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

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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.

INTRODUCTION



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.

REVIEW STATE OF THE ART



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 (Cobena-Álava & Yáñez-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).

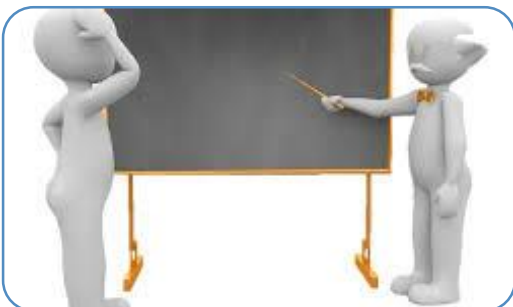


Diagnostic assessment allows teachers to recognize individual differences in the context of learner diversity in the classroom (Kahn-Horwitz, & Goldstein, 2024). Other authors pointed out that the diagnostic evaluation in the first trimester allows the identification of students who know and those who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

REVIEW STATE OF THE ART



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.



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).

REVIEW STATE OF THE ART

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).

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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).

INTRODUCTION

HYPHOTESIS

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.

Research type

- Quantitative
- Descriptive
- Correlational
- Cross-sectional study

n =

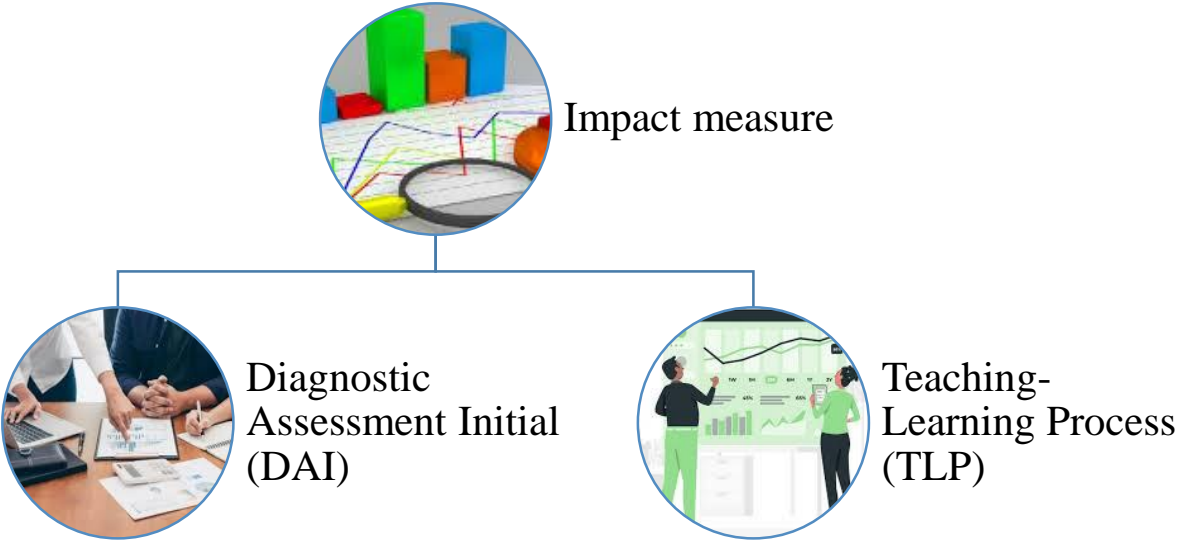
- 313 students

Data analysis

- Descriptive statistics
- SPSS Statistics 25

Hypotheses testing

- Pearson’s correlation



Measure instrument

- 11 items
- Expert judgment
- Cronbach’s Alpha

RESULTS

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

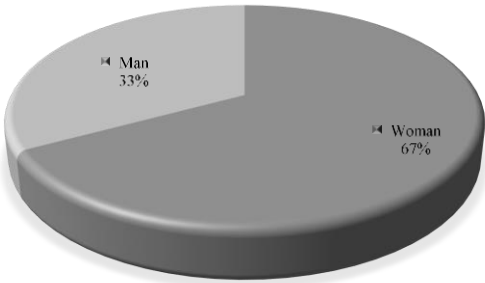
Table 1
Calculation of Cronbach's alpha index.

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

Source: Own elaboration (2024).

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):

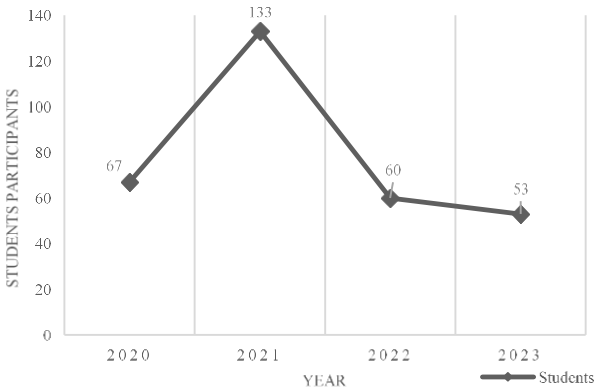
Box 2



Graph 1
Number of participants by sex.
Source: Own elaboration (2024).

Total number of students participating in the study varied from year to year, considering that student enrollment is not always the same: 67 in 2020, 133 in 2021, 60 in 2022 and 53 in 2023 (see graph 2):

Box 3

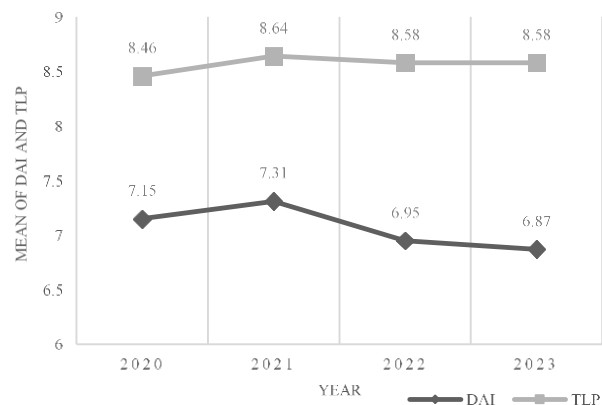


Graph 2
Number of students participants by year.
Source: Own elaboration (2024).

RESULTS

In this research, in 2020 to 2023 there was a favorable gap given between the mean of the Diagnostic Assessment Initial (DAI) and The Teaching-Learning Process (TLP) (see graph 3):

Box 4



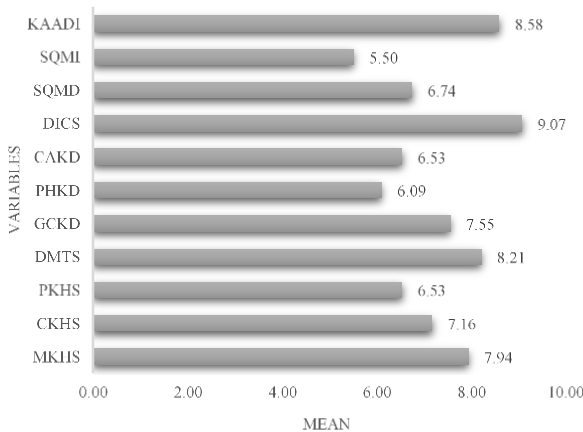
Graph 3

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

Source: Own elaboration (2024).

The impact of the implementation of the Teaching-Learning Process (TLP) in relation to the Knowledge Application Activity in Derivatives and Integrals (KAADI) (see graph 4):

Box 5



Graph 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) (see table 2).

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

Source: Own elaboration (2024).

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)

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

Source: Own elaboration (2024).

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)

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).

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. (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).

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 Knowledge in Degree 1
	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

Source: Own elaboration (2024).

CONCLUSION



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.



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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