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Scientific articles

La exclusión o inclusión de asignaturas en los mapas curriculares durante la actualización de los planes de estudio

The exclusion or inclusion of subjects in the curricular maps during the updating of study plans

A exclusão ou inclusão de disciplinas nos mapas curriculares durante a atualização dos planos de estudos

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Resumen

El objetivo de este estudio fue documentar un procedimiento mediante el cual se procuró simplificar el complejo proceso de tomar decisiones sobre la inclusión o exclusión de asignaturas y seriaciones en un mapa curricular. Para ello, se eligió el método documental, pues se usaron los datos de los anuarios estadísticos de una institución de educación superior, los cuales fueron organizados y analizados para interpretar la relación entre el número de asignaturas actuales y las recomendaciones de la Secretaría de Educación Pública Federal y Estatal, orientadas a mejorar la eficiencia terminal. Los resultados se presentan en forma de tablas que configuran los modos de actuación de las líneas de seriación, junto con un análisis descriptivo de los alcances de cada una. En conclusión, se puede indicar que seguir este procedimiento reduce la incertidumbre al decidir sobre la inclusión o exclusión de una asignatura en el mapa curricular.

Palabras clave: actualización curricular, desempeños ocupacionales, mapa curricular, modos de actuación.

Abstract

Excluding or including subjects in updating a curricular map implies making decisions that will affect generations of students, the greatest problem being the low terminal efficiency generated by the long series of subjects. Therefore, the objective is to document a procedure for modifying curricular maps that makes the complex process of making decisions when excluding/including subjects and series in a curricular map simple. The method is documentary based on data from the statistical yearbooks of the Higher Education Institution, which are organized and analyzed to interpret the relationship that exists between the number of current subjects and the recommendation suggested by the Federal and State Secretariat of Public Education in favor of terminal efficiency. The results are tables that configure modes of action of the serial lines and the descriptive analysis of the scope that each one has. It is concluded that following this procedure reduces uncertainty when deciding to exclude/include a subject in a curricular map.

Keywords: Curriculum update, Occupational performances, Curriculum map, Modes of action.

Resumo

O objetivo deste estudo foi documentar um procedimento por meio do qual se procurou simplificar o complexo processo de tomada de decisão sobre a inclusão ou exclusão de disciplinas e séries em um mapa curricular. Para isso, optou-se pelo método documental, uma vez que foram utilizados dados dos anuários estatísticos de uma instituição de ensino superior, os quais foram organizados e analisados para interpretar a relação entre o número de disciplinas vigentes e as recomendações do Ministério da Educação Pública Federal e Estado, visando melhorar a eficiência dos terminais. Os resultados são apresentados em forma de tabelas que configuram os modos de atuação das linhas seriais, juntamente com uma análise descritiva do escopo de cada uma. Concluindo, pode-se indicar que seguir este procedimento reduz a incerteza na decisão sobre a inclusão ou exclusão de uma disciplina no mapa curricular.

Palavras-chave: atualização curricular, desempenhos ocupacionais, mapa curricular, modos de atuação.

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Introduction

The decision to modify the academic route of a study plan, as part of the updating of study plans and programs dictated by the Federal and State Secretariat of Public Education (SEP) to ensure educational quality in higher education institutions (public IES (Honorable Constitutional Congress of the Free and Sovereign State of Puebla, 2021), requires a methodology that is not yet completely defined because each update phase depends on the current social, cultural, educational, labor and temporal contextualization. Therefore, it is essential to determine the continuity, exclusion or inclusion of subjects and academic content to adjust the professional profile to current work realities.

Given that the responsibility for designing and updating curricula falls on a specific commission for each educational program in an HEI, the uncertainty inherent in its deliberations demands an adequate guide that facilitates decision-making on modifying the number of subjects in each academic period. update. In fact, it is essential that each adjustment in the curriculum is analyzed from an academic perspective, through a systematic sequence of development that guarantees the coherence and effectiveness of the process.

Likewise, it is important to recognize that curricular design can have different meanings and methods of organization and structuring. For example, currently, the institutional trend is oriented towards the contextualization of the modular curriculum, an alternative still in the process of evaluation in terms of effectiveness, especially in comparison with other trends (Díaz, 1993). In fact, despite its exploratory status, modular curricular design is presented as a promising methodology for updating in response to the rapid evolution of the occupational profile and job employability (Candia *et al.*, 2023).

As background, we can cite the case of the Universidad Autónoma Metropolitana, Xochimilco campus, where the academic content focuses on the contextualization of reality with an emphasis on current occupationally. Among the qualities of this curricular design, its ability to improve the terminal efficiency of new entry enrollment stands out. Furthermore, the integration and configuration of an educational module within a critical path map, which synthesizes the curricular design, is achieved through the analysis of curricular performance and its impact on the student's occupation throughout their career until graduation (González, 2015).

Now, reflecting on the contextualization of the occupationally that a graduation profile must fulfill implies addressing work occupationally, which frames the educational objective of forming capabilities and skills, with the purpose of translating these capabilities into modes of action in the following fields:



- Research in science and technology.
- Application and implementation of improvements and innovation.
- Consulting and advice on technological transfer and development.
- Operation and execution of productive tasks.

In the experience of the Universidad Autónoma Metropolitana (UAM), Xochimilco campus, the analysis of the fields of action and professional tasks is a work that is based on formal and exhaustive research on the labor market (Bravo *et al.*, 2021), defining the following concepts:

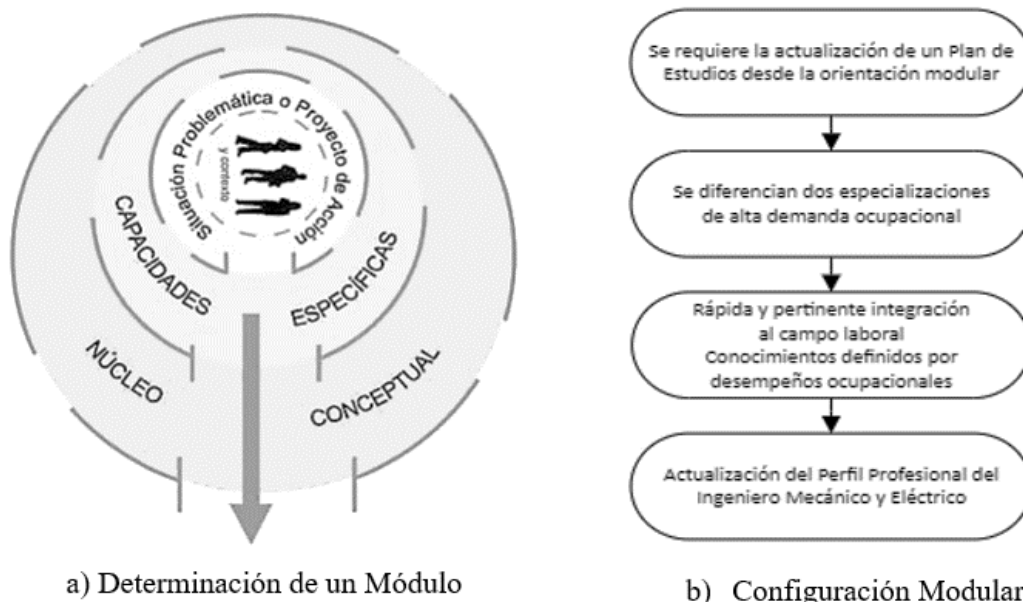
- Occupational market. It is the workspace in which different professionals come together to transform and exchange resources and services that satisfy social needs.
- Professional fields. Specific work area of a profession in which graduates of a bachelor's degree work.
- Professional practices. Actions carried out by a professional to solve the needs of the occupational market.

As for discerning whether the routes of a curricular map should be sequential or concurrent, it is vital to define these terms from their most basic conception and explore them with a descriptive criterion based on teaching experience.

For example, the term “sequential”, according to the Royal Spanish Academy (RAE), refers to a series or succession of things or elements that have a common relationship with each other. On the other hand, “module” is understood as the educational unit that is part of a teaching program, composed of a set of elements that are repeated in the construction of a goal, to make it simpler, regular, economical and efficient (Real Spanish Academy, 2024).

From another graphic perspective (figure 1), the literature defines the module as the curricular component referred to a field of content that constitutes a unit of meaning, which organizes the teaching-learning process with a significant degree of autonomy with respect to the structure. curriculum of which it is a part (Ministry of Education Argentina, 2011).

Figure 1. Graphic organization of the curricular structure by modules: a) determination and b) configuration



Source: Argentine Ministry of Education (2011)

These premises allow us to conceive an educational module as a learning unit of academic content with the capacity for changing action over time, in a multidisciplinary and systemic manner, which integrates teaching at a higher level, scientific or technological research, and an attitude of service or operational. This makes it easier for the construction of the professional mode of action to include skills, methods and efficient representations of the work occupation, which are integrated with values, attitudes and motives for self-realization (González, 2015).

As a member of a curriculum design and evaluation commission, determining what thematic contents should be excluded or included and how they should be located in the temporality of the academic path is a task that requires being approached with great responsibility and honesty. Therefore, being explicit in the use of a support procedure that allows decisions to be made objectively is a contribution that highlights the institutional commitment of the members of these commissions.

For this reason, the objective of this document is to present a procedure to modify curricular maps, sequential series of subjects (quantity and temporal duration) in order to suggest and recommend the inclusion of academic content through the designation of subjects based on taxonomic levels. by Bloom. This work complements what has already been done by Candia *et al.* (2023) regarding high-impact strategies for curricular updating based on the determination of occupational performances.

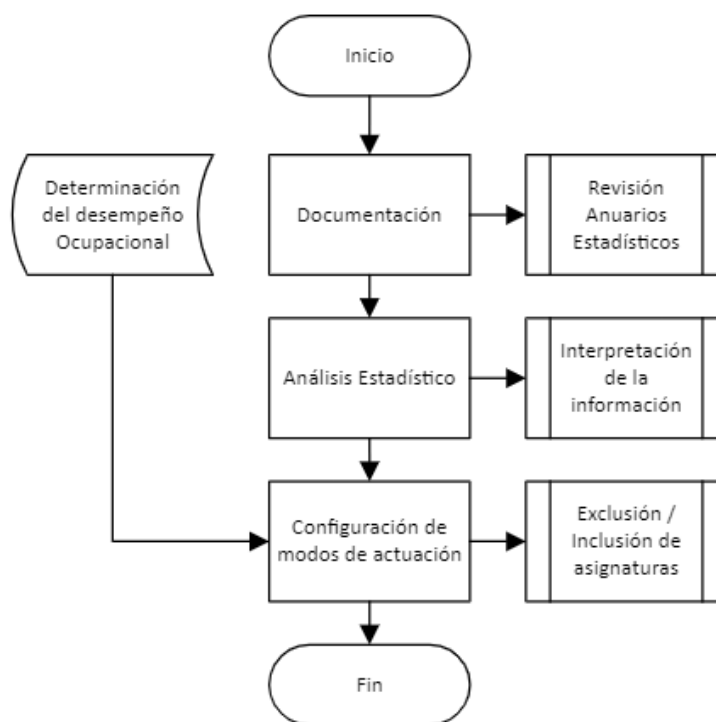
Method

This work is based on documentary research (Reyes-Ruiz and Carmona, 2020), since the collection, compilation and selection of information from statistical yearbooks (Benemérita Universidad Autónoma de Puebla, 2024) was used to analyze the data on income, expenses and terminal efficiency, and associate this information with the relevance of the curricular design, when it is necessary to make decisions about the exclusion or inclusion of subjects in the curriculum of a bachelor's degree in engineering at an HEI.

Next, Figure 2 explains the definition of the parts of the procedure based on the recommendations for organizing a case study (Álvarez and Álvarez, 2018), establishing the research as descriptive-interpretive and executing the following activities:

- Definition of the problem and action plan.
- Collection and analysis of information.
- Preparation of the final report.

Figure 2. Schematic diagram of the method sequence



Source: Adapted from Álvarez and Álvarez (2014)

In the problem of exclusion/inclusion of subjects in curricular maps, the simplification of the curricular sequence requires a deep understanding of the curricular methodology, seen from the modular approach by transformation objects (Díaz, 1993).

This procedure is carried out because the exclusion or inclusion of subjects in a curricular map requires a reference framework that allows us to approach the historical evolution of the terminal efficiency of an educational program. Furthermore, it must relate the series of critical paths with low terminal efficiency, given that academic content focused on the formation of a research-oriented profile can reduce professionalizing and technical conceptual training, which limits prompt and relevant job incorporation.

For example, reducing the serialization of the subject Finite Element Analysis requires the implementation of curricular flexibility, which, in the context of professional training, is understood as the individual ability to learn different and new things as needed. throughout life. Regarding flexibility in higher education, it refers to all processes aimed at training professionals prepared to face the social and labor demands of their environment (García *et al.*, 2022).

The process begins with the analysis of the curricular maps of the 2003, 2009 and 2016 plans of a bachelor's degree in engineering taught in a public HEI (table 1). It should be noted that, although the number of series and serial subjects decreases, the total number of subjects does not coincide with the recommendation of the Federal and State Government regarding the transition to a total of 300 credits, where one credit is equivalent to 0.0625 class hours (Secretariat of the Interior, 2017, 2018). Furthermore, it is worth highlighting that the definition of credit-class hours for this HEI is different.

Table 1. Analysis of curricular maps (2003, 2009 and 2016 plans)

	Number of serial subjects	Number of series	Number of Subjects
Plan 2003	49	24	67
2009 Plan	35	12	60
2016 Plan	30	11	65

Source: Own elaboration

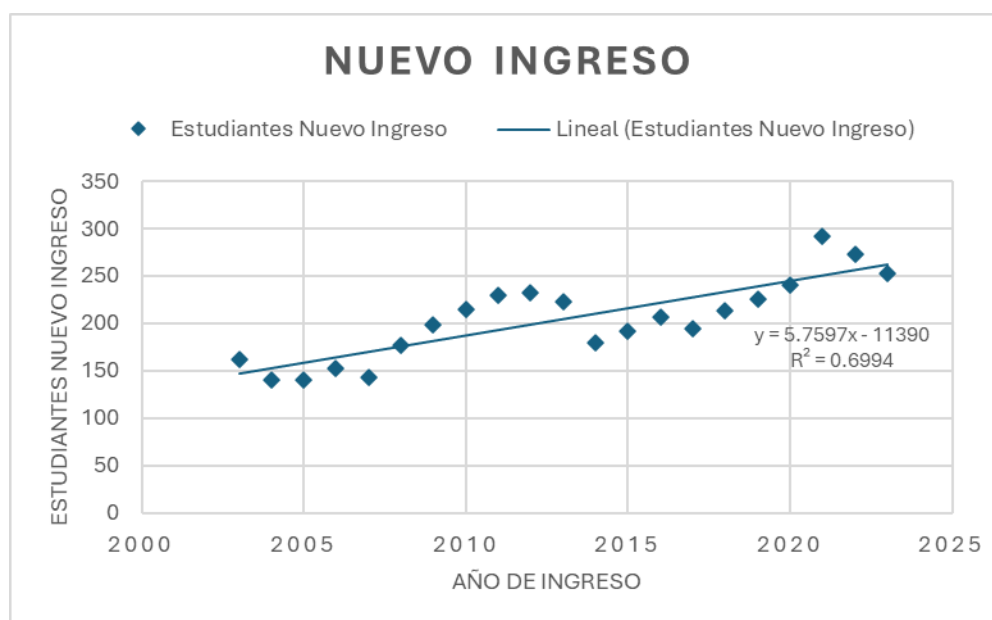
Table 2 presents the behavior of new enrollment, organized according to temporality according to the validity of the corresponding study plan (2003, 2009 or 2016). Figure 3 illustrates the trend in the behavior of new enrollment, with a constant and positive increase in each generation.

Table 2. Data on new enrollment

Generation start	2003 plan income							
2003	2003	2004	2005	2006	2007	2008		
	162	141	141	152	143	177		
Generation start	2009 plan income							
2009	2009	2010	2011	2012	2013	2014	2015	
	199	215	230	233	223	180	192	
Generation start	2016 plan income							
2016	2016	2017	2018	2019	2020	2021	2022	2023
	206	195	213	226	241	292	273	253

Source: Own elaboration

Figure 3. Enrollment of new entrants and their behavioral trend



Source: Own elaboration

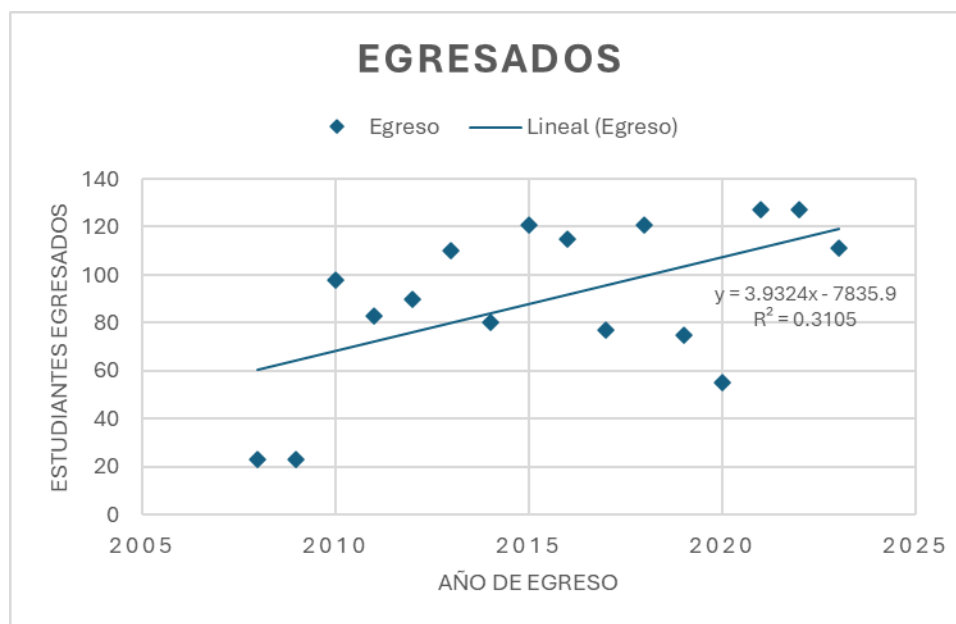
Table 3 presents the enrollment graduation behavior, organized according to temporality according to the validity of the corresponding study plan (2003, 2009 or 2016). Figure 4 illustrates the trend of graduation behavior, with a constant and positive increase in each generation. It should be noted that specific data is not available for the 2019 graduation; Therefore, the same discharge data was used as for 2018.

Table 3. Enrollment graduation data

Generation start	Graduates plan 2003						
2003	2008	2009	2010	2011	2012	2013	
	23	23	98	83	90	110	
Generation start	Graduates plan 2009						
2009	2014	2015	2016	2017	2018	2019	2020
	80	121	115	77	121	75	55
Generation start	Graduates plan 2016						
2016	2021	2022	2023				
	127	127	111				

Source: Own elaboration

Figure 4. Graduation enrollment and its behavioral trend



Source: Own elaboration

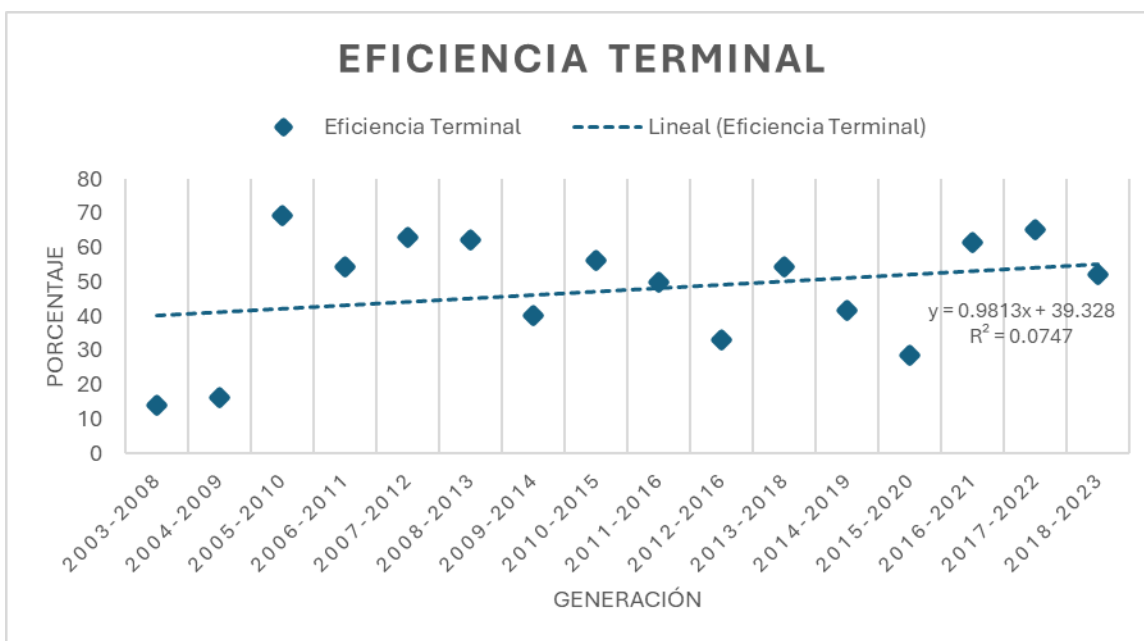
Table 4 organizes the behavior of the generational terminal efficiency of enrollment, which is distributed based on temporality according to the validity of the corresponding study plan (2003, 2009 or 2016). Figure 5 shows the trend in the behavior of terminal efficiency, which shows a constant and positive increase with each generation. It is worth noting that specific data is not available for the 2019 graduation; Therefore, the same discharge data was used as for 2018.

Table 4. Registration terminal efficiency data

Terminal efficiency plan 2003							
Class of 2023	2003-2008	2004-2009	2005-2010	2006-2011	2007-2012	2008-2013	
%	14.2	16.3	69.5	54.6	62.9	62.1	
Terminal efficiency plan 2009							
Class of 2023	2009-2014	2010-2015	2011-2016	2012-2016	2013-2018	2014-2019	2015-2020
%	40.2	56.3	50.0	33.0	54.3	41.7	28.6
Terminal efficiency plan 2016							
Class of 2016	2016-2021	2017-2022	2018-2023				
%	61.7	65.1	52.1				

Source: Own elaboration

Figure 5. Terminal efficiency of enrollment and its behavioral trend



Source: Own elaboration

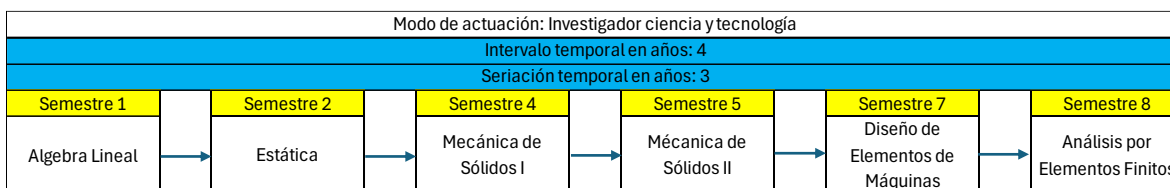
When analyzing the behavior of the data collected, it is interpreted that the reduction of serials and the number of serial subjects has favored terminal efficiency, in conjunction with the institutional strategies intended for this purpose. However, when examining the percentage of terminal efficiency, it is observed that the average is 43.7 and the median is 53.2, values lower than the institutional goals and the recommendations of the Federal and State SEP. Therefore, it is recommended to reduce the number of subjects and series with a modular approach, that is, oriented to the occupational performances of the context.

Results

The analysis of the serialization of the curricular map is carried out from the perspective of the four fields of action that define the orientation of occupational performances, classified according to the taxonomy proposed by Bloom:

- Researcher in science and technology.
- Applier and implementer of improvements and innovation.
- Consultant and advisor in technological transfer and development.
- Operator and executor of productive tasks.

Figure 6. Analysis of the mode of action based on research as occupational performance



Source: Own elaboration

Figure 6 analyzes how, in the 2016 Mechanical and Electrical Engineering curriculum, the subject Finite Element Analysis is located in the eighth semester. This implies that a regular student must wait 3.5 years to take it and, upon completion, must still remain one more year to graduate. Although the subject is relevant to the work occupation of the mechanical and electrical engineer, its application is limited to the course period of the subject, which restricts its impact on the student's graduation profile.

In this context, failing to pass one or more subjects in the sequence increases the student's time at the university, resulting in a 6-month extension of the estimated graduation date per generation, which negatively affects efficiency. terminal. Although the serialization of the subject is based on the cognitive level of analysis (third level of Bloom's taxonomy), and is highly relevant in the mode of action as a science and technology researcher, the contextualization of the work occupation (verified through of job offers on online job boards, according to Candia *et al.* , 2023) demands this skill as a mode of action that prioritizes the capacity of operator and executor of productive tasks.

It is reaffirmed, therefore, that a greater series of subjects tends to reduce terminal efficiency, hence it is essential to reduce long sequences in temporality and avoid the obligation to take subjects with a divided scope at the end of the program, especially if their field of action is vast and broad, so that it can be considered transversal, as seen in figure 9.

Figure 7. Analysis of the mode of action based on application and innovation as occupational performance

Modo de actuación: Aplicador e implementador de mejoras e innovación							
Intervalo temporal en años: 4							
Módulo Capacidades Básicas		Seriación temporal en años: 2 Módulo Ciencias de la Ingeniería					
Semestre 1	Semestre 2	Semestre 4	Semestre 5	Semestre 7	Semestre 8		
Algebra Lineal	Estática	Mecánica de Sólidos I	Mecánica de Sólidos II	Diseño de Elementos de Máquinas	Diseño por Elementos Finitos		

Source: Own elaboration

Figure 7 shows that a modification in the serie, by strategically separating a Basic Capabilities module and an Engineering Sciences module, implies a change in the mode of action as an applicator and implementer of improvements and innovation. Although the third cognitive level is maintained in the content of the subject, the risk of low terminal efficiency due to failures remains high, with a delay of 6 months for each resource. Furthermore, it is considered that the teacher must have a high profile and current certifications to teach the subject, which complicates the academic load due to the small number of teachers with the desired profile and curriculum.

Figure 8. Analysis of the mode of action based on consulting advice as occupational performance

Modo de actuación: Consultor y asesor de la transferencia y el desarrollo tecnológico							
Intervalo temporal en años: 4							
Módulo Capacidades Básicas		Seriación temporal en años: 1 Módulo Ciencias de la Ingeniería			Módulo de Ingeniería Aplicada		
Semestre 1	Semestre 2	Semestre 4	Semestre 5	Semestre 7	Semestre 8		
Algebra Lineal	Estática	Mecánica de Sólidos I	Mecánica de Sólidos II	Diseño de Elementos de Máquinas	Diseño por Elementos Finitos		

Source: Own elaboration

Figure 8 proposes that an Applied Engineering module can reduce dependence on a long sequential line of subjects. To achieve this, it is suggested to modify the orientation of the subject “Finite Element Analysis” to “Finite Element Design” and adjust its content to configure a mode of action as a consultant and advisor in technological transfer and development, placing it at the second cognitive level. of Bloom's taxonomy.

This modification would allow greater flexibility in the preparation of the academic load, since it would not require teachers with a highly specialized profile. In other words, the absence of serialization would allow the student to take the subject simultaneously with some of the resources from the Engineering Sciences module. Maintaining the subject in the eighth semester would justify its inclusion in the Applied Engineering module. However, placing a Bloom's second cognitive level subject in the final semesters is not consistent with the common practice of teaching higher cognitive level subjects in the final stages.

Figure 9. Analysis of the mode of action based on operability as occupational performance

Modo de actuación: Operador y ejecutor de tareas productivas							
Intervalo temporal en años: 4							
Módulo Capacidades Básicas			Seriación temporal en años: 1 Módulo Ciencias de la ingeniería			Módulo de Ingeniería Aplicada	
Semestre 1		Semestre 2		Semestre 4		Semestre 5	Semestre 7
Algebra Lineal		Estática		Mecánica de Sólidos I	→	Mecánica de Sólidos II	Diseño de Elementos de Máquinas
				Módulo Ocupacionalidad Laboral	Transversalidad de la asignatura		
				Simulación por Elementos Finitos			

Source: Own elaboration

Figure 9 allows the curricular map to be reorganized by modifying the position of the subject “Finite Element Analysis”, changing its name to “Finite Element Simulation” and redefining its content to prioritize the teaching of the use and management of *software* based on the method. of the finite elements. This would configure a work occupational module that favors the formation of the graduation profile of the mechanical and electrical engineer, in the mode of action as an operator and executor of productive tasks.

Finally, the subject would become a transversal component and training support for the subjects of the Engineering Sciences module and the Applied Engineering module. In this sense, it is worth noting that, although the Applied Engineering module includes two resources, the delay in terminal efficiency would only be 1 year. This reorganization would also favor the flexibility of the academic load, by not requiring teachers with a highly specialized profile to teach the subject.

Discussion

During the development of this work, it has been verified that, in the field of education, a module is an organized proposal of training elements or components that allows students to develop learning experiences around professional performance, aligned with competitiveness and job offer, and responding to the real needs of the context in which they will work as professionals. Therefore, it is crucial to maintain the coherence of the entire training process, moving from the complex to the simple and specifically relevant (García *et al.*, 2014). Furthermore, it has been proven, coinciding with Soto (2017), that there is a highly significant relationship between the modular curricular design and the specialized occupational profile of the graduate.

In this sense, this research has shown that updating a curriculum approached in a modular way reduces the number of delays in generational graduation and increases terminal efficiency. This is achieved by reducing the period of permanence of students at the university, thanks to the non-obligatory nature of the serialization and the mastery of the academic contents defined from fields of action for each learning module, which is made up of groups of subjects. (Irazoqui and Medina, 2014).

Regarding previous experiences, reference is made to the determination made by Díaz (2021), who evaluated three experiences of modular curricular construction and found that, in the Mexican case, the approaches of the American curricular authors translated in the years were not used. seventy, but their own concepts were used (Díaz, 2021). Therefore, the current proposal for a procedure to exclude or include subjects in a curricular map is valid and appropriate, given the context and specific needs.

Finally, we agree with Aguas (2020) that the results obtained in the graphs demonstrate that knowing and using criteria and indicators (such as serial subjects and terminal efficiency) is a strategy that facilitates the updating of study plans and favors decision-making. decisions.

Conclusions

From the results obtained in this work, it can be concluded that the updating of study plans, whether with a modular or traditional approach, must consider with high relevance the reduction of the number of subjects to define professional profiles based on performance. occupational.

Furthermore, the long and complex serie should be replaced by the concurrence of knowledge and subjects that define a professional performance, and it is suggested that these subjects should also be treated as transversal.

Finally, it can be stated that greater participation of statistics in graduate monitoring programs is necessary to provide a precise and non-speculative report on the positions and activities they perform, which will allow a more exact definition of the percentage of them in the different fields of action.

Future jobs

Although the approach carried out is still initial, future work will continue to explore the association of curricular maps to correlate their organization and impact with the terminal efficiency of educational programs. In fact, a new registry will be proposed for monitoring graduates that allows reliable modes of action to be configured in order to specifically address the occupational nature of graduates. Likewise, the modular orientation of the curriculum will be sought to be an efficient management for educational improvement.

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