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Journal Educational Theory

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Presentation of Content

In the first article we present, *Proposal and evaluation of didactic materials to support the teaching of Physics*, by MONROY-CARREÑO, Mireya, MONROY-CARREÑO, Patricia and MONROY-CARREÑO, Roberto, with adscription in Escuela Nacional Colegio de Ciencias y Humanidades plantel Vallejo-UNAM, as the netx article we present, *Analysis of stress and anxiety in university students to identify correlated factors*, by LOBATO-BAEZ, Mariana, MORALES-ROSALES, Luis Alberto, ALGREDO-BADILLO, Ignacio and RODRÍGUEZ-RANGEL, Héctor, with adscription in Instituto Tecnológico Superior de Libres, Conacyt-Universidad Michoacana de San Nicolás de Hidalgo, Instituto de Astrofísica Óptica y Electrónica, Luis Enrique Erro # 1 and Instituto Tecnológico de Culiacán, as the netx article we present, *Analysis of the level of stress in teachers*, by MARTÍNEZ-ESPARZA, Dora Esthela, PÉREZ-ESQUIVEL, María Mayela and BRAVO LÓPEZ, Tamara, with adscription in Universidad Autónoma de Nuevo León, Universidad Regiomontana de Monterrey and Instituto Politécnico Nacional, as the netx article we present, *Evaluative system design applied to transidisciplinaty projects as a tool for the terminal efficiency increment*, by TOVAR-ROSAS, Claudia Rocio, GARZA-MOYA, Luis Roberto, ARREOLA-BURCIAGA, Josué Mizraim and DELGADILLO-ALVARADO, Jessica Astridt, with adscription in Universidad Politécnica de Gómez Palacio.

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Proposal and evaluation of didactic materials to support the teaching of Physics

Propuesta y evaluación de materiales didácticos en apoyo en la enseñanza de Física

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Abstract

The teaching of science has always faced multiple adversities for the construction of meaningful learning and the subject of Physics is no exception, however, if we consider that today the educational field has had to change due to the sanitary contingency caused by Covid-19, it has made it clear that the form of teaching must be modified to adapt to current conditions. Hence, the objective of this study was to design and evaluate the impact of a didactic material that contributes to improving the understanding of the learning that are most difficult for students in the subject of Physics III at the Escuela Nacional Colegio de Ciencias y Humanidades plantel Vallejo, through a pilot sample by convenience in which 22 students and 12 teachers participated. For this purpose, a hybrid methodology was used in which pedagogical, disciplinary, and technological aspects were aligned; finding that this is a viable option to improve the student performance. Therefore, it is required that teachers be trained in these topics, since a facilitator with greater variability is needed to adjust his teaching to current requirements.

Learning, Science, Evaluation

Resumen

La enseñanza de la ciencia siempre ha enfrentado múltiples adversidades para la construcción de aprendizajes significativos y la asignatura de Física no es la excepción. Además, si se contempla que hoy en día el ámbito educativo ha tenido que cambiar debido a la contingencia sanitaria causada por el Covid-19, dejando claro que la forma de enseñanza debe modificarse para adaptarse a las condiciones actuales. De ahí que este estudio su objetivo fue el diseñar y evaluar el impacto de un material didáctico que coadyube a mejorar la comprensión de los aprendizajes que más se le dificultad a los alumnos, para la asignatura de Física III de la Escuela Nacional Colegio de Ciencias y Humanidades plantel Vallejo, a través de una muestra piloto por conveniencia en la que participaron 22 alumnos y 12 profesores. Para ello, se empleó una metodología híbrida en el que se alinearon aspectos pedagógicos, disciplinares y tecnológicos; encontrando que esta es una opción viable para mejorar el desempeño de los alumnos. Por ende, se requiere que los docentes se capaciten en estos temas, ya que se demanda de un facilitador que tenga una mayor variabilidad para ajustar su enseñanza a los requerimientos actuales.

Aprendizajes, Ciencia, Evaluación

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Introduction

The teaching of science faces different problems such as the distancing itself from the everyday, emphasizing abstract and unattractive contents. On the other hand, it is especially focused on a propaedeutic purpose and the presentation of an academicist, classical, 19th century science (Araújo & Ballesta, 2019, p.12).

Now, specifically for the subject of Physics, several studies focus on the learning of concepts, leaving aside that it is necessary for students to understand equations or formulas so that they can apply them (Kim, Cheong & Song, 2018). In the same sense, Elizondo (2013) states that the difficulties that students have in understanding physics problems are identifying the relevant data of the problem, understanding the meanings of the data, and transcribing them into mathematical language; therefore, it is essential to design didactic materials in accordance with the pedagogical, disciplinary and technological needs that contribute to the achievement of student learning.

In summary, the subject of Physics is considered by many students difficult and boring perhaps because of the abstract concepts that make it up and/or its relationship with mathematics, and if in a face-to-face modality it was complicated, then how to fulfill the mission of this subject that, according to Duarte, Reyes & Fernandez (2013) is "learning ways of thinking and acting that are effective in describing and predicting the behavior of the real world" (p.46).

From the above perspective, it is appropriate to point out that to improve some of the situations described above, Riveros (2012) proposes that it is necessary to have materials that encourage reasoning, as well as to write evaluations before teaching the subject, to know what to ask during the class, this proposal is not difficult to understand, since didactic materials have always had a relevant role in the field of education and in the current conditions caused by the sanitary contingency that is being experienced worldwide originated by COVID-19, a series of didactic challenges have arisen, among them the design of educational materials, the planning of activities and the selection of evaluation processes that adjust to an online modality (Lobos, 2021, p.5).

Therefore, didactic materials have become essential tools for the achievement of learning, hence it is essential that the teacher is trained in the planning, design and/or choice of resources that allow the development of a teaching process conducive to scientific training in the learner. Therefore, the situation of confinement is an opportunity to move towards the integration of information and communication technologies in the construction of teaching resources (Burgueño et al., 2021, p.792).

In the same orientation, Jaímez-González (2019) alludes that teacher require employing diverse pedagogical resources to consolidate the construction of knowledge in the teaching-learning processes, given that didactic materials are employed to promote the development of skills in students, as well as in the improvement of attitudes related to knowledge, without forgetting that these have the quality of being adapt to any learning situation or objective (Morales, 2012).

Likewise, didactic materials serve to develop a quality educational process (Fréré & Saltos, 2013), due to the fact that they are a pedagogical tool that supports the teacher's performance and optimizes the teaching-learning process (Vargas, 2017). Additionally, they support the tasks of the teacher in their planning, teaching development and the evaluation of student learning (Area, 2019 and Gabarda, Rodríguez & González, 2021).

In another order of ideas, educational materials can be classified into curricular and didactic, the latter being those that support the implementation of the curriculum, such as reading documents, internet, computer equipment, among others (INEE, 2019), likewise, they are essential elements in education that must evolve with the context and technological advances; whose usefulness is unquestionable, since they have their origin in the interaction of the teacher, the students and the curriculum (Aguilar et al., 2014).

In another order of ideas, educational materials can be classified as curricular and didactic, the latter being those that support the implementation of the curriculum, such as reading documents, consultation, internet, computer equipment, among others (INEE, 2019), in the same way, they are essential elements in education that must evolve with the context and technological advances; whose usefulness is unquestionable, since they have their origin in the interaction of the teacher, the students and the curriculum (Aguilar et al., 2014).

In summary, it is evident that it is currently required to modify the way of teaching science (Arteaga, Armada & Del Sol Martínez, 2016), which allow students to develop cognitive, instrumental and transversal skills, with the purpose of extending learning to their environment (Drăghicescu et al., 2014).

From the above perspective, it is essential to build didactic materials that are adjusted to the learning that is desired to be achieved with students, according to the curricula and the new normality, that is, to establish teaching for an open learning modality characterized by being synchronous, asynchronous, and interactive (Torres & García, 2019). Additionally, it can be assumed that the importance of implementing methodologies to elaborate didactic materials is that they allow building effective educational resources (Yépez, Sánchez & Zetina, 2021, p.58).

General objective

Design and evaluate the impact of a didactic material that helps to improve the understanding of the most difficult learning for students in the Physics subject.

Specific objectives

1. Identify the relevant elements and methodologies to be considered for the design of didactic materials.
2. Design and implement didactic materials.
3. Evaluate the didactic material and the results obtained.

Description of the method

El desarrollo de este trabajo se fundamentó en una metodología híbrida constituida por cinco fases y que estuvieron cimentadas por las metodologías de Chunga (2015) y Area (2019), dado que contemplan elementos pedagógicos, disciplinares y tecnológicos para el diseño de materiales didácticos. (Figura 1).

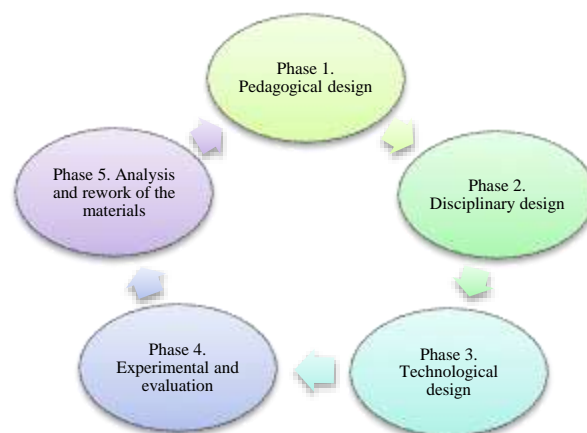


Figure 1 Methodology implemented for the design of didactic materials

Source. Adapted from Chunga (2015) and Area (2019)

It should be noted that the methodology was implemented for the design of teaching materials for the Physics III course, which is taught at the Escuela Nacional Colegio de Ciencias y Humanidades (ENCCCH), Vallejo campus.

Phase 1. Pedagogical design

The following aspects were addressed at this stage:

- Determine why and for what the material is to going to be developed.
- Identify the characteristics and prior knowledge of the recipients.
- Construct materials based on the characteristics of the possible users of the material, that is, assessing the age, educational level, learning styles of the students, among other relevant aspects that can influence the construction of learning.

Based on all of the above, it was considered that the material has a propaedeutic purpose, since it was directed towards high school students between the ages of 17 and 19, but most of them will study a career related to the area of physics-mathematics, since this is an elective subject that is designed, for young people to acquire the conceptual, procedural and attitudinal knowledge required in the first semesters of the career at the bachelor's degree level.

It should be noted that at the beginning of each learning process, diagnostic evaluations were proposed that consisted of drivers questions, small tests, CQA charts (what I know, what I want to know, and what I learned), questionnaires, concept maps, among others. These evaluations were designed so that the teacher could identify the present and absent knowledge of his students.

It is worth mentioning that in addition to carrying out initial diagnostic evaluations, specific evaluations were also carried out in some subjects, with the purpose of correcting some conceptual or procedural deficiencies that prevented the construction of new learning.

It is necessary to highlight that at the beginning of the didactic material an evaluation instrument of learning styles designed by Alonso, Gallego & Honey (1997) was attached, which consists of 80 items and determines four preferences (active, reflective, theoretical and pragmatic) that are classified each in three levels (high, low, very low) and where young people have two possible answers to choose (a positive (+) if they identify with the situation or a negative (-) if they disagreed with the question posed).

The purpose of this activity is for the teacher to implement activities that strengthen each of the styles that can be found in a classroom, since the strategies should be randomly interspersed, in such a way that they involve the largest number of learning styles, in order to strengthen the learn to learn (Gutiérrez, 2018).

Phase 2. Disciplinary design

- This material was designed according to the Physics III syllabus of the ENCCH, which is made up of two units, the first one titled rigid body systems and the second unit called fluid systems, giving a total of 19 lessons to be covered in 64 hours.
- Subsequently, the contents were selected and organized in such a way that they were distributed by degree of difficulty. It is convenient to indicate that preference was given to developing different types of activities for those very difficult or difficult learning, for this the data of the Academic Diagnostic Exam (EDA) were reviewed, which is an internal instrument used in the ENCCH and has the objective of evaluating the achievement of the learning of the subjects of the Curriculum (Gaceta CCH, 2020).
- The resources were designed with an educational intentionality, that is, that the appropriate didactic characteristics were recognized to facilitate learning (Real, 2019), in this case emphasis was given to the stimulation of mathematical skills necessary for the subject of Physics III.
- It should be noted that most of the proposed materials were audiovisual, in other words, they contain audio, text and video. In addition, some activities such as word search, videoquiz, crossword puzzles, hypervideos, among others, were chosen. However, it is essential to emphasize that these were built from active methodologies such as gamification or the flipped classroom, to promote the continuous participation of students.
- Likewise, evaluation criteria and exercises were developed through co-evaluations, heteroevaluations and self-evaluations.

Phase 3. Technological design

The following points were considered in the technological design phase:

- Prospecting of digital resources, materials and similar projections, in order to serve as a parameter and to detect limitations.
- Review of free and easily accessible technological resources, including Sway, Stream, power point, Microsoft Teams, simulators, YouTube videos, Geneally, web pages, among other resources.
- Choice of graphic environment, links, icons, among others.

Phase 4. Experimental and material evaluation

At this stage, an experimental prototype was developed as explained below:

- A two-week pilot test lasting 40 hours was conducted both asynchronously and synchronously. At the end, students were provided with an evaluation instrument to measure the quality of the designed material, also at the beginning and end of the course they were provided with another evaluation format to determine the level of understanding reached by the students.
- In addition, the material was peer reviewed by means of a course designed for the evaluation of the material, which lasted 20 hours in a synchronous and asynchronous modality and not only had the purpose of evaluating the quality of the material, but also to disseminate it among teachers so that they could use it in their classes.

Phase 5. Analysis and rework of the material

This stage consisted of adjusting and modifying the material designed according to the results obtained in the previous phase, therefore, the actions carried out consisted of the following:

- Analysis of the results collected from the previous phase.
- Redesign of didactic and technological dimensions.

Participants

The sample was by convenience and non-probabilistic, specifically it was a purposive sampling, that is, it was not aimed at choosing subjects at random to be representative, but participants were selected who met certain characteristics according to the needs of the research (Argibay, 2009, p.19).

Based on the above, 22 students participated in this study, 54.54% of whom were women and 45.45% men, who were taking Physics III at the ENCCH Vallejo campus, between the ages of 17 and 19 years old; it should be noted that we worked with students who had not passed this subject or who were at risk of failing it. Likewise, to review the material, we worked with 12 teachers (58.33% women and 41.67% men) who teach this subject at the School; in order to provide feedback on the didactic material.

Evaluation instruments

The evaluation instrument to measure the level of understanding reached by the students was very similar to the one applied to them in the EDA test. In this case, the exam had 27 items with three response options, it should be noted that the questions included conceptual and procedural aspects of the subject, in which nine learning difficult to assimilate by young people were addressed and which are presented in the Table 1.

Difficult learning	Items
Determine the mass of the body that generates the gravitational attraction from Kepler's third law.	3
Calculate the center of mass of a system.	3
Apply angular displacement, velocity and acceleration to problem solving.	3
Identify the similarities of linear parameters with angular parameters.	3
Calculate the moment of inertia of different systems or solid bodies.	3
Identifies the characteristics of gauge pressure.	3
Prove Bernoulli's equation with Torricelli's theorem.	3
It uses Bernoulli's equation in its general form and in its particular cases.	3
Identify Bernoulli's equation with the law of conservation of mechanical energy.	3

Table 1 Learning difficult to achieve by students according to the Physics III study program in the period 2019-1
Source: DGCCH (2016)

It should be added that two other evaluation instruments (survey) were designed and applied in phase 4, the first one for students and the second one for teachers. The criteria evaluated in the instrument implemented with the students are presented in Table 2.

Criteria evaluated	No. de ítems
Motivation	10
Understanding instructions	5
Understanding the content	10
Material quality	10
Level of difficulty of the activities	10
Total	45

Table 2 Criteria evaluated in the survey applied for students
Source: Adapted Aguilar et al. (2014)

The survey applied for teachers was designed based on the criteria of González, Guzmán & Barrera (2014) shown in Table 3.

Criteria	No. de ítems
Consistency	10
Transferable and applicable	10
Interactive	10
Aesthetic design	10
Significant	10
Valid and reliable	10
Functionality	10
Total	70

Table 3 Criteria evaluated in the survey applied by teachers
Source: Adapted from González, Guzmán & Barrera (2014)

It should be added that in all cases they were applied through a Google form, through non-probabilistic sampling of the intentional or opinionated type, since according to Arias (2012) the elements are chosen with respect to the research criteria. In the same orientation, the survey was self-administered since the interviewer did not participate in filling out the survey.

For the quantitative analysis, an assessment was established for each item according to the Likert scale, which indicates the frequency with which they identify with the situation described in the item. Where, the weighting is 1) Strongly disagree, 2) Disagree, 3) Undecided, 4) Agree and 5) Strongly agree. To identify the most relevant items, the mean frequency was obtained by means of equation 1.

$$\bar{x} = \frac{A(1)+B(2)+C(3)+D(4)+E(5)}{N}$$

(1)

Where, the values 1, 2, 3, 4 and 5 are obtained from the Likert scale and the letters A, B, C, D and E are the individual index of subjects and N is the total number of individuals by groups.

Results

Throughout this study, reference has been made to a fundamental aspect that refers to the evaluation of materials by the two main actors in the educational process, since it must be considered that resources help to conceive different ways of understanding teaching (Cepeda, Gallardo and Rodríguez, 2017).

On the previous bases and the results obtained, Table 4 is presented, where it is shown that the evaluation of the material by the students was positive, since in most of the criteria average frequencies ≥ 4.0 were achieved, except for two which were the motivation and the level of difficulty of the activities.

Criteria evaluated	\bar{x} Average frequency
Motivation	3.90
Understanding instructions	4.55
Understanding the content	4.33
Material quality	4.22
Level of difficulty of the activities	3.23

Table 4 Average frequency obtained from the students' evaluation of the material

It should be noted that in relation to the results obtained in the case with the students, the aspect with the lowest average frequency was the level of difficulty of the activities, since they state that the tasks should be simpler and perhaps this is one of the possible reasons, why the motivation category also had an average frequency lower than 4.0. Probably, this is caused because the tasks requested are designed to promote reflective thinking in the learner, that is, the student must analyze, investigate to propose a solution to a certain physical phenomenon and not just memorize a concept or procedure; consequently, they must dedicate a greater number of hours to carry out their activities.

However, when the young people viewed their tests, they considered that the material helped them understand various topics that had been difficult for them up to now.

The results of this test are shown in table 5, considering that these were positive, since it was observed that 100% of the reagents had an increase in the percentage of students who answered correctly, this could be caused by two possible reasons, the first refers to the fact that the learning material was potentially significant and the second that the learner presented a predisposition to learn (Encinas et al., 2016).

Difficult learning	Item	Percentage of students %	
		Before	Final
Determine the mass of the body that generates the gravitational attraction from Kepler's third law.	1	50	81.81
	2	36.36	86.36
	3	22.72	59.09
Calculate the center of mass of asystem.	4	68.18	100
	5	54.54	90.90
	6	27.27	95.45
Apply angular displacement, velocity and acceleration to problem solving.	7	40.90	86.36
	8	45.45	77.27
	9	36.36	81.81
Identify the similarities of linear parameters with angularparameters.	10	18.18	90.90
	11	22.72	95.45
	12	22.72	95.45
Calculate the moment of inertiaof different systems or solid bodies.	13	45.45	95.45
	14	50	86.36
	15	50	86.36
Identifies the characteristics ofgauge pressure.	16	27.27	100
	17	27.27	95.45
	18	18.18	100
Prove Bernoulli's equation withTorricelli's theorem.	19	40.90	95.45
	20	31.81	100
	21	36.36	90.90
It uses Bernoulli's equation in its general form and in its particularcases.	22	27.27	68.18
	23	31.81	77.27
	24	31.81	72.72
Identify Bernoulli's equation with the law of conservation of mechanical energy.	25	9.09	59.09
	26	18.18	63.63
	27	22.72	77.27

Table 5 Percentage of students who answered each item correctly before and at the end of the course

With respect to the results emanating from the evaluation of the material by teachers 100% obtained an average frequency > 4.0 as shown in Table 6, therefore it can be deduced that the results were positive given that, according to Aguilar et al., (2014) states that the quality of a learning object should be contemplated in a comprehensive manner, in other words, all aspects evaluated must achieve a positive perception by the users.

Criteria	\bar{x}
	Averege frequency
Consistency	4.56
Transferable andapplicable	4.78
Interactive	4.12
Aesthetic design	4.25
Significant	4.09
Valid and reliable	4.23
Functionality	4.34

Table 6 Average frequency obtained from the evaluation of the material by teachers

In addition, it should be noted that the criterion with the lowest average frequency evaluated by teachers was the item of meaningfulness, which according to González, Guzmán & Barrera (2014) consists of reflecting whether "the contents make sense in themselves, represent something interesting for the addressee and are presented progressively" (p.11).

After the above, and based on the evidence gathered, some activities were redesigned, whose changes consisted mainly in incorporating some resources that favored interdisciplinarity so that students could observe that the subject of Physics is not an isolated subject with respect to other disciplines and the experiential context of young people. Therefore, projects were integrated with the purpose of providing solutions to some of the problems raised in the didactic material.

Conclusion

With respect to the evidence obtained in this research, it can be inferred that in order to improve some of the aspects in the teaching of Physics, a viable option is the construction and choice of materials, hence it is required that teachers are trained in methodologies that allow the design of resources that contribute to the achievement of the construction of new knowledge and in a change of the paradigm that Physics is difficult.

It is important to clarify that pedagogical, disciplinary, and technological elements must be considered in an integral manner when designing materials, since they lead to results that would not be achieved in isolation; hence the importance of developing materials from a systemic approach, that is, visualizing all the factors that intervene in the educational process.

Based on the above, the student is the center of the teaching and learning process, however, it requires a facilitator with a high level of disciplinary, technological and pedagogical training that allows him/her to have a greater variability that helps him/her to adjust his/her teaching to the needs and characteristics of his/her students and the context.

Finally, it should be noted that a limitation of this work is that it was a pilot test with students who owe the subject or who were at risk of failing it, so it can be inferred that perhaps a possible reason for their commitment during the course is due to the need to pass the subject. Therefore, it is contemplated as a future work to implement this material to a group studying Physics III for the first time and evaluate the results to make decisions in the redesign of the proposed didactic material.

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Analysis of stress and anxiety in university students to identify correlated factors

Análisis del estrés y ansiedad en estudiantes universitarios para identificar factores correlacionados

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Abstract	Resumen
<p>In the present study, we analyze the stress, anxiety, state, and academic features of 478 higher-level students. We identify the correlated factors using multiple linear regression and Pearson's correlation coefficients. We use the SISCO and STAI instruments to measure academic stress at the anxiety level. We determine that the most representative stressors in students are the teachers' evaluations with 31% as almost always and 11% as always, physical reactions such as drowsiness or need to sleep 31% as almost always, 12% always. Besides, reactions of depression and sadness show a 9% as almost always, 9% as always. Behavioral and coping reactions show 9% almost always and 9% always. The most outstanding anxiety reactions in the present research revealed that 48% of the students never feel calm, 40% never have happiness like others, 41% are never satisfied or comfortable with themselves. Some psychological changes related to stress and anxiety are closely linked to the suicide rate, derived from the fact that the generated uncertainty becomes a potential source of stress and vulnerability to depressive or anxiety disorders.</p>	<p>En el presente estudio se analizó el nivel de estrés, ansiedad, estado y rasgo académico que presentan 478 alumnos de nivel superior, identificando los factores correlacionados mediante regresión lineal múltiple y el coeficiente de correlación de Pearson. Para medir el estrés académico a nivel de ansiedad se hizo uso de los instrumentos SISCO y STAI, determinando que los estresores más representativos en los estudiantes son las evaluaciones con los profesores con 31% casi siempre y 11% siempre, reacciones físicas que enfrentan tales como somnolencia o necesidad de dormir 31% casi siempre, 12% siempre como reacciones de depresión y tristeza 9% casi siempre 9% siempre reacciones comportamentales y de afrontamiento muestran el 9% casi siempre y 9% siempre. Las reacciones de ansiedad más destacadas en la presente investigación son que el 48% de los estudiantes nunca tienen sensación de calma 40% nunca tienen felicidad como otros, 41% nunca están conformes ni a gusto con ellos mismos. Algunos cambios psicológicos relacionados con el estrés y la ansiedad se encuentran estrechamente ligados a la tasa de suicidio, derivado a que la incertidumbre que se genera se convierte en una fuente potencial de estrés y vulnerabilidad de trastorno depresivo o ansioso.</p>
Academic stress, Anxiety, Multiple linear regression	Estrés académico, Ansiedad, Regresión lineal múltiple

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Introduction

Academic stress and anxiety usually describe a wide range of experiences: nervousness, physiological activation, tension, fatigue, overwhelm, restlessness, and other similar sensations, such as excessive school pressure (Águila, Castillo, de la Guardia and Achon, 2015: 167). The inclusion of stress as part of daily life in the 21st century has become present in different areas (Collazo, Rodríguez, 2011 & Martínez, 2010), and it is considered a social problem. However, academic stress is a topic that has not received enough attention in research (Monzón, 2017: 87).

The accelerated student's life throughout the learning process includes diverse and complex activities such as homework, exhibitions, assignments, exams, commitments, and outings with friends, causing an overload of events, resulting in academic stress, an action that affects the intellectual, physical and psychological environment (Sarubbi & Castaldo, 2013: 291, 293).

Several kinds of research show that from preschool to postgraduate college education, when a person is in a learning period, they experience academic stress. It occurs both for individual study and in the classroom.

Diverse authors have examined factors that allow for highlighting academic stress (Mendoza, Ortega, Quevedo, Martínez, Aguilar, Hernández, 2010: 38), such as the overload of homework and schoolwork, limited time to do the work (Martin, 2007: 95), overwork (Depraect, Decuir, Castro, & Salazar, 2017: 95), application of examinations, activities or tasks that are contradictory to each other, little practice of the classes (Cabanach, Fernández, González, Freire, 2010, Polo, 1996 & Celis, 2001 Bustamante, Cabrera, Alarcón, Monge, 2001), high academic load expressed in the number of courses both face-to-face and/or not face-to-face, the time they must dedicate to study (Lazarus, 1986) (Guadarrama, Mendoza, Veytia, Serrano & Ruíz, 2012), socioeconomic status, work and task overload that contributes significantly to explain the trigger for academic stress and success in academic performance in those students who control and handle in a reasonable tone the stress.

On the subject of anxiety, the research of (Saranson, 1990) describes that it depends on factors such as the degree of demands (difficulty of the task), the ability to control the effects that interfere with oneself concerning about anticipating danger, availability and use of adequate instrumental resources (Gutiérrez, 1996), as well as academic overload and lack of time to complete academic activities (Polo, Hernandez & Pozo, 1996).

A series of changes characterize emerging adulthood in the university. Among those related to eating habits, Risky Eating Behaviors (CAR) are acquired, which are associated with symptoms of anxiety, depression, and stress, before which social support can act as a protective factor (Escandón-Nagel, 2021).

Anxiety during the exam is positively related to the search for social support (Stöber, 2004) (Putwain, Connors, Symes, & Douglas, 2012). On the contrary, not living with the family during the course can be an associated stressor to the risk of anxiety, which is also confirmed in a study carried out with Iranian students (Makaremi, 2000).

Author such as (Jara, Velarde, Gordillo, Guerra, León, Arroyo, & Figueroa, 2018: 196) describe that the main cause is the lack of study habits and strategies. On the other hand, (Medina, 2012: 65,66) indicates that environmental stressors and individual stressors impact the physical, psychological, social, and emotional development of the individual. Besides, the form of teaching by some teachers, the academic model, and evaluation forms. Furthermore, (Laredo, Huante, Hernández, Moran, & Loeza, 2014: 188) mention that the exams and how students prepare to carry them out detonate stress.

(Sarubbi & Castaldo, 2013: 293) explains that social environment, urban or rural origin, home formation, lack of commitment, motivation, interest and time invested in personal study, and class attendance are the factors that generate stress in students.

Despite the various studies carried out, multiple studies have shown that coping with stress is a preventive measure, describing different strategies:

1. Acceptance, such as the attitude of respecting and loving oneself and towards others.
2. Self-analysis, such as reflection on one's thoughts, motivations, feelings, behavior, recognizing self-responsibility to act finally.
3. Social support when people go and seek others for emotional support.
4. Self-control, such as the ability to control feelings, their reactions (Lazarus, 1986). However, (Guadarrama, Márquez, Mendoza, Veytia, Serrano, Luis & Ruíz, 2012) refer to the fact that, if the university student decides to adapt and face those factors that he perceives as a cause of stress, he can satisfactorily resolve the day to day in the school.

One of the critical aspects to highlight is that suicide has become a severe public health problem due to its increase in young people from 15 to 24 years due to stress and anxiety in recent years. An estimated one million people committed suicide in 2000, making suicide one of the top ten causes of death in many countries. 10 to 20 times more people attempted suicide, and the actual numbers are even inferred to be higher. Although suicide rates vary by demographic category, in the last 50 years, they have increased by approximately 60% worldwide (WHO, 2006). In Mexico, October 2014 (PAHO / WHO).

About 65,000 people kill themselves each year, according to the existing suicide data in Mexico. In general, these show an increasing trend in the long term. In 1950 the rates were close to 1.5 suicides per 100,000 inhabitants. By 2008, these rates had multiplied by three and had already reached 4.8 suicides per 100,000 inhabitants. However, it is essential to remark that in the 1960s, suicide rates decreased and arose again after 1970, an upward trend maintained to date.

Hence, in the present paper, we analyze the student perception about factors that generate stress and anxiety when studying engineering careers at the undergraduate level. In this sense, the purpose of this research is to identify the correlated factors between the causes of anxiety and stress and know-how students cope with them.

Materials and methods

Sample selection

We collected the data through an intentional sampling of a Higher Education Institution that attends students from different areas, both rural and urban areas belonging to Libres, Puebla, Mexico. Four hundred seventy-eight students between the ages of 18 and 29 were surveyed, of which 285 were men and 193 women, distributed in four semesters of the Instituto Tecnológico Superior de Libres (ITSL): a) semester 1 with n=174, b) semester 2 with n=105, c) semester 3 with n=113, and d) semester 4 with n=86.

Research instruments

For the present research, the SISCO Academic Stress Inventory (Macias, 2007) was used to recognize the characteristics of stress that usually accompany students of upper secondary, higher, and postgraduate education during their study (Macias, 2007: 90-93).

We use the State-Trait Anxiety Inventory instrument (STAI) proposed by (Guillén & Buela, 2015; 294) to determine the degree of anxiety of the 478 students, allowing us to measure the level of state-anxiety and trait anxiety.

Currently, the STAI questionnaire is widely used to measure the level of anxiety in different clinical contexts (Venderbos, Van Den Bergh, Roobol, Schröder, Essink-Bot, Bangma & 2015) and in populations of university students (Fonseca, Paino, Sierra, Baigrie ., Lemos-Giráldez, Muniz, 2012 & Pottier, Hardouin, Dejoie, Bonnaud, Le Loupp & Planchon 2011). The STAI has shown high reliability and validity (Gross, 2007).

We developed two identical versions of the instruments, a mobile version (via Android, PHP with a Postgres database) and a printed version to facilitate data collection.

Using Cron Bach's Alpha, we obtain a reliability value of 0.826 for the SISCO instrument and 0.721 for the STAI instrument, allowing us to exhibit an adequate indicator to carry out the formal analysis of the data collected. The Kaiser-Meyer-Olkin (KMO) overall mean was 0.823 for the SISCO instrument and 0.888 for the STAI instrument.

Procedure

Once we selected the instruments, their application was at the Instituto Tecnológico Superior de Libres Puebla, Mexico. According to the rules for scientific research, we submitted a prior authorization to the institute manager to carry out the survey.

For this purpose, we established personal contact with the academic director. After that, we applied the instruments with the consent of the students and directors. We carried out the applications of the instruments in classrooms with a maximum time of 25 minutes per group. Then, we carry out the data analysis with multiple linear regression and pearson's correlation coefficient.

Analysis and results

We analyze descriptive statistics regarding stressors, physical reactions, psychological reactions, behavioral reactions, and coping reactions in the SISCO instrument.

Table 1 shows the response percentage for each item with its respective indicator considering as triggers of stress the evaluations of the teachers, overload of tasks, work, reactions of drowsiness, need to sleep, depression, sadness, and concentration problems.

Stressors					
Item	Never	Rarely	Sometimes	Almost always	Always
Competition with peers	21%	24%	44%	7%	4%
Overload of homework and school work	7%	14%	39%	31%	9%
Teacher personality and character	10%	31%	30%	22%	7%
Teacher evaluations	6%	17%	35%	31%	11%
Type of work requested by teachers	3%	26%	46%	16%	9%
Not understanding the issues	9%	30%	44%	12%	5%
Class participation	16%	24%	39%	15%	6%
Limited time to do jobs	5%	18%	49%	19%	9%
Physical Reactions					
Sleep disorders	21%	36%	26%	12%	5%
Chronic fatigue	17%	25%	41%	16%	1%
Headaches or migraine	18%	35%	30%	15%	2%
Digestion problems	18%	35%	30%	15%	2%
To bite nails	29%	18%	18%	28%	7%
Drowsiness or need to sleep	12%	13%	32%	31%	12%
Psychological reactions					
Restlessness	13%	23%	43%	14%	7%
Depression sadness	23%	28%	31%	9%	9%
Anxiety	18%	28%	40%	12%	2%
Concentration problems	9%	22%	48%	14%	7%
Aggression or irritability	25%	27%	35%	12%	1%
Behavioral reactions					
Polemize or argue	28%	24%	44%	7%	4%
Isolation from others	23%	48%	18%	8%	3%
Reluctance	16%	36%	32%	15%	1%
Increase or decrease in food consumption	20%	28%	27%	18%	7%
Assertive ability	13%	30%	28%	19%	10%
Elaboration of a plan and its execution	5%	44%	26%	22%	3%
Praise himself	20%	30%	32%	13%	5%
Religion	50%	29%	17%	2%	2%
Coping reactions					
Assertive ability	13%	30%	28%	19%	10%
Elaboration of a plan and its execution	5%	44%	26%	22%	3%
Praise yourself	20%	30%	32%	13%	5%
Religion	50%	29%	17%	2%	2%
Search for information about the situation	8%	19%	47%	22%	4%
Ventilation and Confidences	13%	27%	38%	17%	5%

Tabla 1 SISCO instrument statistical percentages
Source: Own Elaboration

We analyzed STAI results with descriptive statistics; table 2 shows the response percentage for each item with its respective indicator. Considering relevant aspects such as you are never calm, you have anxiety, disgust, upset, nerves, agitation, and bad thoughts.

Feeling	Never	Sometimes	Frequently	Almost always	Always
Calm	48%	26.7%	29.4%	32.4%	6.4%
Safety	2.9%	26.5%	29.0%	28.2%	13.1%
Tension	10.6%	51.2%	23.4%	10.6%	3.9%
Dislike	19.8%	54.6%	16.7%	6.6%	2%
Relaxed	26.1%	33.8%	20.2%	12.9%	6.6%
Disturbance	31.5%	44.7%	14.6%	6.0%	2.9%
Worry	29.7%	28.8%	41.6%	13.1%	8.5%
Satisfaction	7.11%	24.4%	29.7%	30.3%	8.3%
Afraid	38.7%	42.0%	10.2%	5.0%	3.9 %
Comfort	7.1%	25.5 %	26.7%	28.4%	12.1%
Confidence	5.6%	17.5%	20.7%	30.3%	25.7%
Nerves	11.9%	47.9%	23.8%	13.5%	2.7%
Agitation	32.6%	48.5%	14.6%	2.3%	1.8%
Indecision	19.0%	50.2%	19.8%	8.3%	2.5%
Tranquility	5.2%	24.0 %	28.6 %	28.0%	14.0%
Taste	4.1%	22.8%	26.9 %	11.7%	6.4%
Worry	16.7%	49.5.8%	15.4 %	11.7%	6.4%
Stun	38.0%	38.9 %	13.8 %	5.8%	3.3%
Balance	7.32%	24%	37.0%	21.9%	9.6%
Well-being in the moment	2.9%	19.2 %	22.1 %	34.7%	20.9%

Well-being in general	5.4%	18.8 %	23.2 %	34.5%	17.9%
Tiredness	15.2%	46.4%	19%	13.8%	5.4%
Agree with himself	4.1%	23.4 %	19.0 %	27.8%	25.5%
Happiness like others	40.1%	26.1%	13.8 %	6.9%	12.9%
Fail	17.5%	47.6%	15.2 %	12.1%	7.3%
Rest	17.7%	33.8%	25.9 %	15.8%	6.4%
Tranquility	9.20%	20.2%	23.0 %	26.7%	20.7%
Difficulty	24.2%	42.0%	14.43 %	11.71%	7.5%
Worry	29.2%	32.6%	19.4 %	11.0%	7.5%
General happiness	7.5%	14.2%	15.2 %	31.7%	31.1%
Bad thoughts	31.3%	38.4%	14.0 %	7.7%	8.3%
Lack of trust	26.3%	40.5%	11.7 %	12.1%	9.2%
Safety	6.4%	28.2%	25.3 %	23.6%	16.3%
Decision	12.7%	31.7%	26.3 %	19.4%	9.6%
Out of place	32.6%	42.2%	11.2 %	8.9%	4.8%
Satisfaction	10.2%	24.6%	28.0 %	25.5%	11.5%
Unimportant ideas occupy your head	20.7%	40.7%	18.8 %	11.71%	7.9%
Disappointments	36.8%	38.4%	10.6 %	8.5%	5.4%
Stability	7.5%	18.2%	30.3%	29.28%	14.6%
Tension and nervousness from thoughts	24.2%	41.2%	15.4%	11.7%	7.3%

Tabla 2 STAI instrument statistical percentages

a) Non-standardized SISCO Multiple Linear Regression Coefficients					
Items	B	Desv. Error	Beta	t	Sig.
P19	0.14	0.06	0.112	2.24	0.026
P26	0.15	0.05	0.151	3.17	0.002
P27	0.17	0.05	0.164	3.33	0.001
P29	0.16	0.05	0.166	3.01	0.003
N.A	N.A	N.A	N.A	N.A	N.A
b) Non-standardized Multiple Linear Regression Coefficients STAI					
Items	B	Desv. Error	Beta	t	Sig.
P9	0.115	0.046	0.095	2.477	0.014
P25	0.133	0.044	0.126	3.02	0.003
P31	0.195	0.039	0.202	5.024	0
P37	0.225	0.044	0.222	5.095	0
P40	0.229	0.041	0.227	5.551	0

Tabla 3 Non-standardized Multiple Linear Regression Coefficients
Source: Own Elaboration

Multiple Linear Regression

The Multiple Linear Regression method was applied to analyze the answers of 478 students; the model determined a value of 87.8 for the SISCO instrument and 58.5 for STAI. Once corrected for the sample effect, the values of the independent variable were 86.1 for SISCO and 54.8 for STAI. The standard error of the estimate (square root of the unexplained variable) was 87.8 and 58.5, respectively. By analyzing the SISCO instrument responses with Multiple Linear Regression, the most representative aspects were items P19, P26, P27, and P29 in Table 3a. These items correspond to concentration problems, aggressiveness feelings or increased irritability, praise for themselves, religion (prayers or attendance at mass), ventilation, and confidence (verbalization of the situation that worries).

The representative items were P9, P25, P31, P37, and P40 for the STAI instrument, see Table 3b. The results showed that students feel scared, tend to fail, and have bad thoughts. These are associated with some not revealing ideas that occupy your mind decreasing your performance or generating nervousness and tension.

Pearson's correlation coefficient

The correlation coefficient allows measuring the degree of correlation or association between two random variables (Águila, 2015 & Macías, 2007).

In the present study, the highest correlations between variables were characterized, see Table 4. The interval of Pearson's correlation values was divided into three cases. Each case represents the values of the intervals to be considered for each type of correlation.

#Case	Interval		Meaning
1	0.2	0.4	Low positive correlation
2	0.4	0.7	Moderate positive correlation
3	0.7	0.9	High positive correlation

Tabla 4 Cases for the interpretation of Pearson's correlation
Source: Own Elaboration

Results of the coefficients analysis

The cases of the correlations were divided into a low positive correlation, moderate positive correlation, and high positive correlation. Tables 5 and 6 show the determination of the stressor associations variables from the CISCO and STAI measuring instruments.

Pearson SISCO correlation coefficient					
p20		p22		p28	
p17	.722**	p17	.705**	p20	.724**
p19	.728**	p19	.738**	p24	.730**
p21	.753**	p20	.758**	p26	.758**
p22	.758**	p21	.711**	p27	.773**
p26	.715**	p23	.747**	p29	.796**
p27	.718**	p29	.720**	NA	NA
p28	.724**	NA	NA	NA	NA
p29		p26		p27	
p22	.720**	p20	.715**	p20	.718**
p24	.733**	p26	.716**	p25	.716**
p26	.738**	p28	.773**	p27	.773**
p27	.710**	p29	.710**	p28	.710**
p28	.796**	NA	NA	p29	.815**
NA	NA	NA	NA	N.A	N.A
NA	NA	NA	NA	N.A	N.A

Tabla 5 Pearson SISCO correlation coefficient
Source: Own Elaboration

Pearson STAI correlation coefficient					
p20		p22		p28	
p17	.722**	p17	.705**	p20	.724**
p19	.728**	p19	.738**	p24	.730**
p21	.753**	p20	.758**	p26	.758**
p22	.758**	p21	.711**	p27	.773**
p26	.715**	p23	.747**	p29	.796**
p27	.718**	p29	.720**	NA	NA
p28	.724**	NA	NA	NA	NA
p29		p26		p27	
p22	.720**	p20	.715**	p20	.718**
p24	.733**	p26	.716**	p25	.716**
p26	.738**	p28	.773**	p27	.773**
p27	.710**	p29	.710**	p28	.710**
p28	.796**	NA	NA	p29	.815**
NA	NA	NA	NA	N.A	N.A
NA	NA	NA	NA	N.A	N.A

p1		p6		p10		p15		p16	
p2	.446**	p7	.408**	p19	.439**	p1	.514**	p1	.440**
p15	.514**	p7		p20	.547**	p10	.544**	p2	.432**
p16	.440**	p6	.408**	p11		p16	.588**	p8	.465**
p20	.417**	p17	.412**	p20	.528**	p19	.501**	p10	.555**
p21	.414**	p8		p33	.458**	p20	.596**	p11	.440**
p2		p10	.414**	p13		p26	.447**	p15	.588**
p1	.446**	p15	.414**	p12	.427**	p33	.452**	p20	.613**
p16	.432**	p9		p18	.441**	N.A	N.A	p21	.469**
p20	.483**	p22	.406**	N.A	N.A	N.A	N.A	p33	.409**
p33	.478**	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A
p17		p20		p20		p28		p37	
p7	.412**	p1	.417**	p1	.417**	p31	.506**	p17	.411**
p18	.425**	p2	.483**	p2	.483**	p37	.558**	p28	.558**
p28	.412**	p10	.547**	p10	.547**	p40	.556**	p31	.461**
p19		p11	.528**	p11	.528**	p31		p40	.465**
p2	.402**	p15	.596**	p15	.596**	p28	.506**	p40	
p10	.439**	p19	.585**	p19	.585**	p37	.461**	p28	.556**
p15	.501**	p26	.427**	p26	.427**	p32		p37	.465**
p20	.585**	p33	.507**	p33	.507**	p29	.428**	N.A	N.A
p26	.407**	p39	.411**	p39	.411**	N.A	N.A	N.A	N.A
p33	.480**	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A

Tabla 6 Pearson STAI correlation coefficient
Source: Own Elaboration

The SISCO instrument results concerning the values of the most representative correlations show the following:

1. Item p20, referring to conflicts or tendencies to argue or argue, correlates with ten items; such as anxiety, anguish or despair, aggressiveness feelings or increased irritability, isolation from others, reluctance to carry out schoolwork, elaboration of a plan and execution of his tasks, praise himself, religiosity (prayers and attendance at mass), ventilation and confidences (verbalization of the situation that worries).

2. Item p22, related to reluctance to do schoolwork, is correlated with anxiety, anguish or despair, feelings of aggressiveness or increased irritability, conflicts or tendencies to argue or argue, isolation from others, increase or reduction of food consumption, search for information on the situation of concern, ventilation and confidences (verbalization of the situation of concern).
3. Item p28, corresponding to religiosity (prayers or attendance at mass), correlates with conflicts or tendencies to argue or argue, assertive ability (defend preferences, ideas or feelings without harming others), elaboration of a plan and execution of his tasks, praise himself, search for information about the situation, ventilation, and confidences (verbalization of the situation that worries).
4. Item p29, referring to seeking information about the situation that worries, correlates with reluctance to carry out schoolwork, with assertive skills defending preferences, ideas or feelings without harming others, elaboration of a plan and execution of their tasks, praise himself, verbalization of the situation that worries.
5. Item p26, concerning to the preparation of a plan and execution of their tasks, has a correlation with conflicts or tendencies to argue or argue, religiosity (prayers or attendance at mass), search for information about the situation, ventilation and confidences (verbalization of the situation that worries).
6. Item p27, which refers to praise himself, is correlated with conflicts or tendencies to argue or argue, assertive abilities (defending preferences, ideas, or feelings without harming others), religiosity (prayers or attendance at mass), search for information about the situation.

The STAI instrument correlation results reveal the following:

1. Item p1, referring to I feel calm, correlates with feelings of security, tranquility, pleasure, feeling good, safe, with a feeling of calm, I feel good, and I am happy.
2. Item p8, which corresponds to feel satisfied, is correlated with feeling comfortable and calm.
3. Item p9, corresponding to feel scared, is correlated with feeling nervous.
4. Item p10, referring to feeling comfortable, correlates with feeling balanced and feeling good.
5. Item p11, which corresponds to confidence in myself, is correlated with feeling good and safe.
6. Item p15, referring to feeling peaceful, is correlated with feeling calm, comfortable, pleasing, balanced, good, rested, and safe.
7. Item p16, corresponding to feeling comfortable, is correlated with feeling calm, safe, satisfied, comfortable, confident in myself, feeling calm, and feeling good.
8. Item p17, referring to I am worried, correlates with apprehension about some issues, stunned, and feeling that the difficulties are piling up and cannot overcome them.
9. Item p18, corresponding to feeling dazed, correlates with a feeling of agitation and worry.
10. Item p20 referring to feeling good correlates to feeling calm and confident in myself.
11. Item p19, referring to feeling balanced, is correlated with feeling safe, comfortable, calm, good, rested, safe, and a stable person.
12. Item p28, which refers to the fact that difficulties pile up and I cannot overcome them, correlate with I have bad thoughts, some unimportant ideas occupy my head and bother me when I think about the things I have in hand, I get nervous and tense.
13. Item p31, which refers to having bad thoughts, is correlated with I feel that difficulties pile up and I cannot overcome them. Some unimportant ideas occupy my head and bother me.
14. Item p32, corresponding to I lack confidence in myself, is correlated with worry too much about unimportant things.
15. Item p33, corresponding to feeling safe, confident in myself, calm, comfortable, good, happy, and a stable person.
16. Item p37, which corresponds to some unimportant ideas occupying my head, is related to I am worried, I feel that difficulties are piling up and I cannot overcome them, I have bad thoughts.
17. Item p40, referring to when I think about the things at hand I get nervous, it correlates with feeling that the difficulties pile up and I cannot overcome them, some unimportant ideas occupy my head and bother me.

Discussion and Results

This paper analyzed the level of stress, state anxiety, and academic trait presented by 478 higher-level students. The research aims are to carry out a correlation study to identify the main stressors, anxiety, physical, psychological, behavioral, and coping reactions of university students.

The results of the research indicate that students have psychological reactions to face aggressive feelings or irritability. Besides, they face them with praise themselves, search for information about situations, and elaborate a plan and its execution. We differ with the study of (Herrera, Betancourt, & Camargo, 2013); they conclude that the students search for professional and social support, to a lesser extent, religion and autonomy.

Consequently, the results obtained highlighted that students cannot be calm and relax, having feelings of depression, sadness, anxiety, and anguish. Taking into account (Reyes, 2003), academic performance can be influenced by psychological variables of the individual and become, in turn, a stressor, especially for those with a low tolerance for frustration or failure in the assessment situations faced. It is evident that students feel scared and fail, having bad thoughts, some unimportant ideas occupy their head and bother them, they become nervous and tense. These findings differ from those of (Caballero, Abello & Palacio, 2006, 2007), where exhaustion and cynicism, which negatively affect Self-efficacy, were determined as representative.

We determined that most of the time, academic events that highlight stressors are the overload of tasks and work (exams, essays, research papers, etc.), limited time to perform the tasks, sleep disorders, chronic fatigue, and problems concentration. Other authors argue that exams are one of the fundamental academic stressors in students' daily lives (Barroza & Silerio, 2007; Martín, 2007). In addition to the lack of time to carry out activities inherent to the academic field (Aranceli, 2006; Barroza & Silerio, 2007) and the work of the courses (Aranceli, Perea, & Ormeño, 2006).

Pearson's analysis of the STAI measurement instrument allows us to identify that the search for information about the situation of concern has a high correlation with reluctance to carry out schoolwork, assertive skills, defend preferences, ideas or feelings without harming others, making a plan and executing, praising yourself and verbalizing the situation of concern.

In addition to this, referring to self-praise is related to conflicts or tendencies to argue or discuss assertive skills (defending preferences, ideas, or feelings without harming others). In addition, students who praise themselves have a close relationship with religiosity (prayers or attendance at mass) because most students consider themselves believers in religion.

Consequently, we show that academic stress represents a severe problem at a higher educational level. On the other hand, it can be considered an opportunity for learning techniques to be strengthened to guide students to face future problems in their workplace.

Furthermore, the results indicate that a continuous evaluation of the behavioral level must be carried out to generate strategies that reduce stress. A subsequent correlation analysis between these results and academic performance is required to distinguish between stress that allows generating greater productivity and other that reflects a detriment to the student during their educational development.

Finally, it is essential to highlight that the results show increasing stress and anxiety as the semester progresses in their career. Hence, we need to offer students tools for their management.

If academic stress increases to severe levels, the students can develop diseases such as bruxism, anxiety, headaches, and ear pain. Future work will consider conducting segmented studies due to the peculiarities of the behavior of the student community when interacting with the society in which it operates, its family environment, and the beliefs it presents.

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Analysis of the level of stress in teachers

Análisis del nivel de estrés en los profesores

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Abstract

This research aims to know the stress level of teachers of one of the Santa Catarina Technological University majors and, if it is high, take the appropriate measures to try to reduce it to a safer proportion for teachers, and thus prevent teachers from getting sick or incapacitated very often. It is known to all that if the teacher does not fulfill his obligations, the one directly affected is the student, who will have a poor academic performance. To measure the level of stress, a questionnaire consisting of 23 questions will be applied to the teachers of the cited school, the options that will have to answer those questions are 4: nothing at all, a little, moderately and strongly, with values of 1, 2, 3 and 4 respectively; The answers selected by the teachers will be added and compared with a low, medium and high scale. Subsequently, a relationship of the level of stress against teacher performance will be established through a statistical treatment, where the correlation of these variables will be established by the method of the linear correlation coefficient r of Pearson. Likewise, the equation of the regression line by least squares will also be established with its corresponding graph for analysis.

Resumen

La presente investigación pretende conocer el nivel de estrés de los profesores de una de las carreras de la Universidad Tecnológica Santa Catarina y, en caso de resultar alto, tomar las medidas convenientes para tratar de disminuirlo a una proporción más segura para los maestros, y de esa forma evitar que los docentes se enfermen o incapaciten con mucha frecuencia. Por todos es sabido que si el maestro no cumple con sus obligaciones el directamente afectado es el alumno, quien tendrá un pobre rendimiento académico. Para medir el nivel de estrés se aplicará a los maestros de la escuela citada un cuestionario consistente en 23 preguntas, las opciones que tendrá que contestar esas cuestiones son 4: nada en absoluto, un poco, moderado y fuertemente, con valores de 1, 2, 3 y 4 respectivamente; se sumarán las respuestas seleccionadas por los maestros y se cotejarán con una escala de bajo, medio y alto. Posteriormente se establecerá una relación del nivel de estrés contra el desempeño docente a través de un tratamiento estadístico, donde se establecerá la correlación de estas variables por el método del coeficiente de correlación lineal r de Pearson. Así mismo también se establecerá la ecuación de la recta de regresión por mínimos cuadrados con su correspondiente gráfica para su análisis.

Stress, Analysis, Performance

Estrés, Análisis, Desempeño

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1. Introduction

The concept of stress was first introduced to the field of health in 1926 by Hans Selye. At present, it is one of the most used terms. Selye defined stress as the body's overall response to any stressful stimulus or stressful situation. The concept of work stress according to the World Health Organization is defined as "the physiological, psychological and behavioral response of an individual who tries to adapt and adjust to internal and external pressures", prevailing disorders such as headaches, episodes of anxiety, hypertension and psychosomatic diseases such as colitis, irritable bowel syndrome among others. Work stress appears when there is a mismatch between the person, the job and the organization itself. (Yang X, Ge C, Hu B, Chi T, Wang L., 2009).

Never before have teachers been subjected to such intense, complex, and sometimes contradictory demands from the administration, students, parents, and society at large. Faced with these pressures, many teachers suffer an alarming increase in stress, which can affect their good performance in the classroom.

The most diverse sources agree that, in recent years, the responsibilities and demands that are projected on teachers have increased, coinciding with a historical process of a rapid transformation of the social context, which has resulted in a modification of the role of the teacher, which is an important source of discomfort for many of them, since they have not known, or simply have not accepted, to accommodate themselves to the new demands.

2. Theoretical Framework

Stress, anxiety, tension, burnout and neurosis are some of the terms used to denote the negative aspects of modern life. The expression "being under stress," or "being in a state of stress," usually indicates a dangerous situation that borders on exhaustion. It is difficult to address a phenomenon as widespread as stress and establish its problems among teaching professionals, without first defining it generically. According to numerous experts, stress is an adaptive response to an external stimulus.

The "subject" with which teachers work, human beings in full growth, allows a very small margin of foresight and therefore its management exposes these professionals to considerable doses of stress.

Stress can lead an individual to the situation of exhaustion and consequently develop pathogenic effects. The most common symptoms among teachers are a feeling of exhaustion and frustration or extreme tension. For some, stress would cause, directly or indirectly, in the development of serious organic effects such as hypertension, heart disease, migraines, ulcers, asthma, gallbladder diseases and kidney diseases. On the mental level, permanent stress can lead to depression and general anxiety. (Esteve, 1987).

Some professions, such as teachers, are exercised by people with a great vocation and who, according to this, set high expectations that sometimes creates great frustration among teachers; there are also the administrative or organizational barriers that these education professionals often encounter, consequently causing a higher level of stress.

More and more teachers are suffering from work stress. This is not only a personal psychological problem, but a social problem. One of the causes is that society has changed, but not the training that teachers receive. In addition, the family delegates more and more responsibilities to the school and disregards its responsibility to its children. Teachers also believe that the social prestige of their profession has declined. Education experts relate teacher discomfort with the deterioration of the social image of the teacher and point out as the main problems of current teaching the lack of motivation on the part of students and teachers, the growing disinterest of parents, the excessive number of students per class and the lack of attention of the school authorities.

The teacher feels overwhelmed as a source of authority and knowledge in the face of an increasingly challenging student. Teachers have to teach some students who arrive at school without rules or values instilled in the family and other types of students who correct them in the middle of the class for having an Internet connection.

A long-term effect of stress among teachers is complete emotional exhaustion. This state can lead to an attitude of apathy outside of school generating a number of defensive strategies. This type of burnout can be identified as a type of chronic response to the negative, cumulative, and long-term impact of work stress. (Cooper, 1997). If the teacher presents an important level of stress he will begin to use a defense system that makes him believe that he can eliminate the origin of these tensions, he will begin to be absent to the work place, to get sick or incapacitated, to ask for more and more prolonged leave, not to perform well in classes, etc.; causing a very poor quality performance of their work which affects the students and the institution. A high level of stress in teachers can cause them to literally "burn" with the work they do, reaching burnout syndrome.

Burnout, is an Anglo-Saxon term whose closest translation is "to be burned", worn, exhausted and lose the illusion of work. The studies of Maslach and Jackson (1981, 1985 and 1986) defend that Burnout is a three-dimensional syndrome that develops in those professionals whose object of work are people (users) and add three characteristic dimensions. The first one is the feeling of not being able to give more of oneself to others.

Depersonalization is the second dimension and is understood as the development of feelings, attitudes, negative, distant and cold responses towards other people, especially towards the beneficiaries of one's own work. It is accompanied by an increase in irritability and a loss of motivation towards it. The professional tries to distance himself not only from the people targeted by his work but also from the members of the team with whom he works, being cynical, irritable, ironic and even sometimes using derogatory labels to allude to users and trying to make them guilty of their frustrations and decreased work performance.

A third dimension consists of a feeling of low achievement or low professional fulfillment and that arises when the demands that are made exceed their ability to attend them competently. It involves negative responses towards oneself and towards work, neglecting personal and professional relationships, poor work performance, inability to withstand pressure and low self-esteem.

Lack of personal achievement at work is characterized by painful disappointment and failure to make give personal meaning to work. Feelings of personal failure (lack of competence, effort or knowledge), lack of expectations and horizons at work, and widespread dissatisfaction are experienced. As a consequence, unpunctuality, frequent interruptions, the avoidance of work, absenteeism and abandonment of the profession are common and typical symptoms of this occupational pathology.

As for the symptoms, they can be grouped into four areas:

- a) Psychosomatic.
 1. Headaches
 2. Chronic fatigue
 3. Ulcers or gastrointestinal disorders
 4. Muscle aches in the back and neck
 5. Hypertension and in women lost menstrual cycles.
- b) Behavioral:
 1. Absenteeism
 2. Violent behavior
 3. Drug abuse
 4. Inability to relax
- c) Emotional:
 1. Affective distancing that the professional manifests to the people he serves
 2. Desires to quit work
 3. Irritability
 4. Difficulty concentrating due to anxiety experienced
 5. He doubts his professional competence, with the consequent decrease in self-esteem.
- d) Defensive:
 1. Denial of emotions.
 2. Irony
 3. Selective attention
 4. Displacement to other situations or things.

By work performance we mean the ability of workers, in our case of education, to be able to efficiently perform the work they do in the classroom, fulfilling satisfactorily the following features:

- Good punctuality and assistance.
- Be in constant training.
- Prepare the class in advance.

- Be constantly monitoring whether students are really learning
- Know if students are satisfied with their work as a teacher.
- Try to maintain a cordial relationship with other teachers.
- Respect the authority of the school.

3. Methodological framework

A brief description of the type of research to be carried out shall be included in the research methodology. It will include the techniques and strategies used in the study, as well as the characteristics, size and shape in which the population was selected. It also describes the instrument used for data collection and the procedures that will be used to organize and analyze the statistically obtained data.

Type of Research

This study can be considered as a descriptive study because it aims to show a phenomenon by studying from its characteristics.

The instrument used for data collection will provide descriptive information on the stress level of teachers.

Population and sample

It took the total of the universe that are 30 teachers in the Industrial Processes major, who participated voluntarily.

Instrument

An opinion poll that was prepared for data collection will be used. In this instrument, the teacher will be presented with a questionnaire of 23 questions with space to answer them. It will be used to collect data that has to do with the stress level of teachers.

The questionnaire will be applied to the teachers in a personal way. Each option that the teacher has to answer the 23 questions has the following values:

- a) nothing at all = 1 point
- b) a little = 2 points
- c) moderate = 3 points
- d) strongly = 4 points

The options selected by each of the teachers will be added according to the given score. This score will be related to the scale described below.

Stress level scale

- 1- 65 low stress level
- 66-117 average stress level
- 118-172 high stress level

Finally, information was collected from teachers about their level of teaching performance in this period that the survey was applied to measure the level of stress.

The aspects considered for the level of teaching performance are evaluated in each school period at the Santa Catarina Technological University, and are the following:

- a) Teacher Performance: based on a survey of evaluation of the teacher's actions by their students, which is applied by the Planning Department and has a weighting of 40%.
- b) Capture of qualifications and attendance in a timely manner, with a weighting of 20%.
- c) Punctuality and attendance, which consists of covering your scheduled academic load without delays or faults, weighting 30%.
- d) Teacher updating, which requires assistance and proven participation in at least one course of pedagogy, education or technological update during the period evaluated. Its weighting is 10%.

4. Results

Once the survey has been applied, the statistical processing of the data obtained is carried out. Here it is presented that in any distribution of data it can be visualized if they relate to each other. And with this assertion events can be predicted with a good degree of acceptance, this being one of the main practical applications.(Pagano, 2006)

This technique is simple to perform and with these correlation studies you can check the correlation between two variables and it is the first thing that has to prove their relationship if it is casual or not. Correlation and regression are very interrelated where the former indicates the magnitude and direction and in regression can use the relationship to predict a case.

Next, the calculations made in this case are presented, obtaining the data that are: level of stress as an independent variable and teaching performance as a dependent variable of the group of teachers interviewed, a survey was obtained according to the following table 1 Results of the level of stress and table 2 Results on the level of teaching performance.

Teacher	Score obtained	Stress level
1	72	Middle
2	86	Middle
3	87	Middle
4	69	Middle
5	62	Low
6	50	Low
7	49	Low
8	58	Low
9	62	Low
10	90	Middle
11	118	High
12	78	Middle
13	120	High
14	71	Middle
15	80	Middle
16	79	Middle
17	73	Middle
18	75	Middle
19	55	Low
20	119	High
21	52	Low
22	81	Middle
23	82	Middle
24	64	Low
25	53	Low
26	89	Middle
27	49	Low
28	84	Middle
29	96	Middle

Table 1 Results of the level of stress in teachers
Source: Own Elaboration

X=Stress level	Y=Teaching performance
72	89.56
86	88.73
87	95.07
69	83.73
62	86.82
50	79.33
49	74.68
58	82.06
62	90.98
90	83.72
118	89.21
78	88.35
120	79.85
71	91.47
80	93.87
79	88.70
73	91.64
75	87.49
55	95.28
119	91.56
52	92.67
81	87.91
82	80.43
64	84.38
53	90.14
89	92.72

Table 2 Results on the level of teaching performance
Source: Own Elaboration

The following is the correlation calculation by means of the r-Pearson equation

$$r(1) = \frac{\sum xy - \frac{(\sum x)(\sum y)}{N}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{N}\right]\left[\sum y^2 - \frac{(\sum y)^2}{N}\right]}} \tag{1}$$
$$= \frac{201430.50 - \frac{(2285)(2639.04)}{30}}{\sqrt{\left[185405 - \frac{(2285)^2}{30}\right]\left[232863.08 - \frac{(2639.04)^2}{30}\right]}}$$
$$r = \frac{201430.50 - 201006.88}{\sqrt{(423.62)(712)}} = \frac{423.62}{2844.51}$$
$$r = 0.1489$$

The value of the correlation factor indicates a weak positive relationship, which means that stress does not have a considerable impact on teacher performance, which could be because human psychology behavior is unpredictable.

The calculation of the linear regression equation is presented below.

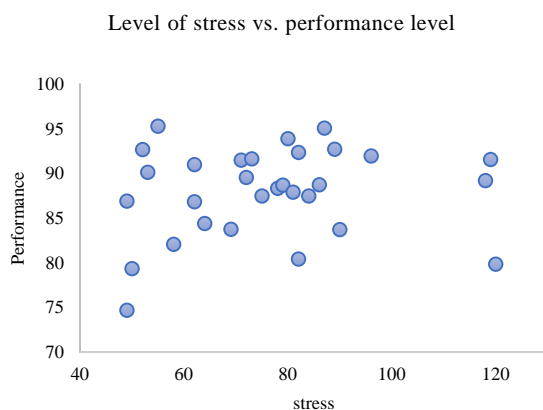
$$by(2) = \frac{\sum xy - \frac{(\sum x)(\sum y)}{N}}{\sum x^2 - \frac{(\sum x)^2}{N}} = \frac{201430.50 - \frac{(2285)(2639.04)}{30}}{185405 - \frac{(2285)^2}{30}} \tag{2}$$
$$by = \frac{201430.5 - 201006.88}{185405 - 174040.83} = \frac{423.68}{11364.17} = 0.0372$$

$$Ay(3) = \bar{Y} - bx(\bar{X}) = 87.968 - (0.0372)(76.16) = 87.968 - 2.8331 = 85.13$$

$$Ecuación\ Linear: Y'(4) = byX + Ay =$$

$$Y' = 0.0372X + 85.13$$

The data obtained are presented in the following graph 1 of dispersion.



Graph 1 Scatter plot
Source: Own elaboration

In the following graph 2 histogram of performance with distribution curve shows the behavior of the impact variable that is performance, yielding the value of the mean of 87.968 with a minimum of 74.68 and a maximum of 95.28, with a standard deviation of 5.04.

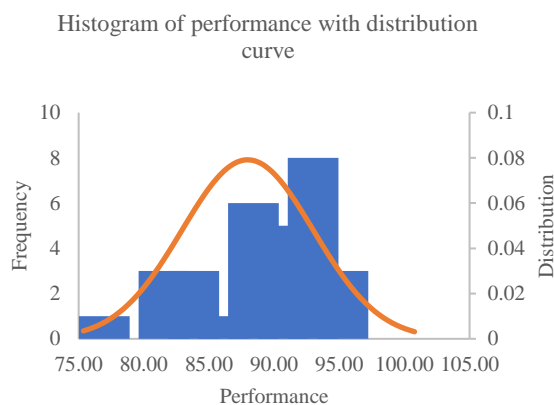


Figure 2 Performance histogram with distribution curve
Source: Own elaboration

It should be noted that the survey and the results of Teacher Performance Level were carried out at the beginning of 2020, considering the last evaluation applied to teachers, which was the one corresponding to the month of December 2019, at that time, the COVID-19 pandemic was not yet present, which came to considerably alter the working conditions of the population.

And in particular of the teaching staff, with great changes in all areas and as is well known, adaptation to changes in usual activities, together with the fear of contagion, isolation and everything that the pandemic has generated in society are factors that contribute to the increase of stress in all people.

In a study conducted at the National University of Asunción, (Gómez Dávalos & Rodríguez Fernández, 2020)a survey using the Perceived Stress Scale (PSQ) developed by Levenstein was applied to 37 teachers during the quarantine period due to the COVID-19 pandemic. They responded with a 4-point Likert scale (1 = "almost never" 2= "sometimes" 3= "often" 4 = "almost always")

The results obtained in the 3 standardized factors, in terms of the percentage of teachers who manifested perception of 3 and 4, were the following:

1. Tension and exhaustion 67%
2. Overload on tasks, perception of lack of time and external demands 74%
3. Frustration, hopelessness, fear of the future 78%.

According to these results, most teachers experience significant levels of stress. It is mentioned that they are preliminary results, so additional studies are required to complement these findings.

There are, however, antagonistic positions to the previous one, because in the article entitled "TheBurnout Syndrome and its effect on teaching performance in times of pandemic", the authors conclude that the fact of having less personal (Espinoza Izquierdo, Moran Peña, & Granados Moreno, 2021)contact with students in times of pandemic is a factor that decreases the emotional wear and tear that can lead to chronic stress or burnout. And that the fact that teachers have become more trained in the use of digital technologies and tools increases teachers' personal satisfaction in meeting new challenges.

It would be interesting to delve into these 2 aspects, but in our institutional context, the perception is that the current pandemic has caused an increase in work stress in teachers.

5. Conclusions

Based on the questionnaire applied to 30 teachers of the Industrial Processes major at this University, it is concluded that 10% of teachers suffer from a high level, 57% a medium level of stress and 33% have a low level of stress, giving a percentage of 67% of the total of teachers with the most accentuated problem.

This research is of vital importance because it allows us to identify the extreme cases of teachers affected by stress at a certain level and thus giving rise to take the most appropriate measures to be able to attend to those teachers on time, before the problem becomes more complicated and can affect the academic performance of students and the school. If the problem is not addressed in a timely manner, the time will come when the teacher gets tired or does not perform in his work and begins to miss or incapacitate, reaching to suffer, in the worst case, the Burnout syndrome.

On the other hand the results should also be considered the average of years in front of group that oscillates between an average of 13.9 years, the average age is 36.7 years, in addition to the total number of respondents 15 are men and 15 are women, of which men manage stress better because they resulted in lower averages, it is worth mentioning that the Institution has a permanent training program where important issues such as personal and professional development are addressed, which includes motivational courses, among others.

Finally, a Pearson r-method correlation of the results of the stress level as an independent variable with respect to teacher performance was made, an indicator that is measured at the end of each period (Sanchez, 2019) for each teacher in an institutional way and it was found that there is a low correlation between these variables, since the result was 0.1489 for teacher performance, this indicator includes several factors, including a survey that is applied to students on the performance of the teacher each period, so it is concluded that the stress factor in teachers is decisive to obtain the desirable results but also other factors such as motivation and compliance with results come into play.

The value of r obtained is 0.1489 which indicates that there is a weak positive correlation between the two variables, which refutes the initial hypothesis and indicates that the level of stress does not affect the performance of teachers.

These results reflect that, although there is a medium or high level of stress in most of the teachers in the sample analyzed, their professional performance is not negatively affected because this indicator determines their permanence in the institution, taking into account that the higher the educational level of the teacher, the greater the prevalence to work even with health affectations.

With the COVID-19 pandemic, the way teachers work radically changed, adapting to teaching online classes demanded a large investment of time, in technology training, material preparation, extended hours of attention to students and a long etcetera.

We have conducted an informal survey and it is perceived that the degree of stress increased by approximately 45% compared to how teachers felt before the pandemic, however, a new study would be required to determine the effect of this extraordinary stressful situation on the level of teacher performance.

This obviously differs from the results of research mentioned at the Paraguayan (Gómez Dávalos & Rodríguez Fernández, 2020) University, where the percentages were around 70% of teachers with a high level of perceived stress, since since that study has passed approximately a year and obviously with the massive vaccination campaigns in our country and the slow return to activities in the new normal, affect the self-perceived level of stress in the educational setting.

However, as has already been reiterated, new studies are required to complement the current ones and the contexts in each country are varied.

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Evaluative system design applied to transdisciplinary projects as a tool for the terminal efficiency increment

Diseño de sistema evaluativo aplicado a proyectos transdisciplinarios como herramienta para el incremento de la eficiencia terminal

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Abstract

The objective of this article is to show the design of an evaluative scheme that begins with the creation of Transdisciplinary projects, applied in students from the currently bachelor's degrees inside the Universidad Politécnica de Gómez Palacio. The projects that are counted into the *Transdisciplinary*, tend to relate agents from different specialties, with the main purpose of unite the knowledge and abilities in the creation of a complete integrating project, supported by diverse members of the team. The Transdisciplinary gives the disciplinary or methodological part the students learn in the classroom, meanwhile the transversally only unites the concepts among the environment where they are, characteristics like ages, sex, among others, this is why this Project emphasizes the discipliner part of the classroom. The way the design is created, sets off from the results obtained from the surveys applied to the eighth four-month period students; besides evaluates the former students from the generation 2014 – 2017. Once the results are obtained, the next step is to create a new evaluation methodology and with it, it is expected to create a change in the evaluation system in the Superior Educative Institutions.

Resumen

El objetivo del presente artículo es presentar el diseño de un esquema evaluativo que parte de la creación de proyectos transdisciplinarios, aplicado en alumnos de las carreras existentes en la Universidad Politécnica de Gómez Palacio. Los proyectos que aplican transdisciplinariedad, tienden a relacionar agentes de diversas especialidades, con el fin de unir los conocimientos y habilidades en la creación de un proyecto integrador completo, apoyado por los diversos integrantes del equipo. La transdisciplinariedad aporta la parte de disciplinaria o metodológica que se ve en el aula de clases, mientras que la transversalidad únicamente une estos conceptos junto al entorno en el que estén, características como edades, sexo, entre otras, por ello este proyecto hace énfasis en la parte disciplinar del aula. La forma en la cual es creado el diseño, parte de los resultados obtenidos en la aplicación de encuestas realizadas hacia los alumnos en el grado de octavo cuatrimestre; además de evaluar a partir del seguimiento de egresados de la generación 2014 – 2017. Una vez obtenidos los resultados se pasará a crear una nueva metodología de evaluación y con ello se pretende crear una propuesta de cambio en el sistema de evaluación en las Instituciones de Educación Superior (IES).

Terminal Efficiency, Evaluation, Transdisciplinarity

Eficiencia terminal, Evaluación, Transdisciplinariedad

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Introduction

At present, the competency-based education model called CBE is the standard that most schools, both in basic and higher education, have implemented in their institutions, whether private or public, although it is not only a new model, but it also applies the four educational skills.

This inculcates the idea that students should have the capacity to develop these competences, as well as carry out projects in conjunction with other people in order to obtain a product that is transcendental and perfectly grounded, as this increases the student's skills and from these projects they can make their first business plans.

This project is based on the detected need to design an evaluation system for integrative projects, as projects are carried out in the university but within the same careers, i.e. multidisciplinary projects and these do not manage to have a lasting impact as it is to make transdisciplinary projects, in addition to the fact that this project is carried out in order to provide a tool to increase the terminal efficiency rate, as a measure of innovative implementation in the institution in which the design of this project is put as a sample.

Currently there are some theories on which this project was based, in order to verify the relevance and possible fields of action of the present, such as the theory of transdisciplinary of Morin (2013), which arises from the union of various disciplines, aim to create a comprehensive project, which has contributions from various skills of the creators, in addition to a set of tools, which contribute to developing a comprehensive and complex project, which responds to the solution of a common problem for various places or regions, The more impact it can produce on the population at which the project is focused, the better, that is to say, transdisciplinary seeks to unite different talents from different areas for the development of a final product, such as a theory, a system, a project, among others, this is done by bringing together the different skills shown in each of those involved, being contributed in the various elements to be used, as is the case of any marketable product, in which different areas are involved for the realization of a single final product supported by the skills of each employee involved in the production process.

Another of the relevant theories for this article was the contribution of Basarab (1996), in his manifesto, that "the transdisciplinary vision proposes to consider a multidimensional reality, structured on multiple levels, which replaces the unidimensional reality of a single level in classical thinking", with this it is understood that the world has entered a stage in which it must be understood that the fact of being in a globalised world must change the meaning at the educational level, In addition, it is necessary to consider the application of new knowledge that cannot be obtained completely in the classroom, such as the possible errors and methodological solutions used in companies, as well as considering the development of the various skills and aptitudes necessary for the creation of various projects and the analysis of the different scenarios to be presented when carrying out a project in a transdisciplinary team.

A relevant point that Basarab brings to education is the mediation of students' knowledge applied in a real environment and the use of innate skills, i.e. the development of a terminal product with the collaboration of different disciplinary areas and thus achieving a collaborative and functional project.

An important task to improve in current education is the intervention of subjects that are not treated very well in the different areas of knowledge in emotional matters, which are used for the development of skills such as communication, which can be reflected in the subjects of development of organisational skills, values, among others, as well as also affecting the administrative area, with subjects such as administrative process, entrepreneurship, among others, which contribute to the student's knowledge in terms of development and improvement of the final projects to be integrated, as with this, they should have a perspective of the activities to be carried out and the way in which these processes can be improved, either by implementing new techniques for processing materials, or by having a balanced work team, with which not only can innovative products be made, but they will also have first-hand projects, as well as being able to patent prototypes and generate changes in the scientific community (Reyzabal and Sanz, 2001).

Transversal projects tend to support not only to create collaborative work, but also have a variety of approaches depending on the project to be carried out, as indicated by the UNAM (2014), whose main theme is the approach of transdisciplinarity, from all points of view, the treatment of problems from the perspective of an engineer, doctor and accountant, can be quite different, since according to the educational background of each of them is their type of thinking and analysis they can reach when trying to solve a concise problem, it is therefore that in this meeting topics such as:

- Interdisciplinarity and multidisciplinary.
- Development of integrative projects in doctoral programmes.
- Technology transfer in transdisciplinary projects.
- Links between educational institutions and industry.
- Disciplinary crossovers.
- Among others.

All of them emphasise the need for a radical change in the current education of higher education institutions, since these changes greatly benefit the integral development of students, as well as being a good option when developing projects at postgraduate level.

Most of the similar projects have been implemented in postgraduate or professional stays dedicated to the development of modern technologies and in which the level of professionalism and attention to detail increases, besides being able to find these same techniques in companies, since they handle different areas of development to culminate in the sale of a product, so the question arose: How can transdisciplinary projects be implemented at the undergraduate level and what would be the scope of such projects?

The terminal efficiency as mentioned by CACEI (2018) indicates that it is the "number of students who finish an educational level in a regular way (within the established ideal time)", i.e. in the ten semesters that by regulation of the Polytechnic Universities the student must graduate, in order to be taken into account as part of the terminal efficiency of the educational programme.

From the above questions arises the reason for proposing this project as a design, which is the prelude to its full implementation as a fundamental and evaluative part of the current school model.

Methodology to be developed

The first part of the implementation of this project was to bring together the teachers of the various careers at the university, who were giving classes in the eighth semester grades, the leaders of this product being the subjects relating to entrepreneurship and technology project management, in addition to having working tables in order to optimise time, each of the careers gave opinions on the types of characteristics they would like the projects to have, number of members, as well as various aspects.

As a second stage, the debate began on the standardisation of the form of student assessment, as the contribution would be dispersed due to the different profiles.

Once the form of evaluation had been defined, a manual was drawn up in which all the established agreements were set out, as shown in Table 1, a preview of the evaluation and monitoring model for transversal projects.

Formation of the idea				
Formation of the working team				
Criteria	Activity	Indicators	Evaluation scheme	Timeline
Evaluation		Once the project delivery scheme has been completed, a prototype presentation will be made, as well as a pre-evaluation, as a means of promoting the project.		

Table 1 Design of the evaluation proposal. Source: Own Elaboration

The last stage was to bring the students together and also to share the knowledge of the implementation of transdisciplinary projects, thus achieving the homologation of opinions and approval for their development, as the project was directly applied in them.

At the end of the previous stage, project proposals were requested, as well as the evaluation of their creation and implementation in real life, as some of the characteristics that the project had to have were the following:

- Have originality.
- Be economically viable.
- Meet one of the following criteria:
- Be social in nature.
- Apply a certain degree of technological innovation.
- Have an entrepreneurial presence by being a profitable idea.
- Support sustainability.
- Use renewable energies.
- Have multidisciplinary characteristics.

Once the step to which the project belonged was evaluated and it was corroborated that the requested characteristics were met, we proceeded to implement the structural design of the project, which must be developed in four months and have the specifications suggested above, since at the end of the same we proceeded to carry out a contest, which lasts one day, as time to expose your project to judges and get recommendations, in addition to support to incubate the project idea.

The knowledge and skills that the students provided in the development of the project were especially essential, since the Bachelor's Degree in International Business (LNI) provided the methodological contribution of sales, as well as the type of trade to be implemented, initial investment, among others.

On the part of the degree course in Information Technology Engineering, the creation of a commercial prototype in some cases and in others the creation of a website for sales and promotion of the articles, as a contribution from the degree course in Manufacturing Technology Engineering, the creation of manufactured products and even models of the materials used was carried out.

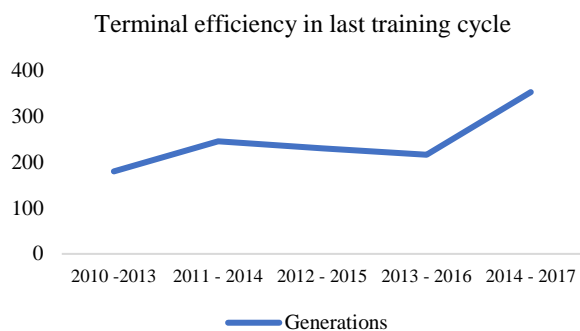
An important part developed by the Biotechnology Engineering course was the management of waste and the use of some substances that could affect the users.

As an implementation by the Animation and Visual Effects Engineering course, the creation of simulations of possible scenarios for the implementation of the product was fundamental in explaining prototypes that in real size would be too large or whose production cost would be too ostentatious.

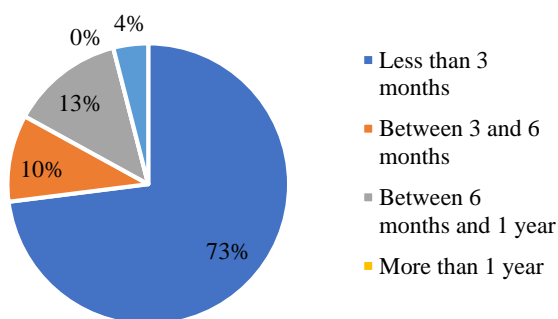
As a culmination of the projects, their effectiveness was evaluated in the years following their implementation, obtaining as a result an increase in completion rates (Graph 1), which shows the increase in the number of students graduating from the various degree courses, since in the years prior to their implementation the number of graduates was low, In the years prior to its implementation, the number of graduates was low, since 3 out of every 10 students who entered each of the specialisations completed their degrees within the time specified by the General Coordination of Technological and Polytechnic Universities (CGUTyP), which is why, on observing an increase in terminal efficiency, the impact of this methodology on students' terminal education was assessed.

The impact that has been obtained until the creation of the design and the relevant tests is that more than 70% of the graduates manage to get their first job in the first three months (Graph 2), these data were acquired as part of the follow-up of graduates carried out annually, in which the graduates indicate their employment situation, salary, sector to which they belong, among others, apart from as can be seen in (Graph 3) most of the graduates have a salary of more than \$8,000. 00 which is a standard for most engineering graduates in local universities and this is achieved in the first years after graduation (one to five years).

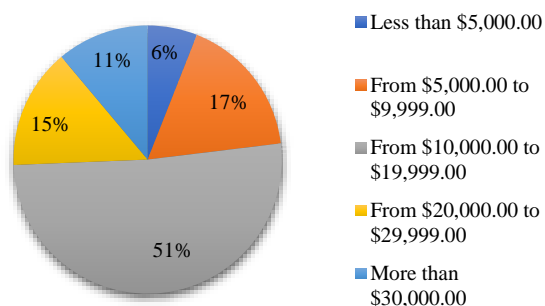
One of the advantages offered is the recognition of the knowledge learnt in the classroom, which makes several graduates request students in the last training cycles to work with them, since the knowledge obtained in the classroom and skills such as working under pressure, being proactive and working with transdisciplinary teams are part of their training and therefore they do not have to obtain any special training or even have difficulties in collaborating with other areas in the company.



Graph 1 Completion rate
Source: Own Elaboration



Graph 2 Time to find first job
Source: Follow-up of graduates from the UPGOP's department of liaison



Graph 3 Detail of salaries obtained by graduates in the first years after graduation

Results

The implementation of these projects provided a reliable tool, as it was evaluated once the first test was implemented with a Cron Bach Alpha, this as a method for validation and thus have a tool that supports the terminal efficiency, since students to enter into this scheme had a reliable and adaptable option to the needs of the various subjects that they take in that term, The project is implemented in the eighth year of the school year, with the aim of providing the students with a real environment such as the one they will find in a company.

The project is implemented in the eighth semester due to certain characteristics of the students, such as:

- Maturity.
- Advanced knowledge of their speciality.
- Coordination to work in a team.
- Time management.
- Ability to innovate new and existing processes.

Discussion

Through the implementation of the project design, it was possible to delve into the criteria used in such projects, such as what is theoretically known as transdisciplinarity and its application in integrative projects, as well as using methodologies suggested in postgraduate courses and student exchange stays abroad.

Acknowledgements

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Special thanks also to the judges who actively supported the students by giving recommendations and possible improvements to the projects carried out by the students.

Conclusions

The present project culminated in the creation of a transdisciplinary project design, which was applied to eighth semester students of the generation of 2014 - 2017, this was a sample test, with which it is intended to modify the model to be implemented, as well as increase the characteristics of this project, in order to make a model of education and modify some gaps that are in the current education system.

In addition, a reliable source of measuring the skills developed by this type of project was obtained.

Another of the advantages obtained was the increase in the retention of the school curriculum, as well as the increase in the terminal efficiency, since there was a high deficiency in terms of the completion of engineering studies, which is why finding the advantages of the implementation of this design is expected to increase the number of graduates of the various specialties.

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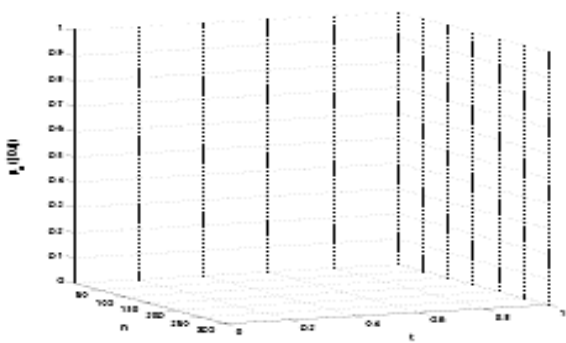
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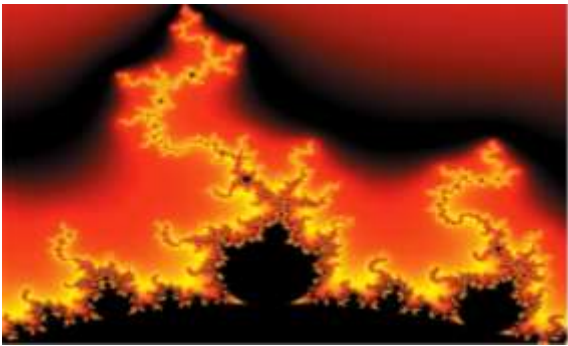


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