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Gender Disparities, Career Choices, and Wage Dynamics in STEM Occupations in Brazil

STEM Classification for Brazilian Higher Education

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Abstract

We propose a STEM field classification tailored to the Brazilian Higher-Education Censuses, henceforth abbreviated as HEC. To the best of our knowledge, this is the first attempt at defining an easily reproducible STEM classification template for Brazilian higher education, that is also consistent across multiple years of the HEC. It can be used as a basis for both researchers and policy makers exploiting HEC data to study issues such as the progress of gender diversity in STEM educational fields, which has become an important topic in academia and public debate. To this end, we take advantage of the availability of *ISCED* codes in HEC data-sets. These codes represent a *UNESCO* international standard for classifying degrees according to subject areas, which allow us to build on a compatible *SAGA-UNESCO* STEM field classification, modifying it to better suit to the context of Brazilian higher education.

Keywords: STEM fields, Higher Education, Brazil, HEC, *ISCED* codes, *INEP*, CINE, *SAGA - UNESCO*, gender

1 Introduction

In recent years, policy and academic debates have placed a spotlight on initiatives seeking to expand and diversify STEM (Science, Technology, Engineering and Mathematics) education. Encouraging and tracking the participation of women and other minorities in STEM is now part of the agenda of many international bodies and research institutes, including *UNESCO*, the *OECD*, the *World Bank*, the *US Census Bureau*, the *US Department of Commerce* and the *National Science Foundation (USA)*. In spite of the growing relevance of this subject, classifications of STEM educational fields aren't always available, particularly within specific contexts, such as the Brazilian higher education system.

Building on a well known international standard, this paper provides a classification guide to STEM degrees in Brazil, that can serve those seeking to utilize *INEP's*[1] HEC data-sets (i.e. "Higher-Education Census"). Maciente et al. (2014) and Schwartzman (2018), offer some alternatives for classifying Brazilian higher education STEM fields, but do not discuss in detail their classification criteria. Both references define STEM fields in the context of cross-sectional data-sets (the 2000 and 2010 Brazilian Demographic Census, and the 2013 HEC, respectively). Using the same inputs (i.e. *ISCED* codes), this paper proposes an updated classification which can cover Brazilian higher education over multiple years in a consistent manner, including the the newest versions of the HEC, up to 2019.

HEC data is collected by *INEP*, from every registered higher education institution in the country, on a yearly basis. Each data-set contains nation-wide, individual-level, identified data, with student, institution and degree characteristics.[2] As such, they provide an impressively detailed panel of higher education in Brazil, which allows researchers to study issues of global significance, including diversity in STEM fields.

The STEM field classification provided here is applicable to all higher education censuses

[1] *INEP* stands for *Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira*, a government research body focused on education statistics.

[2] Data-sets with unique identification numbers - the Brazilian Taxpayer Registry (*Cadastro de Pessoa Física or CPF*) can only be accessed in Brasilia, in a secure room, with prior authorization from *INEP*, but yearly data-sets with re-coded ids are available to the public at: https://www.gov.br/inep/pt-br/acesso-a-informacao/dados-abertos/microdados/censo-da-educacao-superior.

ranging from 2010 to 2019 [3], which contain *ISCED* degree identification codes, developed by *UNESCO* and adopted by many other international organizations such as the *OECD* and EUROSTAT. What makes *ISCED* codes useful when classifying STEM fields, is that *SAGA* (*STEM and Gender Advancement*), a global policy initiative created by *UNESCO*, has already developed an educational STEM field classification, compatible with *ISCED* codes, which are available in *INEP*'s data-sets. Thus, combining *SAGA's* STEM classification with *ISCED* codes, available for Brazilian data, provides a starting point for identifying STEM degrees.

Using the 2017 HEC and replicating the classification recommendations detailed in Section 3, we determine that close to 1.42 million students were enrolled in STEM higher education degrees (excluding technological majors). This represents about 19.7% of 2017 Bachelor's Degrees' enrollments in Brazil. Applying *SAGA's* STEM classification to higher education data for the US[4], we find similar results. In 2017, there were approximately 2.00 million students enrolled in STEM fields in the US (excluding short-cycle degrees)[5], which represented about 22.1% of total Bachelor's or Equivalent enrollment in the United States.

Section 2 briefly explains the format of *ISCED* codes and *SAGA - UNESCO's* method of classifying STEM fields. Section 3 suggests how to successfully apply this classification to the *INEP* data-set, including key adaptations that provide consistency over time and that are best suited to the context of Brazil.

[3]Currently, the last available *INEP* data-set is HEC - 2019

[4]Source: *OECD* (2019), "Education Database: Enrolment by field (Edition 2019/1)", *OECD* Education Statistics (database), https://doi.org/10.1787/f46d4ea6-en (accessed on 28 January 2021).

[5]Many countries, including the US, choose to codify shorter tertiary (2-3 years) at a different *ISCED* level, in line with the newest *ISCED* standards. Level 5 of the *ISCED-F* (2013) is reserved for Short-Cycle tertiary education and level 6 for conventional Bachelor's or Equivalent degrees. However, in the case of *INEP*, this division is not applied, although it can roughly be inferred through the variable that describes type of degree **"CO_GRAU_ACADEMICO"**. To keep the comparison between the two countries clear, the numbers mentioned in this paragraph only refer to strictly Bachelor's or Equivalent (level 6) degrees.

2 *SAGA's* STEM Classification for Brazil

2.1 *SAGA's* STEM field classification

This subsection details *SAGA* - *UNESCO's* Higher Education definition of STEM Fields, which is compatible with the new *ISCED* codes seen in Table 1 (in the right column). *SAGA* considers as STEM, all higher education degrees within three of the broad fields: **05 Natural sciences, mathematics and statistics, 06 Information and communication technologies and 07 Engineering, manufacturing and construction**. This definition is available in the 2017 working paper entitled "Measuring gender equality in science and engineering: the *SAGA* toolkit", therefore it is compatible with the new version of *ISCED* codes division, revised and released in 2013. Table 2 provides a finer breakdown of these fields, only up to the detailed field level.

2.2 *ISCED* codes:

Conceived in the early 1970s, the International Standard Classification of Education (*ISCED*) was officially accepted by *UNESCO* country as a standard for classifying educational fields in 1976. Its central function is to facilitate cross-national comparisons of educational statistics, at all levels. In particular *ISCED* - level 6 codes are used to classify higher education fields of study. The fundamental criteria for separating degrees into fields is subject content, including the distinction between practical and theoretical approaches. The *ISCED* rests on "internationally agreed concepts and definitions and *ISCED* mappings of education programmes and related qualifications in countries worldwide".

Prior to a revision in 2013, *ISCED* codes were compromised of 3 digits followed by an alphabet letter and another two digits (e.g. all Biology degrees were classified by the code "421C01"). The first digit represented the **broad field of study**, in this case "4" - "Sciences", the first two digits combined represented the **narrow field of study**[6] - i.e. in the example above "42" stood for "Life Sciences" - and the third digit combined with the first two provided the **detailed field of study**, the remaining characters (e.g. "C01"), consist of

[6]The "broad fields of study" are interchangeably referred to as "general areas of study" in *INEP* data-sets and "narrow fields of study" are referred to as "specific areas of study".

a letter and two subsequent digits, representing the labels that distinguish between degrees within a same detailed field of study (e.g. distinguish "pure" Biology from Biochemistry).

From 1997 to 2013, *UNESCO* had nine separate broad fields of study, namely, 0 - General programmes, 1 - Education, 2 - Humanities and Arts, 3 - Social sciences, business and law, 4 - Sciences, 5 - Engineering, manufacturing and construction, 6 - Agriculture, 7 - Health and welfare, 8 - Services. In 2013, *UNESCO* revised this classification to appropriately account for the changing landscape of higher education. It added two new broad fields, whilst updating the names and descriptions of sub-fields at each subsequent level of aggregation, and conducting a few inclusions and exclusions at the finest level.[7]

Two main changes stemming from the revision should be noted: first, the separation of the field 3 - Social Sciences into: 03 - Social sciences, journalism and information and 04 - Business, administration and law; Second, the creation of a separate field for ICT (i.e. 06 - Information and Communication Technologies), which formerly was known as 48 - Computing, thus a part of the broad field 4 - Sciences. Crucially, adding these two new broad fields, brought the total up to eleven, meaning that broad field 10 would necessarily require two digits at the start of the *ISCED* code to be represented. Because of this, to keep the number of characters in each code constant, a new convention was set, with the first two digits now representing the broadest level aggregation, instead of only one digit. When needed (from 0 to 9) a zero was added to the start of single digits formerly representing each broad fields. Broad field 0 became 00, broad field 1 became 01 and so on. As an example, the new code for a Biology degree became"0511B01", where "05" at the start now stands for the broad field 05 - Natural sciences, mathematics and statistics.

Table 1 provides a breakdown of *ISCED* broad fields of study, in bold, and the narrow fields contained within them. The left column refers to *UNESCO's* Field division prior to the afore-mentioned 2013 revision (on the right), which added two new broad fields of study.

2.3 *SAGA* and *INEP* consistency issues

SAGA - UNESCO's STEM definition was created to fit the 2013 division of *ISCED* fields, but the yearly higher education censuses, conducted by *INEP*, only started using this classification

[7]Some degrees did switch to a different broad field after the revision and most labels were slightly altered.

division in 2018, as seen in Figure 1. This means that with the exception of the 2018 and 2019 censuses, for all other available years, that is, from 2010 to 2017, the data-sets are consistent with the previous division of fields of study available in the 1997 *ISCED* guide, which was adapted and adopted by *INEP* in the year 2000.

This brings us to the central challenge of defining STEM fields consistently, over time, in spite of *INEP's* 2018 revision. A direct manner of classifying STEM fields would be to adapt *SAGA's* STEM definition to *INEP's* data, by simply considering that for all years prior to 2018 (when *INEP* adopted the new revised *ISCED* codes), narrow-field "48 - Computing", is equivalent to the new broad field "06 - Information and communication technologies", which *SAGA* deems to be one of three STEM broad fields. Its first appearance in census data is only in 2018, after the revision, thus the need for this adaptation.

On the surface, this approach makes sense, since the most relevant change to *ISCED* classification affecting STEM fields was the previously mentioned separation of Computing from Sciences, which created an "extra" STEM broad field, namely 06 - Information and communication technologies. However this approach alone, would ignore several smaller changes to field names and the degree contained within them, which were also a part of *INEP's* 2018 update of *ISCED* classification codes. Most of these changes are also found in the original *ISCED-F* 2013 revision (again, see Figure 1), however *INEP* also promoted some of its own changes, to suit the particular context of Brazilian higher education.

Strange behaviour is detected in the descriptive statistics generated with INEP data using the direct method described in the paragraph above, without accounting for the smaller changes mentioned in the last paragraph, particularly when investigating gender differences across STEM fields. Figure 2 plots the evolution of the share of total STEM enrollment in each of the three STEM broad fields defined by *SAGA*. Here the narrow field of 48 - Computing (contained within 4 - Sciences) in years prior to 2018 is considered equivalent to 06 Information and communication technologies. And the broad field 4 - Sciences (minus Computing), that already does not contain Social Sciences, is considered equivalent to the broad field 05 - Natural sciences, mathematics and statistics.[8]

[8] A quick visual inspection of Table 1, comparing the left and right columns, indicates that these groups are generally equivalent to each other, given that they contain almost identical narrow-fields within them.

Notice that Figure 2 displays a marked jump in the share of STEM enrollment that the field of Information Technology represents, and a drop in the Natural sciences, mathematics and statistics field, exactly when the revision occurs, in 2018. The plots are smooth otherwise. This suggests that the method above does not adequately adjust to the actual changes implemented by *INEP's* revision of *ISCED* codes in 2018. In fact, as we will see in the next subsection, the 2018 trend break is much less apparent when adjusting the data backwards to account for most of the detailed changes made to these fields in the same year.

Figure 3, which depicts the share of women enrolled in each of the STEM fields, is another strong indicator of how this more "direct" method of classifying STEM fields, based solely on *SAGA's* definition, generates inconsistency in the data, between censuses before and after 2018. The eye-catching drop in the share of women participating in broad filed 05 - Natural sciences, mathematics and statistics, is actually caused by *INEP's* removal, in 2018, of female dominated degrees from this broad field, in particular Biomedical degrees, which were moved to broad field 09 - Health and welfare.

In light of this, the next subsection points to a few key recommendations that can be used to construct a more robust classification of STEM fields, which is more reliable overtime and suits Brazilian higher education data better, and is mainly useful for research focused on studying STEM in connection to gender diversity.

3 STEM classification recommendations for HEC data

Many different institutions suggest definitions of STEM educational fields. Here, it will be important that we select as a basis for our classification, a division of STEM fields that best aligns with Brazil's higher education structure, including the different types of degree certificates available, and that can facilitate future links to STEM occupation classifications in our context. Unlike the division used to construct Figures 2 and 3, which closely follows *SAGA-UNESCO's* definition of STEM broad fields, (seen in Table 2), we suggest four distinct STEM fields instead of three.

Group 1 will consist of all Computation and Mathematics related degrees. This requires removing the *ISCED* narrow fields 46 - Mathematics and Statistics (up to 2017) and 054 - Mathematics and Statistics (after 2017) from broad fields 4 - Sciences and 05 - Natu-

ral sciences, mathematics and statistics, respectively; and placing them together with 48 - Computing (also removed from 4 - Sciences) and 06 - Information and Communication Technologies. There are two main reasons why Group 1 suits *INEP* data:

First, several well known STEM field classifications already separate Physical and Life Science degrees from and Mathematics and Statistics degrees and some group Mathematics related and Computer degrees. These include, classifications by the *NCES*, the *US Department of Commerce* and the *US Census Bureau*, the last two of which, have been used to develop crosswalks between STEM higher education fields and STEM occupational fields. Thus, keeping with this convention might ease the process of building of connections between higher education STEM fields and STEM careers in Brazil.

Second, and perhaps most importantly, one of the main reasons why Mathematics and Statistics are often separated from Physical and Life Sciences, is that the proportion of female vs male students enrolled in Physical and Life Sciences and Mathematics and Statistics are vastly different. Typically, a larger share of female STEM college students is concentrated in Physical and Life Sciences. This is true both of the US and Brazil.[9] Thus, for researchers studying gender diversity in STEM education, keeping these two fields together might be particularly problematic.

Lastly, the reason why Mathematics and Statistics are often grouped with Computer degrees is that, on its own, enrollment in these degrees represents a relatively small percentage of total STEM enrollments. According to the 2015 American Community Survey, only about 7% of college educated workers in the US have a degree in mathematics or statistics and in Brazil less than 4% of total enrollments in STEM, over the course of 11 years of *INEP* data, refer to math and statistics degrees. So grouping math related degrees with the second smallest STEM field (i.e. ICT degrees), is a commonly used classification strategy.

The remaining three STEM field groups are easier to interpret. Group 2 will almost exactly reproduce the *ISCED* broad field of Engineering, manufacturing and construction. The broad field code for this group was 5 prior to 2018 revision and 07 after. The most significant modification, however, is the exclusion of Architecture and town Planning majors

[9]See the report "Women in STEM: 2017 Update", produced by the *US Department of Commerce* and referenced in the bibliography.

from this group. It is prudent to separate them from Engineering degrees, because in Brazil the content of architecture related degrees tends to be far less mathematical than traditional engineering. Architecture and town Planning degrees are represented by detailed field 581 prior to 2018 and 0731 from 2018 onward. In our proposed classification, they will compose a new STEM group. With this separation, Group 2 will contain all standard Engineering and Related degrees and Group 3 will contain only Architecture and Related degrees. Finally, Group 4 will contain Physical and Life Science degrees, i.e. those that remain in broad field 4 (prior to 2018) and 05 (2018 onward) after having moved all computer and mathematical related degrees to Group 1.

Table 3 dissects these four STEM groups. The first column separates each group by name, the middle column provides the older *ISCED* field codes and names used by *INEP* up to 2018, that are contained in each group, and the right-most column displays *ISCED* codes and names, post-revision. All narrow-fields (second broadest *ISCED* level of aggregation), included in each of the four STEM groups, have their names and codes labeled in bold next to their two (2010 - 2017) or three digit *ISCED* identification codes (2018 -). Narrow fields typically contain many detailed fields within them and several individual degrees within those detailed fields. Directly bellow these narrow-fields there are also inclusions of individual level degrees, which are uniquely identified by their complete *ISCED* codes, with five or six characters and then individual exclusions from each groups (that originate in one of the already listed narrow-fields).

These degree level (finest) inclusions and exclusions aim to improve the consistency of the four suggested STEM groups, particularly when comparing years before and after the 2018 revision of *ISCED* fields. Using the guideline publication **"Manual para Classificação dos Cursos de Graduação e Sequenciais - Cine Brasil 2018"**, we mapped most of these less prominent changes, happening within the narrow-fields, and adjusted the STEM groups to account for anything that we believed might significantly affect the consistency of the four STEM groups before and after the coding modifications, in 2018.

Specifically, we conduct this process of adjustment backwards, using the new division of narrow-fields in 2018 as a reference. First, within each group we relocate (exclude/include)

degrees that we know either switched to a new STEM narrow-field, after 2018[10], or were entirely excluded from the four STEM groups. In this last case, they are moved to their new Non-STEM narrow-field. A few significant changes should be mentioned at this point:

First, before 2018 all Computer Engineering degrees were included in field 52 - Engineering and engineering trades, and Computer Networks Management and Information Technology Management were part of narrow field 3 - Business and Information. These "computer related" degrees, so to speak were moved to Group 1 - Computer and Math, to retain consistency with the *INEP's* new classification in 2018, in which they were included in broad field 06 - Information and Communication Technologies, which is contained entirely in our suggested Group 1. These changes are registered in Table 2 under the inclusions for group 1 and under the exclusions for group 2, before the 2018 revision.

Additionally, in the 2018 *INEP* revision, Computer Engineering degrees were split into to two types (same names, different codes, based on legal resolutions). One of the types was placed in narrow-field 061 (thus part of STEM Group 1) and the other remained in narrow-field 071 - Engineering and engineering trades. In our classification, again, to retain consistency, both types of Computer Engineering degrees are included in Group 1, since, as mentioned in the last paragraph, all Computer Engineering degrees were moved to Group 1 for years prior to the revision. Again, this can be seen in Table 2 under inclusions to STEM Group 1 and exclusions to Group 2 (right column).

A second significant change to the 2018 classification, worth mentioning, is the creation of the new detailed-field 0712 - Environmental Protection Technology, under broad field 07 - Engineering, Manufacturing and construction. This broad-field is contained in Group 2, and absorbed Environmental Sanitation degrees and Environmental Management degrees, thus justifying the inclusions of these degrees in Group 2, for years prior to the revision, seen in the left column.

Lastly, two Biomedical related degrees originally contained in the narrow field 42 - Life sciences, prior to the 2018 revision, were relocated to broad fields outside of STEM. See the exclusions from Group 4. This was done to match data for years prior to 2018, to the

[10]This process is done manually, since *INEP* altered most degree names slightly. Also, some degrees might not have been relocated if *INEP's* publication did not specifically mention those changes

new classification, which moved all Biomedical related degrees to broad-field 09 - Health and Welfare.Thus, they had to be removed retroactively from Group 4: Physical Life Sciences. A few remaining modifications, that follow the classification guide published by *INEP* in 2018, (see Figure 1), are also listed in Table 3 (under exclusions and inclusions), but are quite minor in terms of there impact on the STEM groups and thus do not warrant further detailing.

With the changes described in the last paragraph, and seen in Table 3, we are able to achieve a more consistent classification of higher education STEM fields in Brazil, that is not as susceptible to the issues brought to light by Figures 2 and 3. Figures 4 and 5, plot the same statistics but now subdividing STEM fields following this section's recommendations. There are thus four STEM groups and as we can see, with the new classification there aren't any major discontinuities in the both the share of enrollment and the share of women with each STEM group, indicating that indeed, the suggested classification offers some advantages, over the direct method mentioned in subsection 2.3.

On a final note, it is also important to make sure that the STEM classification suggested in the present section adequately distinguishes between technological degrees and undergraduate degrees in Brazil. Both are included in *INEP's* Higher Education Censuses, but technological degrees have an emphasis on the practical aspect of subject areas and typically last only 2 to 3 years, as opposed to the conventional, 4 to 6 years, undergraduate degrees. Adding this dimension to the classification can provide a deeper understanding of the data and how STEM fields have evolved differently in Brazil, depending on degree types.

Thus,each STEM group can be divided into two different sub-groups, by type of degree. The categorical variable **"CO_GRAU_ACADEMICO"** contained in all HEC data-sets reads as 3 if degrees are technological. It can be used to distinguish between undergraduate and technological degrees. With four STEM groups, this separation will yield eight distinct STEM sub-groups. However, there are almost no students enrolled in technological degrees in Group 3: Architecture Related and Group 4: Physical and Life Sciences in Brazil, and thus for the sake of brevity and visual practicality, these two sub-groups could be omitted from analyses exploring the distinction between types of STEM degrees.

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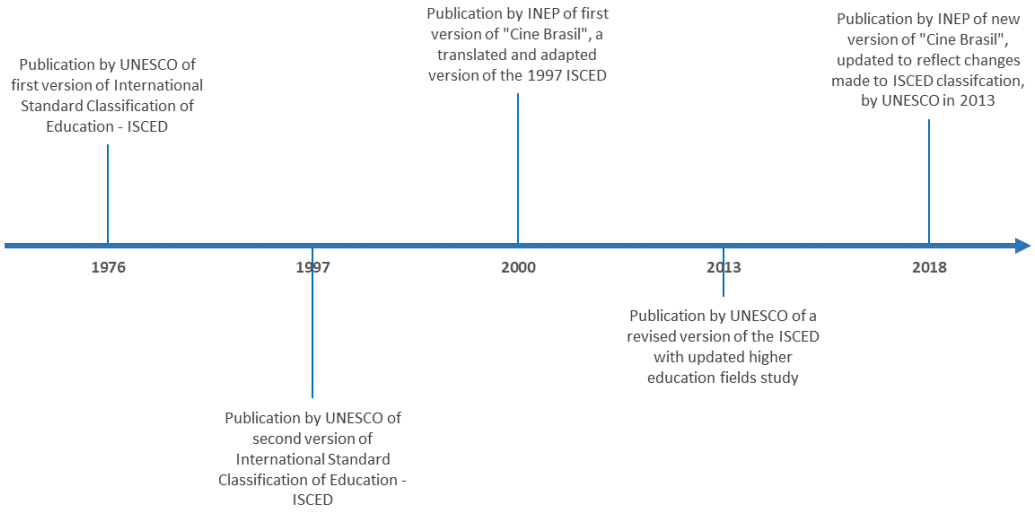
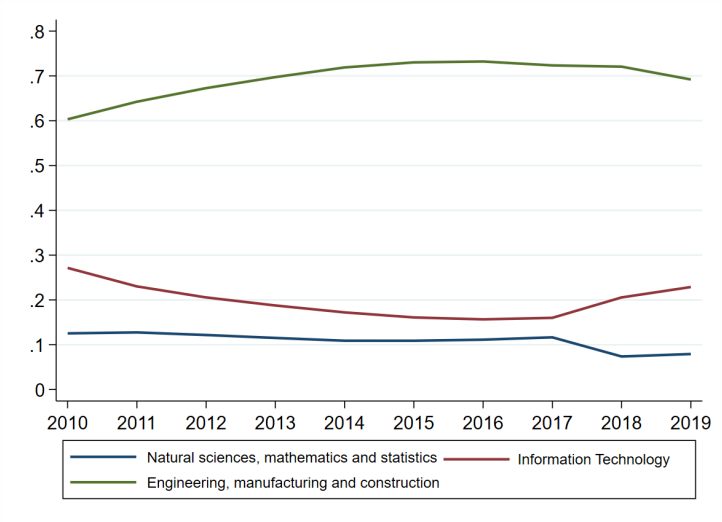
Figure 1: Timeline of ISCED and INEP publications



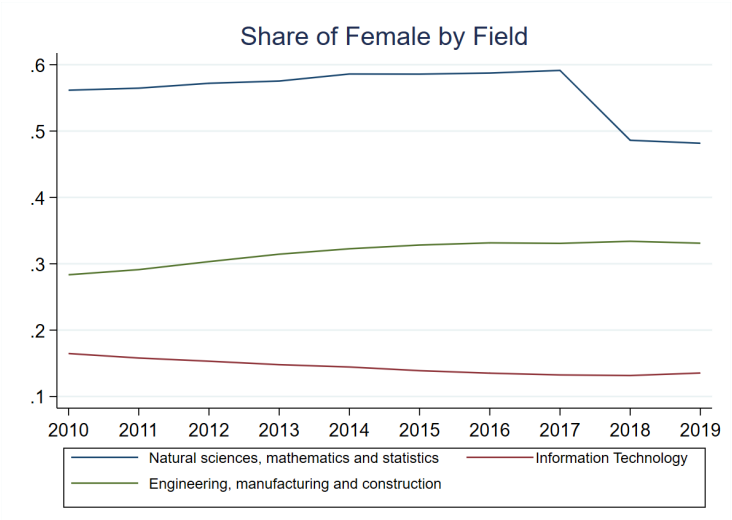
(a) Note: This figure summarizes the chronological order of a few key events relating to the publication of ISCED guides and their subsequent adoption by INEP. This "timeline" also includes the previously discussed revisions by UNESCO, in 2013, and the subsequent adaptation of this revision by INEP, in 2018 .

Figure 2: Share of total STEM enrollment by SAGA fields



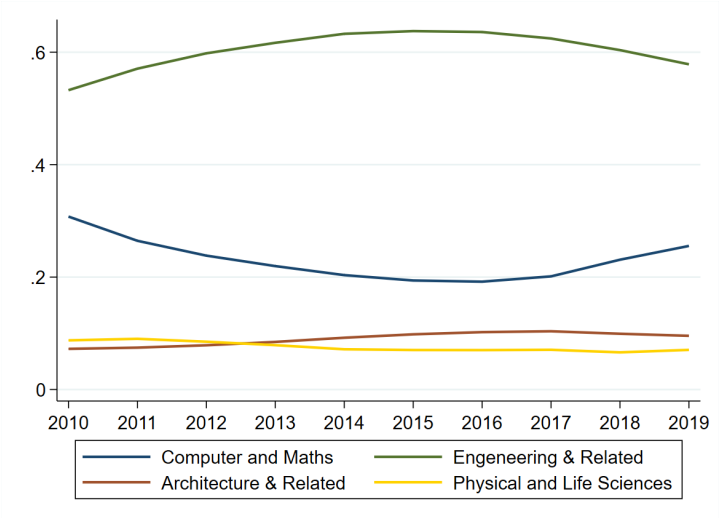
Source: Author's calculations using HEC - INEP data, from 2010 to 2019.

Figure 3: Share of Women in STEM by SAGA fields



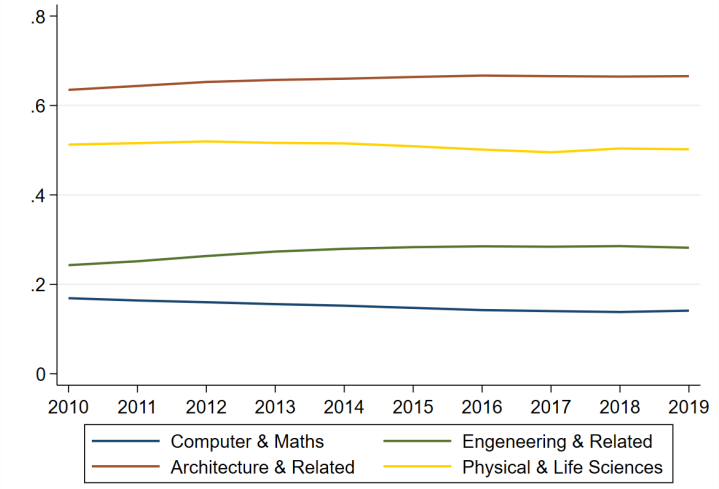
Source: Author's calculations using HEC - INEP data, from 2010 to 2019.

Figure 4: Share of total STEM enrollment by suggested groups



Source: Author's calculations using HEC - INEP data, from 2010 to 2019.

Figure 5: Share of Women in STEM by suggested groups



Source: Author's calculations using HEC - INEP data, from 2010 to 2019.

Table 1: UNESCO - Field of Study Breakdown

ISCED 1997 (and 2011): Fields of Education	ISCED-F: Fields of Education and Training 2013
0 General programmes	**00 Generic programmes and qualifications**
01 Basic programmes	001 Basic programmes and qualifications
08 Literacy and numeracy	002 Literacy and numeracy
09 Personal development	003 Personal skills and development
1 Education	**01 Education**
14 Teacher training and education science	011 Education
2 Humanities and Arts	**02 Arts and humanities**
21 Arts	021 Arts
22 Humanities	022 Humanities (except languages)
	023 Languages
3 Social sciences, business and law	**03 Social sciences, journalism and information**
31 Social and behavioural science	031 Social and behavioural sciences
32 Journalism and information	032 Journalism and information
34 Business and administration	**04 Business, administration and law**
38 Law	041 Business and administration
	042 Law
4 Science	**05 Natural sciences, mathematics and statistics**
42 Life sciences	051 Biological and related sciences
	052 Environment
44 Physical sciences	053 Physical sciences
46 Mathematics and statistics	054 Mathematics and statistics
48 Computing	**06 Information and communication technologies**
	061 Information and communication technologies
5 Engineering, manufacturing and construction	**07 Engineering, manufacturing and construction**
52 Engineering and engineering trades	071 Engineering and engineering trades
54 Manufacturing and processing	072 Manufacturing and processing
58 Architecture and building	073 Architecture and construction
6 Agriculture	**08 Agriculture, forestry, fisheries and veterinary**
62 Agriculture, forestry and fishery	081 Agriculture
	082 Forestry
	083 Fisheries
64 Veterinary	084 Veterinary
7 Health and welfare	**09 Health and welfare**
72 Health	091 Health
76 Social services	092 Welfare
8 Services	**10 Services**
81 Personal services	101 Personal services
85 Environmental protection	102 Hygiene and occupational health services
86 Security services	103 Security services
84 Transport services	104 Transport services

Note: This table provides a breakdown of ISCED-UNESCO higher-education fields of study, broad-fields (codes and names) are displayed in bold, the narrow-fields within them are seen in standard font. Detailed fields and degree labels are not displayed for the sake of brevity. The column on the left refers breaks-down the original ISCED classification. The column on the right refers to the new (2013) ISCED-F revision, which altered field names and introduced two new broad-fields. Similar broad (and narrow) fields are aligned to facilitate the visual comparison of the columns.

Table 2: SAGA -UNESCO's STEM Fields (using ISCED-F 2013)

Broad Field	Narrow Field	Detailed Field
05 Natural sciences, mathematics and statistics	051 Biological and related sciences	0511 Biology
		0512 Biochemistry
	052 Environment	0521 Environment sciences
		0522 Natural environments and wildlife
	053 Physical sciences	0531 Chemistry
		0532 Earth sciences
		0533 Physics
	054 Mathematics and statistics	0541 Mathematics
		0542 Statistics
06 Information and communication technologies	061 Information and communication technologies	0611 Computer use
		0612 Database and network design and administration
		0613 Software and applications development and analysis
07 Engineering, manufacturing and construction	071 Engineering and engineering trades	0711 Chemical engineering and processes
		0712 Environmental protection technology
		0713 Electricity and energy
		0714 Electronics and automation
		0715 Mechanics and metal trades
		0716 Motor vehicles, ships and aircraft
	072 Manufacturing and processing	0721 Food processing
		0722 Materials (glass, paper, plastic and wood)
		0723 Textiles (clothes, footwear and leather)
		0724 Mining and extraction
	073 Architecture and construction	0731 Architecture and town planning
		0732 Building and civil engineering

Note: This table, introduces SAGA's (a global UNESCO program) STEM Classification, which is based on the same ISCED codes seen in Table 1 (right column). The names of degrees were translated from Portuguese into English by the author. Different institutions adopting ISCED have control over how they label/name their country's unique degrees, and thus a translation is required. It is also important to note that in the new field division of 2018, degree names, although retaining some similarity to the previous designations, were mostly renamed by INEP.

Table 3: STEM Fields Classifcation using the HEC data (INEP)

	Before CINE-2018 revision:			After CINE-2018 revision		
	ISCED codes:	Narrow Field or Degree name:'		ISCED codes:	Narrow Field or Degree name:	
Group 1: Computer & Mathematics	**46**	**Mathematics and statistics**		**054**	**Mathematics and statistics**	
	48	**Computing**		**061**	**Information and Communication Technologies**	
	Inclusions:			**Inclusions:**		
	523E04	Computer Engineering		0714E04	Computer Engineering*	
	345G27	Computer Networks Management				
	345G03	Information Technology Management				
	Exclusions:			**Exclusions:**		
	None			None		
Group 2: Engineering & Related	**52**	**Engineering and engineering trades**		**071**	**Engineering and engineering trades**	
	54	**Manufacturing and processing**		**072**	**Manufacturing and processing**	
	Inclusions:			**Inclusions:**		
	422S01	Environmental Sanitation		None		
	850G01	Environmental Management				
	Exclusions:		To:	**Exclusions:**		To:
	523E04	Computer Engineering	Group 1	0714E04	Computer Engineering*	Group 1
	520G01	Geo-processing	Group 4			
	541P09	Wine Production	Non-STEM			
Group 3: Architecture & Related	581	Architecture and town planning		0731	Architecture and building	
	Inclusions:			**Inclusions:**		
	None			None		
	Exclusions:			**Exclusions:**		
	None			None		
Group 4: Physical & Life Sciences	**42**	**Life sciences**		**051**	**Biological and related sciences**	
	44	**Physical sciences**		**052**	**Environment**	
				053	**Physical sciences**	
	Inclusions:			**Inclusions:**		
	520G01	Geo-processing		None		
	Exclusions:		To:	**Exclusions:**		
	422S01	Environmental Sanitation	Group 2			
	421B04	Biology - medical modality	Non-STEM			
	421B07	Bio-medicine	Non-STEM			

Note: This table summarizes the STEM classification proposed by the authors. As mentioned in section 3, Computer Engineering degrees with an asterisk and coded as "0714E04" refer only to the type of Computer Engineering originally placed under the broad field 07 after the 2018 revision. INEP included a second type in narrow-field 061, after 2018.