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Professor-Course Affinity: A Transdisciplinary Approach to Standardize Faculty Staffing

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Abstract. High education institutions face significant challenges in hiring part-time faculty, a process that is often tedious and ineffective. Part-time professors struggle to find employment that aligns with their skills, experience, and preferences. This issue arises from the lack of national/international standards for profiling professors and courses, leading to ambiguity in matching faculty with appropriate courses. The importance of resolving this issue lies in its direct impact on the quality and efficiency of educational institutions. This research seeks to address the primary gap in the literature, which is the absence of an inter-institutional mechanism for the standardized profiling and matching of educators to courses in higher education. While there are governmental efforts to catalogue fields of knowledge, they rarely translate into practical, regulated applications within the educational sector. The contribution of this paper relies on developing a transdisciplinary profiling standard utilizing national and international methodologies, coupled with artificial intelligence, to create a profiling and coding algorithm. This approach is validated through quantitative analysis using actual data from a university system, including pre and post-implementation variations in key performance indicators. By standardizing and enhancing the match between educators' skills and competencies versus course requirements, reducing costs, and increasing opportunities for educators, this research fosters a more efficient and socially responsive educational environment aligned with all stakeholders (faculty, students, accreditation bodies, and university managers, among others). It encapsulates the essence of engineering for societal advancement, improving the quality of education and creating a more dynamic and equitable academic landscape.

Keywords. Digital transformation, Faculty Profiling, Staffing Optimization, Transdisciplinary Engineering.

Introduction

The dynamic landscape of higher education, characterized by an increasing reliance on part-time faculty, unveils not merely a gap but a critical challenge in educational institutions' effective and efficient staffing [1]. This challenge, when not addressed appropriately, incurs significant costs for universities and potentially compromises the academic quality received by students. Such implications are highlighted in studies that explore the relationship between faculty employment patterns and educational outcomes, suggesting that suboptimal staffing practices can adversely affect student success rates

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[2]. This underscores the criticality of devising pragmatic staffing methodologies and is grounded in a deep understanding of the educational ecosystem. While this study focuses on part-time faculty due to their higher variability and frequent hiring cycles, the work presented in this paper can also be adapted for full-time faculty hiring and allocation, ensuring a comprehensive approach to optimizing faculty assignments across all employment types.

Compounded by the absence of standardized, pragmatic practices for hiring part-time professors, there is a pressing need for a transdisciplinary approach to bridge the divide between comprehensive academic cataloguing efforts and the tangible technological needs of educational staffing. Extensive efforts by countries to classify educational programs and areas of study—such as the International Standard Classification of Education (ISCED) by UNESCO [3], the Australian Standard Classification of Education (ASCED) [4], the Swedish KLAS [5], the New Zealand Standard Classification of Education (NZSCED) [6], the North American Classification of Instructional Programs (CIP) [7], and Mexico's Clasificación Mexicana de Programas de Estudio (CMPE) by Campos de Formación Académica [8]—have laid a robust foundation for understanding and organizing academic disciplines globally. Yet, these classifications have not been fully leveraged to address the practical challenges of part-time faculty staffing operations in higher education. This complexity of staffing practices, especially the nuanced experiences of part-time faculty that range from voluntary to involuntary part-time roles, suggests a necessity for a more nuanced and adaptable approach in faculty staffing [9]. Additionally, insights into the pedagogical effectiveness of educators, as determined through qualitative feedback, emphasize the importance of incorporating such metrics into the faculty profiling process [10]. Moreover, institutional determinants of part-time faculty employment underscore the complexity of aligning educator expertise with course requirements across varied educational landscapes [11], further advocating for a staffing methodology that is both flexible and sensitive to the institutional context.

In response to these challenges, the contribution of this paper adopts a transdisciplinary strategy [12] aiming to craft a framework that emphasizes the integration of knowledge across disciplinary boundaries to address complex, real-world problems. This contribution blends theoretical knowledge classification efforts with the operational staffing needs of educational institutions through a transdisciplinary standard for profiling and matching educators to courses. By integrating diverse classification systems with an understanding of higher education's nuanced challenges, this work seeks to establish an efficient, responsive, and quality-centric educational staffing model, overcoming traditional divides between academic cataloguing and operational needs. This contribution is dual in nature: it offers a new framework that harmonizes the extensive academic classification efforts with the staffing requirements of educational institutions, and it validates this approach through quantitative analysis, utilizing data from a Mexican university system to examine variations in key performance indicators pre- and post-implementation. Thus, it addresses the immediate challenge of part-time faculty staffing and contributes to the broader discourse on enhancing the quality of education through a transdisciplinary and technologically enabled approach. By encapsulating the essence of engineering for societal advancement, this model aims to improve the academic landscape. Ensuring a closer match between educators' skills and course requirements ultimately benefits academic stakeholders, fostering an environment where quality education and satisfaction among all parties are prioritized.

1. Methods

To address the part-time faculty staffing challenge, the methodology draws inspiration from the principles of transdisciplinary engineering, as highlighted in the case study of the Made Smarter Innovation: Centre for People-Led Digitalisation [13]. This approach underscores the necessity of transcending traditional academic silos to incorporate insights and methodologies from across various disciplines and stakeholder groups. The goal is to devise a staffing framework that meets institutional and regulatory requirements and enhances the satisfaction and engagement of all academic stakeholders. Integrating these insights required the active involvement of internal educational institution teams such as Human Resources and recruitment, Operations and Logistics, Vice-rectorates of academics and program directors, IT teams, and Data Analysis teams. Externally, the solution must comply with regulatory and accrediting bodies. The designed solution must be technically viable and fully operable by the responsible teams, ensuring it seamlessly integrates into the existing institutional framework and operational workflows. By adopting such a comprehensive and inclusive approach, the methodology aimed to develop a staffing solution that is both technologically advanced and pragmatically deployable, meeting the complex demands of the educational staffing process.

1.1. Algorithm origins

The algorithm development was initiated in response to student dissatisfaction revealed in the Net Promoter Score (NPS) surveys and due to the low outcomes in the standardized national exams (EGEL) for some engineering programs [14] in a particular private Mexican high educational institution, which acts as a host institution for this research. These surveys highlighted student complaints regarding a noticeable misalignment between part-time faculty qualifications and the courses they were tasked with teaching, which is likely a contributing factor to the low outcomes observed in the EGEL. However, it is important to acknowledge that poor teaching can occur even with well-matched tutors. To explore this possibility, the analysis includes student satisfaction data and EGEL outcomes and a comprehensive evaluation of faculty performance. The data for this study comes from internal university systems, encompassing faculty evaluations, administrative records, and standardized test scores. Such feedback consistently pointed to discrepancies between students' expectations of instructional expertise and what was delivered in their courses. This complaint also resonates with and can be linked to the challenges faculty recruitment teams face in identifying suitable candidates. These difficulties stem from the existing methodology, which was somewhat manual and complicated due to its inherent ambiguity. This complexity often resulted in the mismatch that students highlighted in the NPS surveys, thus underscoring the urgent need for a refined approach to measuring faculty-course affinity.

A systematic review of the existing mechanisms for allocating part-time faculty to courses was undertaken in response to these concerns. This review aimed to validate the accuracy of student and staff perceptions and to assess the adequacy of the processes in place. The effort was conducted in close collaboration with teams dedicated to curriculum design and instructional design, who are responsible for defining the qualifications necessary for part-time faculty assignments. It was discovered that although the current processes are documented and adhere to government and accrediting body requirements, they are complex to execute and do not adequately ensure that the

teacher's profile matches the course assignment. This complexity impedes the verification of a faculty member's qualifications against the detailed needs of a specific course.

Given the findings, the logical first step was to identify existing efforts to classify academic content that could be applied to the Latin American context, specifically in Mexico. The chosen response was to utilize the CMPE [8] and the CIP [7]. Based on these classifications, work began with transdisciplinary teams to develop a new algorithm based on proven and widely used methodologies.

1.2. "Get a Teacher" Algorithm and process development

The emphasis was placed on how to employ the reference frameworks pragmatically and realistically in a manner that is 100% operable. This project aims to create an algorithm and a transdisciplinary mechanism for day-to-day operations rather than proposing a new classification methodology. This paper builds upon existing knowledge and efforts, elevating them to the next level.

Upon selecting these reference frameworks, a new local classification process was developed with the support of transdisciplinary teams, considering the needs of each stakeholder. This initiative, named "Get a Teacher" (GaT), comprehensively evaluates part-time faculty's work experience, academic qualifications, and years of relatable experience. For part-time faculty previously hired by the university, GaT assigns flags based on student and administrative academic staff evaluations. These flags, which can be positive or negative, indicate whether a faculty member is enabled or restricted from teaching a specific course. Moreover, GaT classifies courses based on their name, content, academic level, complexity, and other curricular requirements as stipulated by curricular & instructional design teams. Thus, GaT generates two sets of alphanumeric codes: one linked to the part-time faculty based on their expertise and experience and another linked to the courses, reflecting their curricular and instructional requirements. The encoding process designed by GaT generates a ten-digit code. The digit sequence for this coding is illustrated in Table 1.

Table 1. GaT codification.

1										1st digit, educational level
	2									2nd digit, broad field
		3								3rd digit, specific field
			4							4th digit, detailed field
				5	6					5th and 6th digit, unitary field
						7				Complexity level*
							8	9	10	Consecutive number of the study program**

*3 complexity levels (1,2,3).

** The last three digits of the code refer to an inventory of academic programs specific to the institution, which makes the coding more granular on one hand but also more specific on the other. This allows for a complete alignment between the qualifications of teachers and the courses they teach.

The first digit serves a dual purpose: for part-time faculty, it indicates the level of education where they acquired expertise in a specific field of study; for courses, it denotes the minimum academic level a faculty member must have attained in the field they wish to teach, as shown in Table 2.

Table 2. Level of education in a specific field of study.

Identifier	Academic levels
B	High School
T	Advanced Technician
L	Bachelor's Degree
E	Specialization
S	Medical Specialization
M	Master's Degree
D	PhD
Q	Equivalence

Table 3. Hierarchical fields of knowledge. The complete catalogue, broken down field by field due to its volume, should be requested from the authors of this article.

Hierarchical fields of knowledge
Broad knowledge field
Specific knowledge field
Detailed knowledge field
Unitary knowledge field

Digits two through six (Table 1) reference the granular specificity of the knowledge field or fields required for teaching a course, detailed in Table 3. Each number in the hierarchical fields of knowledge corresponds to a specific category, ranging from broad to detailed unitary fields. The numbers are generated based on the classification systems used by educational institutions and are regularly updated to reflect new areas of study and emerging disciplines.

Table 4. Fields of knowledge example.

ID	Broad Field	ID	Specific Field	ID	Detailed Field	ID	Unitary Field
3	Social Sciences, Administration and Law	3	Business and Administration	5	Business Management and Administration	01	Educational System
						02	Business Administration
						03	Public Administration
						04	Administration in the Field of Engineering and Construction
						05	Administration in the Field of Agronomy
						⋮	⋮
						n	…

Table 4 exemplifies the structure of one of these hierarchies, starting with the broad field "3" and ending with the unitary fields within "Business Management and Administration". This example contains only one hierarchy for illustration purposes. To access the complete catalogue, please contact the corresponding author. The catalogue adapts knowledge fields based on the Mexican CMPE and the North American CIP proposals. To illustrate the use of all the previous tables, let us describe the coding process for a part-time faculty member required to teach a master's level course in "Advanced Policy Analysis." According to accreditor regulations, this course must be taught by a faculty member with a PhD degree, following FIMPES criterion 5.2. Given the characteristics defined by our framework, GaT assigns the code D335032. Here's the breakdown of the code:

D: Indicates the minimum educational level required is a PhD (Doctorate).
3: Represents the broad field "Social Sciences, Administration and Law".
3: Indicates the specific field "Business and Administration".
5: Refers to the detailed field "Business Management and Administration".
03: Specifies the unitary field "Public Administration".
2: Denotes the subject complexity level required for the course.

This code (D335032) indicates that the faculty intending to teach this course must possess doctoral-level expertise in Social Sciences (broad field), Administration and Law (specific field), Business Management and Administration (detailed field), and Public

Administration (unitary field). It's important to note that this step only identifies potential faculty-course affinity. If a faculty member is being rehired or is already in the GaT database, they are assessed based on previous assignments and student evaluations. Each faculty member and each course generates multiple alphanumeric codes based on their academic degrees, prior experiences, and the course's unique characteristics as defined by curriculum and instructional designers. Therefore, the matching process facilitated by GaT is not always one-to-one. Depending on the course specifications, the match can be many-to-many, generating an affinity percentage with the course content to be taught.

1.3. Numerical illustration

By scrutinizing the Industrial Engineering program's curriculum, the GaT algorithm was applied post-mortem to courses identified for their low performance in the EGEL exam and notable student dissatisfaction in NPS surveys. This analysis involved coding all 51 distinct Industrial Engineering courses and profiling 251 part-time faculty members who taught these courses to the student cohorts in question. Additionally, to evaluate the impact of GaT on student satisfaction, the algorithm was applied to a program with high EGEL performance, and the faculty-course alignment was compared in these instances. This comparison helps assess whether ideal allocations correlate with higher student satisfaction and performance outcomes. As a control group, it also studied the electromechanical engineering program, which had a similar volume of students and faculty and profiled courses. The EGEL exams for this control group were administered in the same year as those for the Industrial Engineering program. This allowed us to establish a benchmark for ideal faculty-course alignment, demonstrating how GaT's optimal allocation mechanisms can lead to improved educational outcomes and greater student satisfaction.

1.3.1. Results

This comprehensive process revealed key insights, particularly within core courses like Physics, Supply Chain, and Metrology, which displayed significantly low affinity scores. These findings suggest a critical misalignment between the part-time faculty's expertise and the curriculum requirements for these essential courses. Table 5 showcases a matrix of the coded courses, providing a glimpse into the depth of analysis possible with GaT, although limited to five courses due to space constraints. Table 6 outlines the faculty coding, illustrating GaT's detailed faculty profiling mechanism. Remarkably, Table 7 details the actual affinity percentages between faculty and their assigned courses, for a selection of five courses. This table highlights the disparities in current profile affinity, particularly in foundational courses critical to the program's core learning objectives.

Table 5. Course GaT coding example.

Academic Program	Course	GaT Code 1	GaT Code 2	GaT Code 3
IINS61F15	SUPPLY CHAIN II	L510321	L335081	M514071
IINS61F15	LABOR LAW	L341002	L341072	M341001
IINS61F15	PHYSICS	L421003	L421002	L423002
IINS61F15	METROLOGY	L531012	L510002	L421012

Table 6. Faculty GaT coding example.

Part-Time faculty ID	GaT Code 1	GaT Code 2	GaT Code 3	GaT Code 4
28919	L512013	M334002	L335081	M514071
591039	M335007	L334002	L531012	L421003
595329	E335053	L334002	M321001	M421012
5063	D331011	E511014	L423002	M421011

Tables 7 and 8 present the affinity percentages for courses in two programs: Industrial Engineering and Electromechanical Engineering. Table 7 shows the affinity percentages for key courses within the Industrial Engineering program, identified as having low performance in the EGEL exam and notable student dissatisfaction. The percentages represent the degree of match between the qualifications and expertise of all part-time faculty members collectively assigned to each course. To validate our findings and provide a benchmark for comparison, Table 8 includes data from the Electromechanical Engineering program, which served as the control group. This program had a similar volume of students, faculty, and profiled courses, and its EGEL exams were administered in the same year as those for Industrial Engineering. The affinity percentages in Table 8 also represent the collective match between the qualifications of faculty members and the courses they teach. This comparison helps demonstrate how GaT's optimal allocation mechanisms can lead to improved educational outcomes and greater student satisfaction when the alignment between faculty expertise and course requirements is closer to ideal.

Table 7. Global affinity percentage industrial engineering

Course	Affinity %
SUPPLY CHAIN II	73%
LABOR LAW	90%
PHYSICS	29%
METROLOGY	67%
CHEMISTRY	80%

Table 8. Global affinity percentage electromechanical engineering

Course	Affinity %
CONTROL SYSTEMS	95%
ELECTRICAL MACHINERY	89%
AUTOMATION	92%
POWER ELECTRONICS	88%
MECHATRONIC DESIGN	91%

The results underscore GaT's prowess in conducting a more specialized and accurate faculty profiling. The correlation between poor EGEL outcomes and the prior suboptimal faculty assignment has been notably demonstrated (Table 9). The correlation coefficients reflect the strength of the relationship, with higher values suggesting a stronger correlation between faculty expertise as determined by GaT and student outcomes in the EGEL examination. The low-affinity scores for Physics and Metrology are particularly noteworthy, as they directly align with areas of poor performance in the EGEL [15], indicating potential mismatches in faculty qualifications. The results reinforce the importance of the GaT algorithm in improving educational quality by ensuring a better match between faculty expertise and course content.

Table 9. Correlation of GaT affinity and EGEL performance

Course	EGEL Knowledge Area	GaT Affinity	EGEL Performance	Correlation Coefficient
Supply Chain II	Supply Chain Management	83%	Satisfactory	0.92
Physics	Process Engineering	29%	Poor	0.84
Metrology	Maintenance Systems and Materials	45%	Poor	0.87

The granularity afforded by GaT enables pinpointing the most suitable faculty member for each course. Moving forward, the focus will shift towards automating the

hiring and assignment processes. This proactive approach aims to circumvent academic underperformance linked to mismatched faculty assignments and elevate student satisfaction. Implementing GaT's findings and methodologies promises comprehensive benefits for students and the institution, aligning staffing practices with academic excellence and operational efficiency.

2. Discussions

The findings of the GaT algorithm present a groundbreaking advancement in addressing the long-standing challenge of part-time faculty staffing in higher education. Aside from its successes, the current iteration of GaT, shown in this work, was only a post-mortem analytical tool, which signifies the foundation of a broader digital transformation in educational staffing. However, the GaT project has since evolved; it now encompasses the digital portals for faculty recruitment and is integrated into the timetabling processes, becoming a part of the educational institution's SIS banner. GaT is currently in use at one university and is on the cusp of integration into a second. These two universities have a combined enrollment of 300,000 students, 14,000 faculty members, and more than 300 unique academic programs. This collaboration will amass over 30,000 faculty profiles and 20,000 distinct courses coded with GaT, signifying that GaT will become a crucial part of a broad, transdisciplinary digital transformation process within these institutions. It's worth noting that, given page limitations, the current discourse does not delve into the sophisticated AI and machine learning technologies now integrated with GaT for autonomous operation and coding.

The ongoing technological integration and digitization of GaT, currently under copyright protection to prevent commercial replication, are anticipated to automate staffing and timetabling processes and establish GaT as a national repository for part-time faculty. One of the clear challenges for GaT is to operate effectively across different academic jurisdictions, which may necessitate scaling the implementation in zones with similar regulatory frameworks. Additionally, GaT aims to ensure faculty members possess the knowledge and expertise to teach specific courses. The system includes a primary level of alignment based on fields of knowledge and a secondary level based on institution-specific requirements. For universities interested in promoting transdisciplinarity, GaT can identify whether faculty members meet these competencies, allowing institutions to specify such requirements for specific courses or academic programs. This development could standardize faculty assignment practices across Mexican universities, dramatically transforming the educational staffing paradigm. Consequently, Future research should explore the scalability of GaT's application across diverse educational institutions, aiming to standardize part-time faculty staffing nationwide. Moreover, GaT's potential for global adaptability warrants further investigation, notwithstanding the need for localized studies to ascertain its applicability in different educational contexts. However, expanding the GaT algorithm to a national level presents an intricate, big-scale transdisciplinary, inter-university collaboration that must be navigated. This task, while ambitious, entails far more than technical scalability; it encompasses the multifaceted interplay of political, commercial, and educational dynamics. The transdisciplinary effort required for national implementation cannot be understated. It would necessitate the alignment of diverse academic institutions with varying internal processes, academic cultures, and technological infrastructures. A macro-level approach must be orchestrated to facilitate a coherent and standardized

faculty staffing practice that can operate within the complex legal and educational frameworks that govern higher education in Mexico. Commercial implications are also at the forefront of this initiative. As GaT enters the broader market, issues regarding intellectual property, data privacy, and potential monetization strategies must be handled with foresight and caution. The current audit protection is a first step, but a comprehensive commercial strategy must ensure that GaT remains an accessible and equitable solution for all institutions. Politically, the endorsement and support of educational authorities and accreditation bodies will be pivotal. Advocating for GaT's integration would involve highlighting its potential to enhance the quality of education nationwide, potentially influencing educational policy and funding priorities. This national effort will require technical adeptness, strategic partnerships, and policy-level engagement to establish GaT as a transformative force in Mexican higher education. As such, the project's trajectory will undoubtedly contribute to shaping a future where educational institutions can thrive on the pillars of efficiency, quality, and innovation afforded by GaT.

3. Conclusions and further research

The GaT initiative marks a significant leap forward in standardizing the recruitment and alignment of part-time faculty with academic program requirements. This transdisciplinary approach to staffing improves operational efficiency and promotes educational excellence. Furthermore, the potential for social change is substantial. By ensuring a closer match between educators' qualifications and the courses they teach, GaT enhances students' learning experiences and success rates and fosters a more inclusive and equitable educational environment. Additionally, GaT empowers educators by aligning them with courses that best fit their expertise, increasing job satisfaction and professional fulfilment. This system allows faculty members to be recognized for their strengths and assigned to roles where they can excel, potentially leading to better career advancement opportunities. Moreover, if GaT becomes a standard, it could facilitate inter-institutional mobility for faculty, allowing them to seek better job opportunities across different educational institutions. This mobility could lead to a more dynamic and competitive academic labour market, where educators have the flexibility to move among institutions that best match their professional profiles and career aspirations. The GaT initiative not only aims to improve the operational aspects of academic staffing but also has the potential to create a more equitable, inclusive, and dynamic educational landscape, aligning with the broader goals of social change and educational reform. But, while GaT has demonstrated substantial utility within the framework of the current study, its real promise lies in its nationwide implementation. The complexity of such an undertaking cannot be overstated, requiring concerted efforts across various academic, political, and commercial landscapes. Realizing this vision at a national scale will involve bridging gaps between differing institutional practices and cultures, navigating the intricacies of educational policies, and harmonizing a vast array of academic curricula.

Further research pends ahead as GaT moves into the next development phase, future research should focus on enhancing the proposed algorithm's foundational catalogue and mechanism's base rules. This involves refining GaT's coding system to ensure more nuanced and precise faculty-course alignments, reflecting higher education's diverse and evolving landscapes. The research will also explore how GaT can be adapted to the

specific contexts of various educational institutions, not just within Mexico but potentially on a global scale. In summary, GaT's envisioned future as a standardized, transdisciplinary digital solution across educational institutions promises a transformation in the academic staffing paradigm. Its integration into digital hiring platforms and timetabling systems underscores its potential as a cornerstone of educational reform. The ongoing adoption of GaT by universities across Mexico, serving hundreds of thousands of students and tens of thousands of faculty members, confirms its practicality and transformative impact. The projected transversal institutional processes, underpinned by GaT, will undeniably lead to an educational renaissance characterized by enhanced efficiency, quality, and equitable access to quality education.

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