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Systematic study on the choice of higher education institutions in the engineering field

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Abstract: This research systematically examines the factors that influence the choice of higher education institutions in the field of engineering. Through a comprehensive review of recent literature, using the PRISMA 2020 methodology, 98 academic articles were analysed, of which 13 met the established inclusion criteria. The study identifies ten main factors influencing students' decision, the most significant being family, educational and economic aspects, mentioned by 11-12 authors. Individual factors were cited by seven authors, while social and academic environment and gender stereotypes were mentioned by five and four authors respectively. The findings reveal that institutional choice is more influenced by external factors than by personal preferences. The research highlights the persistence of socio-cultural barriers in the selection of engineering careers and emphasises the need for educational policies that address these challenges. The results provide valuable information for educational institutions and policy makers, suggesting the implementation of more robust financial support and career guidance programmes to optimize engineering education.

Keywords: *Engineering, systematic review, Higher education, Systematic review, University selection factors.*

1. Introduction

The choice of a higher education institution is crucial in the academic life of students, especially in engineering, where it can influence their future career. The decision is influenced by geographical, socio-economic and cultural factors in each region.

The globalisation of higher education has transformed the educational landscape over the last decade, offering students more options at national and international levels. Educational institutions seek to attract and retain the best student talent in a competitive environment generated by this phenomenon. Understanding the factors that influence applicants' decision-making is crucial for educational institutions in this context...

The institutional selection process is not limited to academic aspects, but involves family, economic, social and personal dimensions. The existing literature suggests this. The relative importance of these factors may vary significantly according to the geographical region and the specific cultural context. However. In some regions, economic factors may be determinant, while in others institutional prestige or future job opportunities may be more important.

In this sense, the study seeks to identify and analyse the factors that influence the selection of engineering higher education institutions through a systematic review of the existing literature. Engineering education is fundamental to the technological and economic development of contemporary societies. This research is relevant in this context.

A thorough understanding of these factors will benefit educational institutions in designing strategies and provide valuable information for prospective students and their families in decision-making. The

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knowledge can be useful for educational policy makers in developing programmes that facilitate access and retention in higher education.

2. International Background

On the five continents, there are different characteristics for high school students to choose a university in order to continue their professional training. The analysis was carried out, starting with the countries of the Asian continent.

In this context, Ke, et al. [1] conducted a study in which they suggested interviewing 67 international students who were studying at universities in China. Of these, 25 were studying engineering. It is also noted that only 9 students were from the American continent. I identify that the main element that attracts international students to China is the activity and reputation of the universities, the scholarships offered, the educational excellence, the courses in a global language such as English; as well as the social and economic particularities of the country, such as the collaboration programmes between communities, and the global recognition of the degrees acquired. Students were encouraged by friends and even relatives to attend all universities in China because of the convenience and safety of the cities [1].

Cynthia and Chong [2] study focused on the elements that influence the choice of private institutions for international students in Malaysia. I conducted research involving 110 individuals, of whom 76 were male and 34 were female, who opted for educational mobility alternatives. Of the total number of survey participants, only 70 were pursuing undergraduate studies, and only 50 were studying engineering-related subjects. It was found that students opt for private institutions for several reasons, including the continuity of professional education at postgraduate level, and also that these professions are not accessible at all universities. In addition, financial support is offered to help cover school fees, university costs, accommodation and the like. Similarly, it is essential to consider the reputation of the institution itself, both nationally and globally, in order to find employment opportunities in the short term [2].

In the study by Khalid, et al. [3] he notes that he interviewed 18 international students at Universiti Sains Malasya (USM). Of these, 8 students were pursuing their PhDs, 7 were completing their Master's degrees and only 3 were in pre-Master's degrees. Thus, the interviewees ranged from approximately 20 to 41 years old. Interview participants highlight elements such as the low attendance rate, the cost of living, the ease of cultural adaptation, and the reliability and prestige of the university [3].

In another study conducted for Malaysian higher education institutions, Connie, et al. [4] conducted an interview with 90 high school students in order to determine which elements influence the selection of a university for further studies. It is deduced that the educational programme, the reputation of the academic institution, job opportunities, education, and the cost of schools are aspects that truly impact on the selection of a university, even if the government provides support and scholarships [4].

Por, et al. [5] also conducted a study on the factors, based on universities in Cambodia. The surveys were conducted at the Stung Treng campus of Build Bright University with a total of 330 students. The students included 124 males and 206 females. Of the total number of students, 295 were in their bachelor's degree, while 35 were in their master's degree. It indicates that the main elements for selecting a university are based on the influence and opinions of parents, and the suggestions of teachers at bachelor level are a crucial aspect. The quality of the graduates of the suggested universities. In addition, the cost of enrolment, the prestige of the university, the student climate and the location of the university [5].

In research conducted on the third largest island on the planet, Ahmad [6] conducted a survey study of students at two university institutions. They selected 344 students from Lambung Mangkurat University in Banjarmasin Indonesia and 152 from Antasari State Islamic University in Banjarmasin Indonesia. A total of 94 male and 402 female volunteers participated. Surveys were sent to WhatsApp groups, and descriptive statistics were conducted using the K- means method. The two key factors that

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motivate students are based on the reputation and excellence of the university. There was no relevant distinction between genders [6].

In Vietnam's international university programme, a survey was conducted to determine the key elements in the selection of that university. Thai and Luu [7] found the following factors through statistical analysis. First, employment expectations at the end of university are the main element, and there is an accreditation effect when studying at recognised institutions. Therefore, there are universities that are promoting employment opportunities from their campuses. Secondly, there is the impact of parents and family members attending a specific university, in Vietnam, parents volunteer to learn about the education sector and encourage their children to attend. Third, but no less relevant, as it is currently gaining relevance in choice, is the use of technologies. For example, the relevance of social networking platforms as venues for social engagement, people-to-people interaction and business growth in this sector is on the rise [7].

In European countries, students from Latin America show a higher preference. Based on Abbas, et al. [8]. A survey was conducted among students at a university in Germany and the UK. The students consulted come from China, Denmark, Turkey, Finland, Italy, Mexico, the United States, Thailand, India, Pakistan, Malaysia, Poland, among other countries. The most relevant responses focused on academic aspects, with respondents indicating that they chose these universities because they are very innovative and very advanced in the field of education. They also indicate that they choose these countries because there is no discrimination based on race, religion or gender. They also offer great opportunities for student jobs [8].

Research was conducted by Ha, et al. [9] in which they examined various publications to establish which factors are most relevant for conducting research on a global scale. I examined 46 publications from 1998 to 2023, and their main findings were that employment experiences and opportunities are paramount, followed by quality of education, and finally, cost of study and quality of life. As a result, Australia has also become an alternative place to study [9].

A research was carried out in Egypt, with the aim of recognising the elements that affect the selection of national universities. A total of 230 questionnaires out of 384 were obtained and distributed through the social network WhatsApp. According to the students, they show more interest in universities with their preferred majors. They believe that Egypt's national universities provide a variety of professions. Similarly, it is noted that the reputation of the university plays a significant role in the choice decision [10].

At the Southern African University of Technology, Funeka, et al. [11] conducted a survey of first year undergraduate students to determine the determinants of university selection. I selected 60 students from the DUT from the subjects of Accounting and Computer Science, Applied Science, Arts and Design, Construction Engineering and Technology, Health Science and Management Science. The interviewees indicated that they opted for this university because it offers cooperation with industries, which speeds up the process of getting a job. In addition, the university has a positive attitude towards strengthening, enhancing and preserving the reputation of the institution by continuously improving the educational programmes; likewise, the marketing proposition related to the university is enhanced. Although there are positive aspects, there are also negative aspects. These include students feeling that they are not considered and sometimes experience racist treatment. For this reason, they propose that the administrative department should consider students more in order to recognise their needs. The location of the university has also contributed to its high demand, as it is close to shopping centres, a community and the beach [11].

3. Background in Latin America

On the other hand, several effects emerge in Latin America. For example, in the research carried out for universities in Argentina, Manzano-Sánchez [12] points out as the most significant aspect that students face difficulties when they do not determine in which degree course they wish to study. This phenomenon is perceived when several students change degree programmes or even universities in the

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first year, either because they are unaware of what is on offer or because they are unaware of the scope of the degree programme itself [12].

In contrast to Mexico, in the research by García Martínez, et al. [13] carried out at the University of Hermosillo, it is noted that students opt for the university mainly because of the geographical location and infrastructure; thirdly, costs, as it is a public institution and the cost of enrolment is more affordable compared to public schools [13].

4. Research Methodology

4.1. Paradigm

Hernández, et al. [14] suggest that the quantitative approach is where research objectives and questions are derived from a narrow idea, the literature is reviewed and a theoretical framework is constructed, For Creswell and Creswell [15] the key advantages of the quantitative approach include its precision and accuracy through the use of robust statistical methods. Objectivity is a significant advantage by minimising subjective bias in data collection and analysis.

For their part, Hernández, et al. [16] point out that the quantitative approach is characterised by its objectivity and precision by minimising subjectivity through structured methods and statistical tools. The numerical nature of the data collected facilitates its analysis. Next, Johnson and Christensen [17] mention that quantitative studies are characterised by being highly structured and controlled, with hypotheses and variables clearly defined from the outset, which allows the results obtained to be generalised to larger populations, provided that a representative and adequate sample is used.

This study employs a quantitative approach, as it is sequential and evidential, representing a set of processes. It is not possible to "skip" or avoid steps; each stage precedes the next. We can redefine some stages, although the order is rigorous.

4.1.1. Level

For Hernández, et al. [16] exploratory research allows the researcher to adjust the focus as the study progresses, being flexible and open-ended. To gain a preliminary understanding of the phenomenon, they employ qualitative methods such as interviews, focus groups and literature review. In this sense, the present research employs an exploratory level of research, as it is used when the topic is new or little studied.

4.1.2. Method

On another point, the comparative method according to Comte and Durkheim quoted by Baena [18] consider that comparison constitutes the fundamental method of the social sciences, similar to experimentation. According to Littré quoted by Baena [18] comparison presupposes the existence of similarities and differences. One does not compare things that are absolutely identical or completely different. To compare is to examine similarities and differences simultaneously. For Nohlen [19] the comparative method seeks to identify causal factors and relationships between independent variables (causes) and dependent variables (effects), being an alternative to experiment.

In this research, the comparative method will be used to analyse, contrast and identify significant patterns, similarities and differences in the case study, enriching the understanding of the case.

4.1.3. Procedure

According to Urra Medina and Barría Pailaquilén [20] a systematic review reduces bias and chance errors by summarising the results of several primary research studies. For Snyder [21] the purpose of a Situation Review is to recognise all empirical evidence that addresses a specific research question and that satisfies certain pre-defined inclusion or exclusion criteria.

Ciapponi [22] points out that systematic reviews (SRs) serve crucial functions, such as

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summarising available knowledge in a field, setting priorities for future research, answering questions that individual studies cannot resolve, identifying deficiencies in previous research that require correction, and developing or validating theories about particular phenomena. Thus, SRs produce diverse forms of knowledge that are valuable to different users.

The PRISMA statement contains a comprehensive document that explains and supports the 27 elements set out, as well as detailing how these guidelines were developed. As an educational resource, it includes seven explanatory tables that address key issues related to the methodology and conduct of systematic reviews (SRs). Topics covered include terminology, formulation of research questions, identification and collection of data, assessment of study quality, risks of bias, statistical synthesis methods such as meta-analysis, and biases associated with selective publication of studies or results [23].

The PRISMA 2020 version was created primarily to evaluate systematic reviews (SR) focused on studies on health interventions, regardless of the design of the included studies. However, it can also be applied to SRs from other fields, such as social or educational interventions, and can be adapted to different purposes, such as investigating aetiology, prevalence or prognosis. This tool is useful for both SRs with statistical synthesis (such as meta-analysis) and those without, and is suitable for original, updated or "living" (continuously updated)

reviews. In addition, it provides definitions of key terms used in PRISMA 2020 and its flowchart, accompanied by detailed explanations that facilitate their understanding and application [22].

For this study, the first 4 sections of the PRISMA 2020 methodology were used, which according to Sánchez, et al. [24] are described below:

Section one should clearly and concisely state the subject of the research, which should mention that it is a systematic review, thus facilitating its location in databases [24].

Section 2 consists of a single topic, referring to the summary of the paper. It has the main purpose of the article, where the research design used can be specified and a review of the background and emerging methodologies can be made.

For Section 3, which contains the introduction, the focus is on topics 3 and 4 of the PRISMA protocol. Both are related to the introduction that an SR should contain, a justification of the SR in the context of existing knowledge (topic 3). Before concluding this section, it will be necessary to provide an explicit statement of the objectives of the SR (topic 4).

Section 4 of the Method addresses topics 5 to 15 of the PRISMA protocol, which deal with the methodology for conducting a SR properly.

Incidentally, eligibility criteria are selected to determine the inclusion and exclusion of articles in the final synthesis, as well as the principles of informational grouping. In order to obtain solid results that allow us to analyse studies in line with our interest, the search must be fruitful. The process of locating sources and resources begins with the selection of studies according to eligibility criteria. Sources to include and exclude are determined, using keywords to extract data and answer the research question.

A content analysis is necessary to extract the information from the documents reviewed and to align each article according to defining and determining elements.

In that sense the PRISMA 2020 methodology is used in this systematic review because it ensures a structured, transparent approach to information collection and analysis. In addition, it provided a detailed guide in which the review of the ninety-nine articles was identified, selected, evaluated and synthesised for our case, thus ensuring that the steps of the process were rigorously documented. This is essential to minimise bias and ensure that the results obtained are reliable.

In addition, PRISMA facilitated comparability in the review of papers by establishing standards that promote uniformity in the presentation of results, along with flowchart and guidelines for assessing the quality of studies, thus making the systematic review comprehensible and guiding this research.

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5. Findings

In the present study, the information flow proposed by PRISMA [25] was adhered to and the four stages of the process were implemented with the aim of generating a high level of confidence in the documents intended for the study. The stages of the Return Service are illustrated in Figure 1.

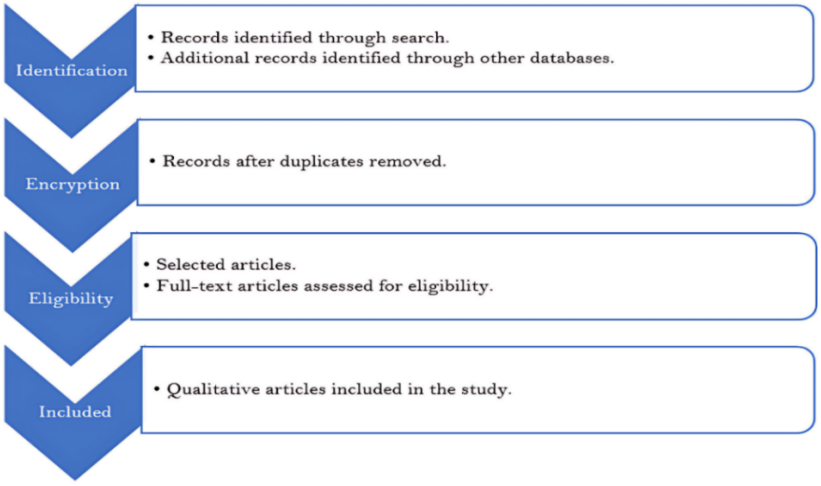

Figure 1.
PRISMA Flow Diagram.
Source: Reynosa Navarro, et al. [26].

During the initial phase, databases were used to identify manuscripts that corresponded to the research topic. The following words were used: 'factors', 'influence', 'choice', 'university' and 'engineering careers'; in addition, only articles from the years 2024 were selected. After examining the articles present in the databases in synthesis and performing the first analysis, the resulting studies were N=98 articles that could be considered full text.

In the second step, duplicate manuscripts were removed and those not related to the research object were excluded. For this step, 12 duplicate manuscripts were removed and 39 manuscripts that are not related to the object of research were excluded.

In the third step, relevant information was extracted from each paper, and in the final step, the inclusion of papers in the study was determined. For this step, it was determined to include 13 manuscripts. In this step, a logbook was developed in order to record information from the final manuscripts.

Table 1 shows an example of the format used to complete the information in each manuscript.

Table 1.
Example of a logbook.

Manuscript no.	Summary	Main Findings	Reference style

The previous table shows in the first column the list of the manuscripts, then the second column shows the abstract of the manuscript, highlighting the purpose, materials and procedures, and conclusions of each research; then, the third column sets out the most relevant findings of each study; finally, the fourth column illustrates the reference style of each manuscript.

Table 2 illustrates the analysis of the identified factors. The first column represents the element to be assessed, the next column represents the authors of the research and the third column represents the number of the factor.

Table 2.
Frequency of Factors mentioned by authors.

Factors	Autohrs	Quantity
Family factors	Vásquez Soto, et al. [27]; Rivera Talavera, et al. [28]; Chuica Mogollón and Estrada Arismendiz [29]; Joya Aldana [30]; Rodríguez Garcés, et al. [31]; Quispe Gonzales [32]; Quemada [33]; Sainz [34]; Cervero [35]; Armijos Troya [36]; Villegas Ávila, et al. [37]; Rudi and Sgreccia [38].	12
Educational factors	Vásquez Soto, et al. [27]; Romero González [39]; Chuica Mogollón and Estrada Arismendiz [29]; Joya Aldana [30]; Rodríguez Garcés, et al. [31]; Quispe Gonzales [32]; Quemada [33]; Sainz [34]; Cervero [35]; Armijos Troya [36]; Villegas Ávila, et al. [37]; Rudi and Sgreccia [38].	12
Economic factors	Vásquez Soto, et al. [27]; Rivera Talavera, et al. [28]; Chuica Mogollón and Estrada Arismendiz [29]; Joya Aldana [30]; Rodríguez Garcés, et al. [31]; Quispe Gonzales [32]; Quemada [33]; Sainz [34]; Armijos Troya [36]; Villegas Ávila, et al. [37]; Rudi and Sgreccia [38].	11
Individual factors	Vásquez Soto, et al. [27]; Rivera Talavera, et al. [28]; Chuica Mogollón and Estrada Arismendiz [29]; Rodríguez Garcés, et al. [31]; Quispe Gonzales [32]; Cervero [35]; Villegas Ávila, et al. [37].	7
Social and academic environment	Vásquez Soto, et al. [27]; Quispe Gonzales [32]; Quemada [33]; Villegas Ávila, et al. [37]; Rudi and Sgreccia [38].	5
Gender stereotypes	Vásquez Soto, et al. [27]; Quispe Gonzales [32]; Villegas Ávila, et al. [37]; Rudi and Sgreccia [38].	4
Geographical factors	Quemada [33]; Sainz [34]; Villegas Ávila, et al. [37]	3
Vocational guidance	Cervero [35]; Villegas Ávila, et al. [37]; Rudi and Sgreccia [38].	3
Institutional support	Quemada [33]; Villegas Ávila, et al. [37]	2
Fear of failure	Cervero [35]; Villegas Ávila, et al. [37]	2

Table 3 symbolises the synthesis of the factors, where the initial column denotes the element number, the subsequent column denotes the factors and the third column denotes the number of authors who agreed.

Table 3.
Success Factor identified.

No.	Factors	No of authors
1	Family factors	12
2	Educational factors	12
3	Economic factors	11
4	Individual factors	7
5	Social and academic environment	5
6	Gender stereotypes	4
7	Geographical factors	3
8	Vocational guidance	3
9	Institutional support	2
10	Fear of failure	2

The selection of a higher education institution in the field of engineering is influenced by a number of factors, including family, educational and economic factors. Ten factors are highlighted in total.

6. Conclusions

Significant patterns were found in the factors influencing the selection of higher education institutions for engineering studies. In the studies reviewed, 11-12 authors mentioned family, educational and economic aspects as the most influential factors. They identified ten main factors. The choice of a higher education institution is influenced by the wider social and economic context, not only the individual. Seven authors mentioned external aspects more than individual factors. Educational decisions in engineering are not influenced by personal preferences, but by external influences and practical considerations. Four authors mentioned gender stereotypes, while five authors mentioned the social and academic environment as a significant secondary factor. Socio-cultural barriers in the

choice of engineering careers persist and require attention in future education policy.

Institutional support and fear of failure, mentioned less frequently, can have a crucial impact on individual cases and should not be underestimated. The findings have valuable impacts on educational policies and institutional strategies. Socio- cultural challenges should be taken into account, more financial support should be provided and vocational orientation programmes should be implemented in order to optimise engineering education.

6.1. Future Work

It is suggested to examine the impact on the academic decision-making process and content creators in the field of science and technology. It is also recommended that a study be conducted on the interrelationship between socio-economic factors and the development of STEM skills in pre-higher education, with a focus on the field of engineering.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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