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Article

Diagnostic assessment of knowledge in basic sciences and its relation to the teaching-learning process in the university environment

Evaluación diagnóstica del conocimiento en ciencias básicas y su relación con el proceso de enseñanza-aprendizaje en el entorno universitario

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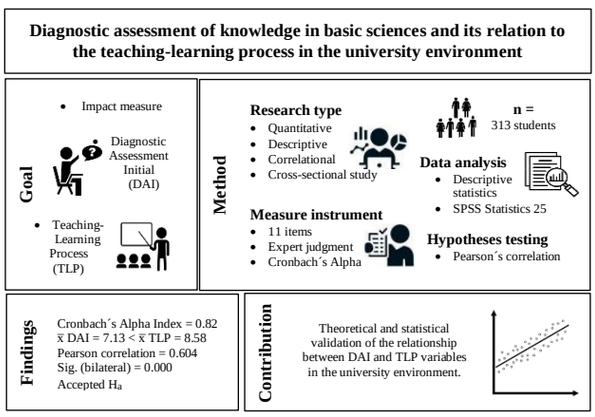
Abstract

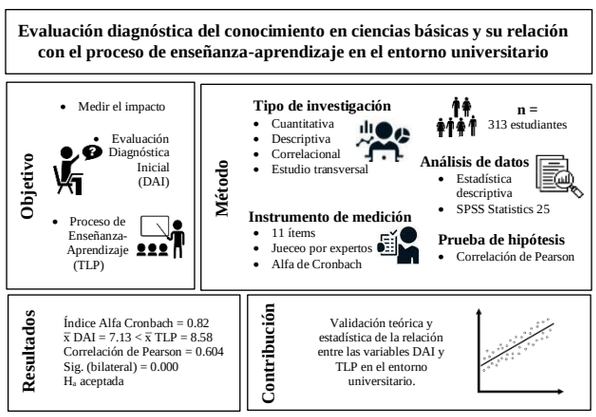
Identifying the deficiencies in the learning acquired in undergraduate students allows the design of new methodological strategies in the teaching-learning process. The objective of this research is to measure the implementation of the initial diagnostic assessment of knowledge in basic sciences and differential and integral calculus as part of the Physicochemistry learning unit, and its impact on the implementation of the teaching-learning process. This research is quantitative, descriptive, correlational, and cross-sectional, with convenience sampling of 313 students. The instrument used consisted of 11 items, with validation by expert judgment and Cronbach's Alpha. Data analysis was performed with descriptive statistics and hypothesis testing with Pearson's correlation. The findings corroborate that diagnostic assessment implementation of prior knowledge has an impact on the teaching-learning process in a university environment.



Correlational study, Deficiencies in knowledge, Implementation teaching-learning process

Resumen

Identificar las deficiencias en el aprendizaje adquirido en estudiantes de pregrado, permite el diseño de nuevas estrategias metodológicas en el proceso de enseñanza-aprendizaje. Siendo el objetivo de esta investigación, medir la implementación de la evaluación diagnóstica inicial del conocimiento en ciencias básicas y en cálculo diferencial e integral como parte de la unidad de aprendizaje de Fisicoquímica, y su impacto en la implementación del proceso enseñanza-aprendizaje. Esta investigación es de tipo cuantitativa, descriptiva y correlacional, de corte transversal y con muestreo por conveniencia de 313 estudiantes. El instrumento utilizado consistió en 11 ítems, con validación por jueceo de expertos y Alpha de Cronbach. El análisis de datos se realizó con estadística descriptiva y la prueba de hipótesis con la correlación de Pearson. Los hallazgos corroboran que la implementación de la evaluación diagnóstica del conocimiento previo tiene un impacto en el proceso de enseñanza-aprendizaje en un entorno universitario.



Estudio correlacional, Deficiencias en los conocimientos, Aplicación del proceso de enseñanza-aprendizaje

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Introduction

The diagnostic assessment of knowledge in basic sciences consists of identifying the level of learning in a given area of knowledge. In this case, this evaluation allows us to have a diagnostic that helps to define the problems faced by the social sciences in terms of education and the exact sciences in the development of new methodologies for the teaching-learning process.

In this regard, talking about the teaching-learning process takes us back to the two main theories that are relevant. The first theory, with a traditional approach, highlights the importance of the teacher as the one directly in charge of transferring knowledge to the student. While the second one, emerges as a theory with a constructivist approach, that is, it puts the student at the center of the learning process, where it makes the student responsible for generating his own knowledge.

For this reason, in the present research, diagnostic assessment is taken up again as a milestone for the development of methodological approaches and the contribution to the teaching-learning theory, as well as the impact it has on the learning achieved in undergraduate students. Due to the above, this type of research is of utmost importance, especially in developing countries where educational levels present deficiencies from the formulation of curricula to the teaching-learning processes.

The technique used in this research is quantitative, which presents an added value with respect to other research techniques, given that it has numerically measurable results, which allows the analysis of variables for the generalization of results in a given population.

Characterizing the impact on student learning, as a result of the teaching-learning process based on previous knowledge evaluations, is a very complicated task for research, since it is necessary to identify the main variables that impede or strengthen this process. For this reason, this research focuses on clarifying the variables studied.

The problem to be solved with this research is formulated from the following question:

- What is the relationship between Diagnostic Assessment Initial (DAI) in basic sciences and differential and integral calculus in the Teaching-Learning Process (TLP) with a traditional and constructivist approach in a university environment?

In this sense, the central hypothesis focuses on:

- H_0: The Diagnostic Assessment Initial (DAI) in basic sciences and differential and integral calculus has no significant relationship with the Teaching-Learning Process (TLP) with traditional and constructivist approach in a university environment.

- H_a: The Diagnostic Assessment Initial (DAI) in basic sciences and differential and integral calculus has a significant relationship with the Teaching-learning Process (TLP) with a traditional and constructivist approach in a university environment.

This research article is composed of nine sections, which are described below, in order to clarify and explain in general terms the contents of each one of them. In the first section, there is an introduction to the research topic, emphasizing the problem to be solved, the central hypothesis, the added value of the technique used and the generalities of the research.

The second section presents a review of the literature and provides an overview of the theory underlying the research, referring to diagnostic evaluation and the teaching-learning process in university environments. The third section details the method used, the type and design of the research, the description of the variables, the measurement instrument, the participants, the procedure and the data analysis.

The fourth section includes the results and discussion, with descriptive statistics, as well as the discussion in the light of the supporting theory. The fifth section contains the conclusions and recommendations, where the main findings, limitations and future work are presented.

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The sixth section includes the annexes, which include the instrument used, with the items applied for the development of the research. Now, in section seven on declarations includes conflict of interest, contribution by authors, availability of data and materials, funding of the research work and acknowledgements to the participating teachers and students, as well as to the institution from which they came.

Likewise, the eighth section shows the abbreviations of this article. Finally, the ninth section lists the references of the authors who directly contributed to this study according to the literature review: antecedents, basics, supports, differences, discussions.

State of the art review

Diagnostic evaluation is understood as a tool that helps students to become aware of the possession of certain concepts with which they have to perform correctly during the course. As facilitators, it allows teachers to have a diagnosis to level the students' knowledge and reach the fulfillment of the objectives expected in the course (Gómez et al., 2011).

That is why, at the beginning of the school cycle, diagnostic assessment is applied as a strategic tool to identify inaccuracies in students' knowledge, resulting from the previous teaching-learning process (Cobeña-Álava & Yánez-Rodríguez, 2022). In this sense, it is possible to affirm that students' prior knowledge is the most important factor, given its influence on learning (Ausubel, 1983).

Diagnostic assessment as an evaluation instrument helps to have value judgments, allowing to have the students' learning level and therefore allows teachers to deliver quality products in the teaching-learning process (Martínez & Laurido, 2012). In this regard, it is important to emphasize that each student has his own knowledge, the result of his experience and his own context (Bombelli & Barberis, 2012).

This knowledge will determine their level of competencies in the learning units, reflected in the effective performance in the solution of disciplinary problems (Zavala et al., 2023), i.e., the problems of each of the topics developed during the course, established in the curriculum.

Diagnostic assessment allows teachers to recognize individual differences in the context of learner diversity in the classroom (Kahn-Horwitz, & Goldstein, 2024). Other authors pointed out that the diagnostic evaluation in the first trimester allows the identification of students who know and those who can participate in remedial activities so that at the end of the course, they obtain the expected knowledge (Liemans et al., 2024)

On the other hand, the diagnostic assessment, seen from the pedagogical point of view, is extremely important to be carried out at different moments of the teaching-learning process. This tool allows the identification of students' knowledge and helps teachers to make adaptations in the content of the learning unit to achieve the objectives sought (Vera, 2020).

Therefore, this assessment should be performed at the beginning of the course to detect prior knowledge and make adjustments in the teaching process (Cejas & Alvarez, 2006). A noteworthy aspect of diagnostic assessment is to identify essential learning to achieve quality education (Muñoz et al., 2023). Also, diagnostic assessment is an extremely necessary tool to provide the results expected in the classroom (Acosta & Rodríguez, 2023), at different educational levels, with emphasis on undergraduate studies.

On the other hand, it is worth mentioning that, since the human being is born, his learning system is active, due to this it is extremely important to understand that previous experiences and knowledge are quite necessary, since from these the new knowledge will be constituted. In this context, the learner understands and gives meaning to his new learning, new concepts that regulate mental processes and thinking, such as attention, perception and memory that affect the information that is processed (Machado, et al., 2018).

Ordinarily, the teaching-learning theory mainly comprises two models: the traditional approach and the constructivist approach. First, there is the traditional model, where teaching is the center of this process. Therefore, the teacher is the main responsible for the transmission of knowledge with a merely expository technique, contemplating a master class. The student, on the other hand, only listens to the class.

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With this model, knowledge is understood as a construction that comes from the outside, from the scientific knowledge of a subject or discipline, for which the teacher is in charge of organizing the knowledge and preparing it for exposition. The teacher is the expert, the one who understands the subject, and also masters it, explains it and is up to date.

Therefore, learning seen from this model, is the way to acquire or increase knowledge in some subject or area for its subsequent application (Gargallo-López, et al., 2011).

In this teaching model, the students' prior knowledge is not contemplated (Morales et al., 2015). It is reiterative, that the teacher uses exclusively the lecture or expository lesson, only communication is one-way and rarely becomes bidirectional, only in the space dedicated to questions and answers.

It is worth mentioning that the teacher's material is based on books and the evaluation process is focused on assessing whether students learned by repeating what they learned (Gargallo-López, et al., 2011). By way of summary, teaching with this approach focuses on the transmission of knowledge in a certain topic or subject (Cabrera-Medina et al., 2016).

Due to the above, it is important to note that in recent decades the traditional way of learning has been questioned, since students, upon graduating from university, have the responsibility to apply the knowledge acquired in the social reality.

In this context, the graduate must contemplate the social, economic and technological changes to be competitive in the labor market. In this regard, the professional must necessarily migrate from the traditional model to the constructivist model where the teaching-learning process contemplates more options in the generation of knowledge (Ramos & Palacios, 2007).

Consequently, the second model of constructivist approach refers to learning, here learning is the center of the process. Therefore, the learner is primarily responsible for the creation of his or her own knowledge, while the teacher is merely a facilitator of knowledge (Gargallo-López, et al., 2011).

In this sense, the teaching-learning process, now is not conceived as the mere transmission of knowledge, but now knowledge is constructed, including the accumulation of the previous learning process, through experiences and contemplates acquiring knowledge to an already existing one, capable of being modified or reorganized according to the mind of each person (Piaget, 1950).

Therefore, the learning techniques to be used by teachers focus on those with an active cooperative method, as opposed to those used previously, with respect to the traditional passive method. This is due to the Copernican revolution, where the focus of the teaching process is more concentrated on learning and, therefore, the teacher's approach is defined as a guide, tutor or facilitator, while the student acquires his own knowledge (Tünnermann, 2011).

The constructivist theory has five objectives: 1) To understand and express scientific messages with oral and written property; 2) To interpret and represent scientific concepts correctly; 3) To apply strategies for problem solving; 4) To plan and carry out scientific activities in teams; 5) To reason based on their own criteria according to the context (Harré,1986; Osborne,1996; Insausti & Merino, 2000).

With the constructivist approach, the student builds scientific knowledge that involves the development of scientific competencies, therefore, the student is more autonomous and participatory (Espinosa-Ríos et al., 2016). The above, leads universities to create different learning strategies where the teacher is a guide in the solution of problems or the application of knowledge (Fernández & Aguado, 2017). It is emphasized that students responsible for their knowledge should develop critical and creative thinking (Lozano-Ramírez 2020), which will depend on their knowledge, skills, abilities and attitudes to acquire more knowledge (González-Zambrano et al., 2022).

In this sense, innovative environments for learning, motivation and co-instructional strategies should be contemplated in the construction of learning, promoting the memory of previous knowledge in students, for the generation of competencies, with pedagogical and technological material (Salgado, 2022).

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Therefore, what is sought with learning supported with the constructivist theory, focuses on the student understanding what he is learning conceptually and individually, through different interactive methods with group techniques (Morales et al., 2015). This leads the student to generate his own knowledge, from the already existing knowledge, therefore, he will achieve true learning.

Thus, learning is the acquisition of knowledge in a critical way (Cabrera-Medina et al., 2016) and to evaluate it, in addition to exams, other methods are applied such as case studies, self-assessments or problem solving (Gargallo-López et al., 2011).

Finally, it is important to highlight that, in university environments, the teaching-learning process has been evolving, the student is the main responsible for his learning, since he is required to be involved so that, from previous knowledge, new knowledge is created, contemplating the context, meeting the new requirements of society in the formation of committed professionals. This inevitably implies that teachers generate new strategies to transfer knowledge (Huerta-Chávez, 2022; Soltero-Sánchez et al., 2021; Soltero-Sánchez et al., 2023).

Therefore, it is important to emphasize that the profile of the university professor must comply with two fundamental aspects, the first is to know the content and the second is to have pedagogical knowledge of the content, i.e., to know the subject and transmit the knowledge (Carreira & Zabalza, 2024). Now, the modern teaching-learning process must be addressed by updating knowledge and skills. In order to reduce the work overload of teachers, an appropriate management system must be introduced (Al Aimun et al., 2024). Finally, the machine learning algorithm can also be used in the evaluation system (Li, 2024).

Method

Type and design of research

This research was developed under a quantitative approach, that is, the data collected were used to test the central hypothesis, according to the numerical measurement made and the descriptive statistical analysis, in order to establish the behavior of the variables studied and to test the theory supporting this research.

This research is also non-experimental, that is, the study was carried out without the intentional manipulation of the variables since they were only observed in their natural environment. The data were collected cross-sectional, i.e., they were collected during the period from 2020 to 2023 (Bernal, 2016; Hernández et al., 2014).

Variables

Diagnostic Assessment Initial (DAI) in basic sciences and differential and integral calculus

It contemplates the initial knowledge that the undergraduate student has in basic sciences and differential and integral calculus, as a basis for the implementation of the teaching-learning process in the learning unit of Physicochemistry I, specifically in the topic of development and calculation of derivatives and integrals.

Teaching-Learning Process variable (TLP) with traditional and constructivist approach

This variable jointly contemplates the teaching-learning process both the traditional and constructivist approaches, both theories are applied after the diagnostic evaluation in the area of knowledge of basic sciences as well as differential and integral calculus. Teaching is based on the traditional approach for the transmission of knowledge whose responsibility lies with the teacher and learning is based on the constructivist approach where the student is directly responsible for generating his own knowledge, in the learning unit of Physicochemistry I in the topic of development and differential and integral calculus.

Measurement instrument

The instrument used for the diagnostic evaluation in basic sciences and differential and integral calculus, as well as the impact on the teaching-learning process with a traditional and constructivist approach in a university environment, consisted of 11 items, on a 10-point Likert scale, with 10 being the maximum score that the students could answer when evaluating the knowledge acquired, both initially in the first 10 items and finally in item 11 by the professor. The instrument was validated by means of the expert judgment technique and Cronbach's Alpha index.

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Participants

The sample was non-probabilistic and non-random, that is, not all the subjects of the study population are part of the sample. The above, because, due to the nature of the present research, convenience sampling was chosen because of the ease of access and availability of the subjects of the population to participate in the study (Bernal, 2016; Hernández et al., 2014).

This sample consisted of 313 students of the learning unit Physicochemistry I of the Bachelor's Degree in Pharmaceutical Chemical Biologist, who voluntarily agreed to participate in the two stages of data collection in this research, in the diagnostic stage and in the final stage corresponding to the evaluation of knowledge after the implementation of the teaching-learning process.

Procedure

At the beginning of the 2020B to 2023B semester school year of the Physicochemistry I learning unit of the Bachelor's Degree in Pharmaceutical Chemistry and Biology, the measurement instrument was applied in two parts.

First, they were provided with the instrument in Google Forms to answer exclusively 10 items, in order to detect the level of knowledge on a 10-point scale in basic sciences and differential and integral calculus.

Next, the data obtained from the diagnostic evaluation were analyzed to generate a didactic plan to generate learning. In which we proceeded to apply the traditional teaching method, explaining the topic of derivatives and integrals in a master class. Likewise, based on the knowledge that the students had, they were considered for the creation of learning with the constructivist method.

Subsequently, the second part of the measurement instrument was applied in Google Forms, which consisted of 1 item where the level of learning achieved in the activity of differential and integral calculus was evaluated, with which the impact of the diagnostic evaluation in the teaching-learning process with the traditional and constructivist method in favor of the generation of knowledge in the undergraduate student was measured.

Data analysis

Data were processed with the statistical program SPSS (Statistical Package for the Social Sciences) version 25 and Microsoft Excel spreadsheet software. Descriptive statistics were used for data analysis, measures of central tendency, graphs and hypothesis testing.

Results and discussion

The measurement instrument used in this research, in addition to having been evaluated by expert judgment, and in order to have a valid and reliable scale, the Cronbach's Alpha Index was calculated, from which acceptable values above 0.70 were obtained, as indicated by Nunnally (1978) and Hair et al. (1999).

From this measurement instrument, it is possible to assure that both the design and the validation are supported by the theories of teaching-learning and diagnostic evaluation. In other words, the measurement instrument is reliable when presenting consistent and coherent results, that is, when applied at different times during the period 2020 to 2023, it was possible to obtain accurate results in the behavior of the variables studied.

Likewise, the instrument applied showed validity by accurately measuring the variables described in the research. This was also corroborated by calculating the Cronbach's Alpha index, with which favorable results were obtained that were higher than the parameters established to classify the instrument as a valid and reliable measurement scale (see table 1):

Box 1

Table 1

Calculation of Cronbach's alpha index

Variables	Cronbach's Alpha > .70 (Nunnally, 1978)
MKHS, CKHS, PKHS, DMTS, GCKD, PHKD, CAKD, DICS, SQMD, SQMI, KAADI	0.82

Source: Own elaboration (2024).

With respect to the categorical variable of sex, 313 students participated in the survey, of which 210 were women and 103 were men, which in percentage terms corresponds to 67% and 33% respectively (see graph 1):

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Box 2

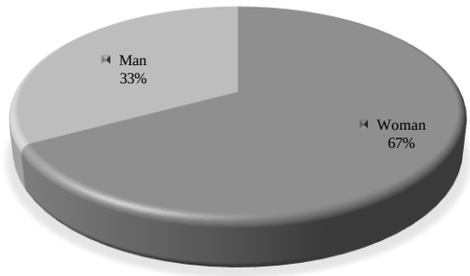

Figure 1

Number of participants by sex.

Source: Own elaboration (2024).

On the other hand, the total number of students participating in the study varied from year to year, considering that student enrollment is not always the same. Given that, even when the semester begins with a number of students registered in the lists of the learning unit, sometimes they drop out and the research only reflects the data of the participants in the two stages of the survey of the measurement instrument, which were: 67 in 2020, 133 in 2021, 60 in 2022 and 53 in 2023 (see graph 2):

Box 3

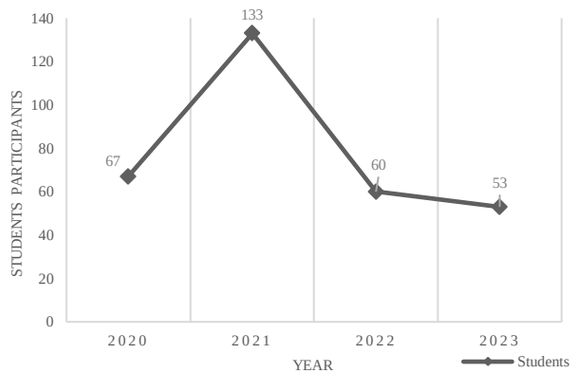

Figure 2

Number of students participants by year

Source: Own elaboration (2024)

Since this research was longitudinal, it was obtained that the mean of the Diagnostic Assessment Initial (DAI) throughout the three years under study, presented an improvement in the mean obtained after the implementation of the Teaching-Learning Process (TLP). This allowed verifying the importance of the diagnostic evaluation as a strategic tool to identify inaccuracies in prior knowledge, as pointed out by Cobeña-Álava & Yánez-Rodríguez (2022).

This allowed the students to realize the knowledge they had at the beginning of the course and, in the case of the teacher, it allowed him to have an initial diagnosis to design the course and level the knowledge to meet the objectives established in the study plans, in accordance with Gómez et al. (2011).

In this research, in 2020 there was a favorable gap given that the mean of the Diagnostic Assessment Initial (DAI) was 7.15 and of The Teaching-Learning Process (TLP) was 8.46; in 2021 in the DAI variable a mean of 7. 31 and in the TLP variable the mean was 8.64; in 2022 the mean of the DAI variable was 6.95 and in TLP was 8.58; and in 2023 the mean of DAI was 6.87 and in TLP was 8.58 (see graph 3):

Box 4

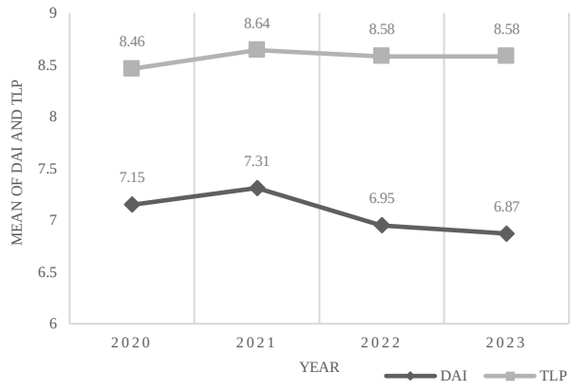

Figure 3

Diagnostic Assessment Initial (DAI) and the Teaching-Learning Process (TLP) over 2020 to 2023

Source: Own elaboration (2024)

These results demonstrate the importance of prior knowledge in students' learning, which also contemplates the experience and context in which they learned, as well as the effective performance in the solution of problems in the different disciplines. This also allows the teacher to have a quality teaching-learning process, by making adjustments or adaptations to achieve the objectives, in accordance with Acosta & Rodríguez (2023); Bombelli & Barberis (2012); Cejas & Alvarez (2006); Martínez & Laurido (2012); Muñoz et al. (2023); Vera (2020); Zavala et al. (2023).

Now, the results obtained in each of the variables of the Diagnostic Assessment Initial (DAI), show the mean values of:

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- 7.94 in Mathematics Knowledge in High School (MKHS);
- 7.16 in Chemical Knowledge in High School (CKHS);
- 6.53 in Physics Knowledge in High School (PKHS);
- 8.21 in Diagnostic Mathematics Test Score (DMTS);
- 7.55 in General Chemical 1 Knowledge in Degree (GCKD);
- 6.09 in Physics Knowledge in Degree (PHKD);
- 6.53 in Calculus Knowledge in Degree (CAKD);
- 9.07 in Differential and Integral Calculus Score (DICS);
- 6.74 in Self-Qualification when Making Derivatives (SQMD);
- 5.50 in Self-Qualification when Making Integrals (SQMI).

In this respect, they show the impact of the implementation of the Teaching-Learning Process in relation to the Knowledge Application Activity in Derivatives and Integrals (KAADI), where the mean was 8.58 points on a scale of 1 to 10 (see graph 4):

Box 5

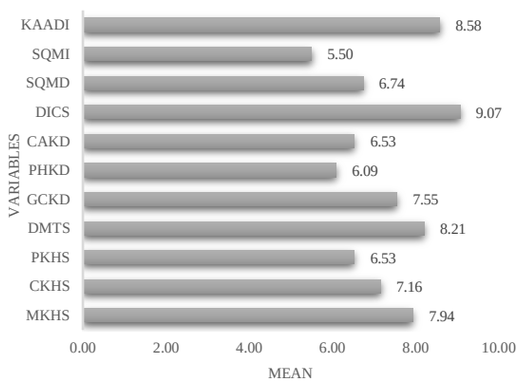

Figure 4

Diagnostic assessment variables and their impact on the teaching-learning process

Source: Own elaboration (2024).

The measures of central tendency are shown below exclusively for the variables of the Diagnostic Assessment Initial (DAI), where the minimum values were mostly 1 with the exception of the variables Diagnostic Mathematics Test Score (DMTS) and Differential and Integral Calculus Score (DICS) whose values were 6.

The maximum values for most of the variables were 10, except for the variable Self-Qualification when Making Integrals (SQMI) with a value of 9 (see table 2).

In relation to the mean, the values ranged from 5.50 to 9.07, including values of 6, 7 and 8, in the variables (see graph 4 and table 2). While the standard deviation spanned values from 1.04 to 2.26, reflecting that for the case of $\sigma = 1$ most of the sample data are clustered close to the mean and for the case of $\sigma = 2 > 3$ most of the data are spread over a wider range in relation to the mean. However, the behavior of the data is within a normal distribution (see table 2).

From this it can be asserted that there are deficiencies in the students' knowledge of the basic topics necessary for the development of differential and integral calculus, from the basic subjects in high school and in those at the undergraduate level such as mathematics, physics and chemistry.

Box 6

Table 2

Central tendency measures about Diagnostic Assessment Initial (DAI)

Variable	N	Min	Max	Mean	Standard deviation
MKHS	313	1.00	10.00	7.94	1.65
CKHS	313	1.00	10.00	7.16	2.22
PKHS	313	1.00	10.00	6.53	2.05
DMTS	313	6.00	10.00	8.21	1.13
GCKD	313	1.00	10.00	7.55	1.66
PHKD	313	1.00	10.00	6.09	2.01
CAKD	313	1.00	10.00	6.53	2.01
DICS	313	6.00	10.00	9.07	1.04
SQMD	313	1.00	10.00	6.74	1.94
SQMI	313	1.00	9.00	5.50	2.26

Regarding the variable of the implementation of the teaching-learning process with a traditional and constructivist approach, which was measured by the variable Knowledge Application Activity In Derivatives And Integrals (KAADI), the mean was 8.58 as already mentioned (see graph 4) and the minimum value was 7 and the maximum was 10, while the standard deviation was 0.85 (see table 3). This corroborated that all the data obtained were very close to the mean, which was the expected value. Therefore, the development of new teaching-learning strategies after the application of initial diagnostic assessments highlights their functionality and importance, as well as their theoretical, practical and methodological contribution.

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Box 7

Table 3

Central tendency measures about Teaching-Learning Process (TLP)

Variable	N	Min	Max	Mean	Standard deviation
KAADI	313	7.00	10.00	8.58	0.85

Likewise, the above allows highlighting the importance of both the teaching and learning process, going back to the origins of the human being, that is, from his birth, where the learning system is ready to create new knowledge.

It is for this reason that the change of the values obtained in the diagnostic assessment initial was denoted in comparison with the values obtained in the implementation of the teaching-learning process in relation to the Knowledge Application Activity in Derivatives and Integrals (KAADI), obtaining lower initial values compared to the final values where an increase in the student's learning is clearly marked.

Since, from the previous knowledge is that new learning is generated, for this, the student understands and gives meaning to what is learned, which affects his mental and thought processes including the memory of the new information he processes, thus creating new knowledge, in agreement with Machado, et al. (2018).

However, the calculation of the measures of central tendency for the main variables, the Diagnostic Assessment Initial (DAI) and the implementation of the Teaching-Learning Process (TLP), had mean values of 7.13 and 8.58 respectively, which represents an increase in knowledge. For the case of the DAI variable, the minimum value was 3, which included the mean values of the following 10 variables:

- Mathematics Knowledge in High School (MKHS);
- Chemical Knowledge in High School (CKHS);
- Physics Knowledge in High School (PKHS);
- Diagnostic Mathematics Test Score (DMTS);
- General Chemical 1 Knowledge in Degree (GCKD);
- Physics Knowledge in Degree (PHKD);
- Calculus Knowledge in Degree (CAKD);
- Differential and Integral Calculus Score (DICS);
- Self-Qualification when Making Derivatives (SQMD);
- Self-Qualification when Making Integrals (SQMI).

The maximum value was 9.40, since the averages of the variables mentioned were considered and the standard deviation was 1.12, which represents that all the values are very close to the mean, the expected value (see Table 4). Likewise, in the case of the TLP variable, we considered the values obtained from the variable Knowledge Application Activity In Derivatives and Integrals (KAADI) of the measuring instrument (see table 3 and 4):

Box 8

Table 4

Central tendency measures about Diagnostic Assessment Initial (DAI) and the Teaching-Learning Process (TLP)

Variable	N	Min	Max	Mean	Standard deviation
DAI	313	3.00	9.40	7.13	1.12
TLP	313	7.00	10.00	8.58	0.85

Source: Own elaboration (2024).

It should be noted that the Diagnostic Assessment Initial (DAI) as a tool for identifying the knowledge that students had, had a direct impact until the Teaching-Learning Process (TLP) was applied, which for this research covered both the traditional teaching model where the teacher was directly responsible for teaching the subject with knowledge that the student had to learn, as well as the constructivist model, where the student as the main responsible for generating his own knowledge and the teacher was only a guide in the teaching-learning process, which included problem solving or else the application of knowledge, this in agreement with Cabrera-Medina et al. (2016); Fernández & Aguado (2017); Gargallo-López, et al. (2011); Morales et al. (2015), thus proving the theory described.

Even though the traditional way of learning has been questioned by society itself, demanding graduates who are able to apply the knowledge acquired for the transformation of social reality, according to Ramos & Palacios (2007). This does not detract from the importance of this traditional teaching model.

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Therefore, the constructivist theory, comes as a complement to the previous one, where the teaching-learning process, now is not conceived as the mere transmission of knowledge, but now knowledge is constructed, including the accumulation of the previous learning process, through experiences and contemplates acquiring the knowledge to an already existing one, capable of being modified or reorganized according to the mind of each person in accordance with Piaget (1950). This is ratified when testing the central hypothesis of this research.

In this same sense, to test the central hypothesis, Pearson's correlation coefficient was calculated to identify the relationship between the two quantitative variables under study in this research, finding that both are associated, that is, there is a correlation between them.

With this calculation it was found that the Diagnostic Assessment Initial (DAI) in basic sciences and differential and integral calculus has a significant relationship with the Teaching-Learning Process (TLP) with a traditional and constructivist approach in a university environment.

Likewise, the association or correlation that exists between both variables is positive, that is, they move in the same direction; these variables are associated in a direct sense. This means that if the value of the DAI variable changes, it will also change in the TLP variable. Furthermore, the correlation that exists is high, i.e., it has a significant relationship (see table 5):

Box 9

Table 5

Pearson´s correlation calculation

		DAI	TLP
DAI	Pearson´s correlation	1	.604**
	Sig. (bilateral)		0.000
	N	313	313
TLP	Pearson´s correlation	.604**	1
	Sig. (bilateral)	0.000	
	N	313	313

** The correlation is significant at the 0.01 level (bilateral).

Source: Own elaboration (2024).

Thus, the results obtained corroborate the implementation of various teaching techniques included in the active cooperative method, with the direct participation of students in the creation of their own knowledge in an autonomous, participatory, critical and creative way, as well as the ability that students should possess to obtain more knowledge in accordance with Espinosa-Ríos et al. (2016); González-Zambrano et al. (2022); Lozano-Ramírez (2020); Tünnermann (2011), which implies a positive and open attitude to generate their own knowledge.

In this regard, these results corroborate the theoretical contribution regarding the innovative environments that teachers adopt to guide the teaching-learning process, which, when well implemented, are able to promote the recall of the knowledge possessed by students and therefore, contribute to the development of competencies with pedagogical and technological material, also including interactive methods and group techniques, according to Morales et al. (2015) and Salgado (2022).

As well as the fulfillment of the objectives of the constructivist theory according to Harré (1986); Osborne (1996); Insausti & Merino (2000):

1) Understand and express scientific messages with oral and written property;

2) Interpret and represent scientific concepts correctly;

3) Apply strategies for problem solving;

4) Plan and carry out scientific activities in teams;

5) Reason based on their own criteria according to the context.

Finally, when correlating the variables DAI and TLP, the constructivist theory is corroborated, where not only exams are no longer applied to evaluate learning, but now self-evaluations are performed, as was the case of the first variable that was measured by this method, and on the other hand, problem solving to evaluate the second variable, coinciding with Gargallo-López et al. (2011).

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Therefore, ineludibly, students as responsible for creating their own knowledge and teachers as guides in the teaching-learning process, the ways of transmitting knowledge are a challenge in teaching that implies the development of new strategies in congruence with Huerta-Chávez et al. (2022); Soltero-Sánchez et al. (2021); Soltero-Sánchez et al. (2023).

Conclusions and recommendations

It is well known that since the human being is born, he is ready to absorb the knowledge that the world offers him and his learning system is uncovered. It is also important to emphasize that the student's attitude towards learning has an influence on this process, because he will have to dedicate his mental structures to retain and apply knowledge, with the purpose of turning knowledge into meaningful learning, creating his own concepts and reflections about the topics he faces daily, from his particular life with daily life to the academic part in the classroom.

The teaching-learning process has evolved from the first theory focused exclusively on teaching, the so-called traditional teaching theory, where the lecture as the main tool of the teacher for the transmission of knowledge had greater relevance and at the same time the responsibility of generating knowledge in the student lay mainly on him. Therefore, the preparation of the material to be shared with avant-garde and updated knowledge was also the responsibility of the teacher, without losing sight of the expository technique as the only option.

However, this teaching-learning process, not only remained in a traditional approach, but has evolved to the constructivist theory, which focuses mainly on learning, where the student takes a fundamental role in the generation of their own knowledge. Hence the importance of having a diagnostic assessment every time a course is started, which will provide an initial overview to identify the knowledge students have and to be able to create or adopt different teaching methods to guide students' learning.

The reinforcement of previous knowledge in the different topics of basic sciences and differential and integral calculus, as well as the technique for students to remember the above, is extremely necessary for the teacher to achieve the learning objectives set out in the courses.

Although each course will have its own scope, we must not lose sight of the fact that the concepts and methodological theoretical applications in the knowledge that a student must have to take a certain course is crucial for him to effectively create knowledge, which is also understood in the constructivist theory as meaningful learning, that is, from a previous concept, new concepts will have to be adhered to and new theories or learning applicable to the course in turn will have to be created.

Now, by means of the scientific method for the development of the present research, which included the quantitative analysis carried out, we have a main finding, with direct contribution to the teaching-learning theory in university environments, as well as practical and methodological applicability in science for teachers who develop in this university context and who wish to replicate the method.

This finding corroborates that the implementation of the initial diagnostic assessment in basic sciences and differential and integral calculus presents a positive correlation with the implementation of the teaching-learning process with a traditional and constructivist approach. This means that the adequate application of an initial evaluation has a direct impact on the teaching-learning process.

Therefore, the choice of a good measurement instrument theoretically supported, duly validated by expert judgment and with the appropriate statistical indexes, is a good start for the development of new theoretical, practical and methodological contributions to the state of the art, as shown in this research.

However, the main limitations faced by this research were, in the first instance, the selection of the sample. Given that it was a non-probabilistic sample, since the period in which the sampling was carried out was non-probabilistic and by convenience, in which the students voluntarily agreed to participate.

Although the results were generalized, this can only be done in the context in which the research was carried out. Due to the above, it is extremely important to carry out the probabilistic and random sampling with the probability that any student from the population studied can be selected in future research, in order to provide greater statistical support.

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Another limitation of this research was that the data analysis focused on descriptive statistics for the description of the behavior of the variables in tables, graphs and even in hypothesis testing.

However, for future research, it is suggested to incorporate new statistical techniques such as the Exploratory Factor Analysis (EFA) that will allow to expand the explanation of the variables, incorporating the necessary factors that clarify the problems studied and allow to have a closer approach to the frontier of knowledge of the state of the art in the teaching-learning theory. Through the creation of innovative models with theoretical, practical and methodological contribution, with a view to subsequent modeling, by means of the use of structural equations and statistically acceptable adjustment indexes.

The last limitation presented in the research refers to the measurement of the variable of the implementation of the teaching-learning process, which was carried out by means of traditional evaluation exclusively, with an exam for the development of the calculation of derivatives and integrals, where the students demonstrated the learning achieved, so it is recommended in future research to implement other techniques that reinforce the knowledge.

In this same sense, it is possible to affirm that the study of the teaching-learning process continues to be a challenge both for scholars in the field and for the educational sector. Since it not only contemplates the traditional teaching techniques, but now new strategies will have to be sought to influence student learning and for this, research is essential, which involves the involvement of the teacher and the student as an inseparable binomial to effectively contribute positively to this process.

In order to continue with the present research, it is recommended to incorporate several variables that allow strengthening the teaching-learning process. In the case of students, we suggest the incorporation of motivational factors, i.e., including intrinsic and extrinsic motivation, which favor or drive learning by finding reasons to learn. Since, on many occasions, the careers chosen by students do not really respond to the expectations they had hoped for, which limits their learning.

Additional variable that can be incorporated on the part of both the student and the professor, is the commitment, as an agreement that is established between both parties to have a learning attitude in order to fulfill the objectives established in the courses that are taught and taken, regardless of whether the subject matter that is taught or studied is to their liking.

Here only the commitment with the teaching-learning process will have to be contemplated, in order to effectively transmit and promote the creation of knowledge. Contemplating, the teaching-learning agreement, where both the student and the teacher do their part for the achievement of the learning objectives set.

In this same sense, the variable of ethics can be incorporated in students in the learning process, from the conceptualization of acting correctly, that is, that students demonstrate their learning without it being the replica of the knowledge of others, avoiding copying tasks, exercises, problem solving, exams and even research projects. This variable can support the explanation of the teaching-learning process, in order to characterize it from a different perspective, which is ethics, understood as the conduct of the human being to do the right thing.

On the other hand, for the teaching process that directly involves the teacher conversely, it is suggested to incorporate the impact of the various innovative instructional techniques in the teaching-learning process. These are more focused on the constructivist theory, which will be able to explain the teaching-learning process from an innovative perspective, which may result in the improvement of the fulfillment of the expected learning objectives.

As a conclusive point, the diagnostic assessment is significantly related to the teaching-learning process; therefore, by applying this tool correctly and interpreting it correctly, it has a significant impact on the teaching-learning process, i.e., the teacher knows the level of knowledge of the students and from there establishes a work plan to level the students' knowledge and thus initiate the teaching of new knowledge established in the course to promote or guide learning.

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Annexes

Below are the items evaluated in the instrument applied, which consists of two central variables, the first variable referring to the Diagnostic Assessment Initial (DAI) in basic sciences and differential and integral calculus, which was measured with 10 internal variables and the second referring to the implementation of the Teaching-Learning Process (TLP) which was measured with only one variable when applying the knowledge acquired in differential and integral calculus (see table 6).

Box 10

Table 6

Items and variables of the instrument applied.

Central Variable	Variable	Item
DAI	MKHS	Mathematics Knowledge in High School
	CKHS	Chemical Knowledge in High School
	PKHS	Physics Knowledge in High School
	DMTS	Diagnostic Mathematics Test Score
	GCKD	General Chemical 1 Knowledge in Degree
	PHKD	Physics Knowledge in Degree
	CAKD	Calculus Knowledge in Degree
	DICS	Differential and Integral Calculus Score
	SQMD	Self-Qualification when Making Derivatives
	SQMI	Self-Qualification when Making Integrals
TLP	KAADI	Knowledge Application Activity in Derivatives and Integrals

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author´s contribution

González-Quezada, Esperanza: Contributed to in the development of the research introduction. She supported with the analysis and review of the state of the art. She supported in the application of the measurement instrument. She analyzed the results and discussed them. She performed the breakdown of references by type of contribution to the research. She supported in the writing of the article.

Soltero-Sánchez, Alma Luz Angélica: Contributed in the design of the measurement instrument. She supported in the application of the measurement instrument. She analyzed the results and discussed them. She performed the breakdown of references by type of contribution to the research. She supported in the writing of the article.

Huerta-Chávez, Irma Alicia: Contributed to analysis and review of the state of the art. She contributed to the development of the method, type and design of the research. She carried out the statistical data analysis and prepared the tables and graphs. She analyzed the results and discussed them. She developed of conclusions and recommendations. She contributed in the writing of the article.

Figueroa-Ochoa, Edgar Benjamín: Contributed to analysis and review of the state of the art. He contributed to the development of the method, type and design of the research. He carried out the statistical data analysis and prepared the tables and graphs. He analyzed the results and discussed them. He developed of conclusions and recommendations. He contributed in the writing of the article.

Availability of data and materials

The databases and statistical analysis are available upon request via e-mail to the corresponding author of this article.

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Abbreviations

CAKD	Calculus Knowledge in Degree
CKHS	Chemical Knowledge in High School
DAI	Diagnostic Assessment Initial
DICS	Differential and Integral Calculus Score
DMTS	Diagnostic Mathematics Test Score
GCKD	General Chemical 1 Knowledge in Degree
KAADI	Knowledge Application Activity in Derivatives and Integrals
MKHS	Mathematics Knowledge in High School
PHKD	Physics Knowledge in Degree
PKHS	Physics Knowledge in High School
SQMD	Self-Qualification when Making Derivatives
SQMI	Self-Qualification when Making Integrals
TLP	Teacher-Learning Proccess

References

Antecedents

Carreira, J. M., & Zabalza, M. A. (2024). Undergraduate radiodiagnostic professors. *Radiología*, *66*(1), 94-101.

Cejas, C., & Alvarez, P. (2006). Evaluación de los resultados del aprendizaje. *Revista Argentina de radiología*, *70*(2), 149-155.

Cobeña-Álava, J., & Yánez-Rodríguez, M. A. (2022). La evaluación diagnóstica y su influencia en el proceso de enseñanza aprendizaje en estudiantes de educación general básica. *Polo del Conocimiento: Revista científico-profesional*, *7*(6), 1498-1513.

Kahn-Horwitz, J., & Goldstein, Z. (2024). English foreign language reading and spelling diagnostic assessments informing teaching and learning of young learners. *Language Testing*, *41*(1), 60-88.

ISSN: 2523-2495.
RENIECYT-CONAHCYT: 1702902

Li, D. (2024). An interactive teaching evaluation system for preschool education in universities based on machine learning algorithm. *Computers in Human Behavior*, 157, 108-211.

Liemans, J., Lacourt, L., Santoro, L., Cauchie, D., & Bruyninckx, M. (4-6 March, 2024). Participation in remedial activities to overcome a lack of basic skills in mathematics: analysis of the evolution of the student's results involved in an assessment device in a psychological and educational sciences program. 18th International Technology, Education and Development Conference, In INTED2024 Proceedings, Valencia, Spain.

Salgado, A. M. (2022). Psicogénesis y aprendizaje significativo. *Tempus Psi¬cológico*, *5*(1), 50-64.

Zavala, J., Carpio, C., Cruz, E., Serrano, A., Trejo, A., & Pacheco, V. (2023). Evaluación y promoción de competencias profesionales: identificación de casos, evaluación diagnóstica e intervención modalidad presencial y a distancia. *Revista Electrónica de Psicología Iztacala*, *26*(4).

Basics

Acosta, C., & Rodríguez, R. (13 - 14 de julio de 2023) Importancia de la evaluación inicial diagnóstica integral en grupos de licenciatura de la BENV de forma generalizada para todas las asignaturas por semestre. IX Congreso de Innovación Educativa y Docencia en Red. Valencia, Spain.

Al Aimun, A., Ahmad, M. E., Singha, P., Karim, S. I., & Chakraborty, S. (2024). Assessment In Educational Science: An Insight Of A Government College In Sylhet. *IOSR Journal Of Humanities And Social Science*, *29*(3), 42-52

Ausubel, D. (1983). Teoría del aprendizaje significativo. *Fascículos de CEIF*, *1*(1-10), 1-10.

Bernal, C. A. (2016). Metodología de la Investigación. Administración, economía, humanidades y ciencias sociales (4 ed.). Pearson.

Gómez, B. R., Maldonado, C. R., Giraldo, E. L., González, D. R., & Ospina, A. O. (2011). Evaluación diagnóstica inicial en programas de educación superior virtual de la Católica del Norte Fundación Universitaria. Estudio cuasiexperimental. *Revista Virtual Universidad Católica del Norte, September-December 2011* (34), 60-77.

Hernández, R., Fernández, C. y Baptista, M. P. (2014). Metodología de la Investigación (6 ed.). McGraw-Hill.

Piaget, J. (1950). The Psychology of Intelligence. Routledge.

Ramos, A., & Palacios, J. (2007). Elementos del aprendizaje experimental basado en un problema para la enseñanza superior en Fisicoquímica. *Educación Química, 18*(3), 214-221.

Tünnermann, C. (2011). El constructivismo y el aprendizaje de los estudiantes. *Universidades*, (48), 21-32.

Supports

Gargallo-López, B., Suárez-Rodríguez, J., Garfella-Esteban, P. R., & Fernández-March, A. (2011). El cuestionario CEMEDEPU. Un instrumento para la evaluación de la metodología docente y evaluativa de los profesores universitarios. *Estudios sobre educación, 21(Diciembre)*, 9-40.

González-Zambrano, N. N., Salazar-Barrios, G. M., & Prieto-López, Y. (2022). Plan de formación docente para promover el aprendizaje significativo de los estudiantes con el uso de herramientas tecnológicas. *593 Digital Publisher CEIT, 7*(1), 177-195.

Huerta-Chávez, I. A., González-Quezada, E., Soltero-Sánchez, J. D. R, & Figueroa-Ochoa, E. B. (2022). Impact of theoretical teaching, laboratory practice and the use of specialized software in the meaningful learning of university students. *Journal High School, 6*(15), 16-37.

Martínez, J. L., & Laurido, C. (2012). Evaluación diagnóstica de conocimientos científicos en dos cursos de educación secundaria mediante un mismo instrumento de autoevaluación. *Revista de la Asociación Colombiana de Ciencias Biológicas, 1*(24), 90-96.

Soltero-Sánchez, J. D. R, Huerta-Chávez, I. A., Padilla-Muñoz, R. & Figueroa-Ochoa, E. B. (2021). Quantitative analysis of the incorporation of undergraduate students to scientific work in a public university in Jalisco. *Journal-Health Education and Welfare, 5*(8), 28-41.

Soltero-Sánchez, J. R., Huerta-Chávez, I. A., González-Quezada, E., and Figueroa-Ochoa, E. B. (2023). Ludic didactic strategies for meaningful learning in undergraduate students. *Journal University Management, 7*(17), 13-31.

Vera, F. O. (2020). La importancia del proceso de enseñanza-aprendizaje y la evaluación diagnostica. *Cuadernos de Educación y Desarrollo, 12*(8), 1-14.

Differences

Cabrera-Medina, J. M., Sánchez-Medina, I. I., & Rojas-Rojas, F. (2016). Uso de objetos virtuales de aprendizaje ovas como estrategia de enseñanza–aprendizaje inclusivo y complementario a los cursos teóricos–prácticos. *Revista educación en ingeniería, 11*(22), 4-12.

Espinosa-Ríos, E. A., González-López, K. D., & Hernández-Ramírez, L. T. (2016). Las prácticas de laboratorio: una estrategia didáctica en la construcción de conocimiento científico escolar. *Entramado, 12*(1), 266-281.

Insausti, M. J., & Merino, M. (2000). Una propuesta para el aprendizaje de contenidos procedimentales en el laboratorio de física y química. *Investigações em Ensino de Ciências, 5*(2), 93-119.

Machado, G. E., Álvarez, M., & Suárez, S. D. (2018). Impacto educativo del Laboratorio Virtual Propiedades Coligativas a través del tiempo. In XIII Congreso de Tecnología en Educación y Educación en Tecnología. Congreso llevado a cabo en Buenos Aires, Argentina

Morales, L. M., Mazzitelli, C. A., & Olivera, A. D. C. (2015). La enseñanza y el aprendizaje de la física y de la química en el nivel secundario desde la opinión de estudiantes. *Revista electrónica de investigación en educación en ciencias, 10*(2), 11-19.

ISSN: 2523-2495.
RENIECYT-CONAHCYT: 1702902

González-Quezada, Esperanza, Soltero-Sánchez, Alma Luz Angélica, Huerta-Chávez, Irma Alicia and Figueroa-Ochoa, Edgar Benjamín. [2024]. Diagnostic assessment of knowledge in basic sciences and its relation to the teaching-learning process in the university environment. Journal University Management. 8[19]1-16: e1819116.
https://doi.org/10.35429/JUM.2024.8.19.1.16

Discussions

Bombelli, E. C., & Barberis, J. G. (2012). Importancia de la evaluación diagnóstica en asignaturas de nivel superior con conocimiento preuniversitario. *Revista Electrónica Gestión de las Personas y Tecnología, 5*(13), 1-9.

Fernández, C. L., & Aguado, M. I. (2017). Aprendizaje basado en problemas como complemento de la enseñanza tradicional en Fisicoquímica. *Educación química, 28*(3), 154-162.

Hair, J. F., Anderson, R. E., Tatham, R. L., y Black, W. C. (1999). Análisis Multivariante. Quinta Edición. Prentice Hall.

Harré, R. (1986). Varietes of realism: A rationale for the natural sciences. Oxford: Brasil Blackwell.

Lozano-Ramírez, M. C. (2020). El aprendizaje basado en problemas en estudiantes universitarios. *Tendencias pedagógicas, 37*(2021), 90-103.

Muñoz, L. A., Mesía, L. H., & Gonzales, O. V. (2023). Sistematización de estrategias de acompañamiento y monitoreo del desempeño académico de estudiantes universitarios de primer año. *Spirat, 1*(1), 27-38.

Nunnally, J. C. (1978). Pyscometric Theory. Mc Graw Hill.

Osborne, F.J. (1996). Beyond Constructivism. *Sci. Educ., 80*(1), 53-82.

ISSN: 2523-2495.
RENIECYT-CONAHCYT: 1702902

González-Quezada, Esperanza, Soltero-Sánchez, Alma Luz Angélica, Huerta-Chávez, Irma Alicia and Figueroa-Ochoa, Edgar Benjamín. [2024]. Diagnostic assessment of knowledge in basic sciences and its relation to the teaching-learning process in the university environment. Journal University Management. 8[19]1-16: e1819116.
https://doi.org/10.35429/JUM.2024.8.19.1.16