financial assistance.

In the public education sector, Virginia Tech and Colorado School of Mines are one of the leading STEM schools that are mainly funded by the government. On the other hand, private institutions rely on endowments.

All higher education institutions rely predominantly on grants and endowments, and not the student's tuition. So why do many schools create a hurdle for students by making education's cost flying in the sky.

Nevertheless, universities' dedication for the student success was shown not only from the programs offered. In this comparison the following variables were used: Standardized testing threshold, Teaching quality, Affordability, and the return of investment.

The following data was collected from the Princeton review of 2015:

	Institutions	Aid for International students	SAT min	International Student %	Student Faculty ratio	Professor Accessibility	Return of Investment
Ivy League	Brown	Yes	1370	11.91%	9:1	87	95
	Cornell	Yes	1330	9.67 %	9:1	77	94
Private	Caltech	Yes	1500	8.29%	3:1	72	99
	Illinois Institute of Technology	Yes	1150	26.84%	13:1	67	89
Public	Colorado school of mines	No	1250	5.8%	16:1	NA	NA
	Virginia Tech	No	1100	5.8%	14:1	81	90

Table 1.1: Comparison of the three University models of the U.S educational system:

Interpretation

The higher educational institutions models illustrated in the previous table showed main factors that distinguished one model from the others. Financing is a big decisive factor to attend a university, as well as the admissions criteria. Theoretically, a low student to faculty ratio is intended to mean a high faculty accessibility, however, it is not the same for Caltech and Cornell University. Having more faculty implies an investment of more money. The Ivy and Private models were successful in providing financial assistance to many international students although the many charges they have. On the other hand, the public model, with a high student to faculty ratio, was not able to provide assistance to students.

There are many variables that we do not see that University policy makers have to be careful with. If the university only relies on students funds, it will most likely go bankrupt (23). So why don't many universities save our next generation from debt? A university is the influence of all generations. If it supports the idea of debt then it supports the idea of the economy crisis.

Accessibility

One of the factors that favored the attraction of international students is by allowing them to work while studying. International students want jobs! (24). Depending on the country students coming from the government had regulated policies.

All international students are eligible to work on campus, and if qualified they can also be

granted an OPT. An OPT is a great way for international student to have hand on the field, develop their skills, and get paid, therefore, a high return of investment.

Science is a fast growing field, research is endless, exciting and promising. Due to many reasons, the U.S government has allowed a longer Optional Practical Training (OPT) in the scientific fields by allowing a 17 month extension making a 24 months one This extension was applied on May 10th 2016 (25)

International will have the opportunity to prove their skills and work in the world leading and innovative industries.

With the high university cost of attendance international students see their education not only an investment of time but also of a lot of money, as many refuse not to attend because that matter (26). In any field, all investments are well studied and should have a return. Jobs in science promise great starting salaries that rise quickly, therefore high return of Investment. From a survey conducted by Learning Group Academy the motive most of its students who chose to study business is the high return of investment. The U.S is known by its strong programs in Business and political sciences due to geopolitical position, due to Wall Street and the White House.

Strategy

Educational advisers and consultants should encourage their advisees seek innovation, because that's what tomorrow is awaiting for. Pollution is a threat to every single on earth. If multicultural scientists, with different point of view, gather many issue could be solved.

Moreover, public institutions, especially, should lower the financing to educationally qualified international students. It is true that "International students help many universities have enough graduate students to support research programs that help attract top faculty and that also thereby help U.S. students by having a higher-quality program than they otherwise would have," (27) but undergraduate students do also play a major role in this development.

For those who are seeking a business degree for the sole purpose of launching a business, STEM would be a perfect route for that. For instance, one of the top world companies are pharmaceutical

Nevertheless, science is a universal and logical language. The English barrier should also be taken into consideration. Universities should not rely a lot on the standardized testing as it does not predict the academic not the societal achievement. But they should consider a new assessment with different variables that predicts more accurately student's success (28). For instance – Ambition and persistence.

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