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Cognitive development, learning strategies and academic performance in the first stage of university training

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Abstract.

Undergraduate training remains a challenge to train entrepreneurial specialists with research-oriented attitudes. Depending on the level of functional development of the brain, the level of learning will be different in relation to chronological age. The ACRA learning strategies scales (Román & Gallego, 2001) Allow to verify the frequency, type of strategy and specific technique used by students, being the Coding strategies the most important for effective performance throughout life; although there is an abbreviated and validated version of this scale applicable only at the university level by De la Fuente and Justicia (2003); In the study, the 2001 version of Román & Gallego is applied to analyze, according to age, the correspondence between the learning strategies used by the students with their academic performance, as well as to verify if there is a difference according to gender, during a period of three years . Data sheets and final grades of the students were also applied; a multiple linear regression analysis; it is a mixed type investigation.

It is observed that the Coding strategies are not used very frequently; In Academic Achievement (AP), only 7.85% of students obtained a final grade of 14 or more, coincidence of rating of use with scales that measure the same learning strategies. The type of registered strategies and the registered age (18-19 years) influence the AP and only the Acquisition strategies show a slight relationship with the AP.

There is no gender relationship.

Keywords: ACRA, Adolescence, Brain development, Effective learning, Effectiveness

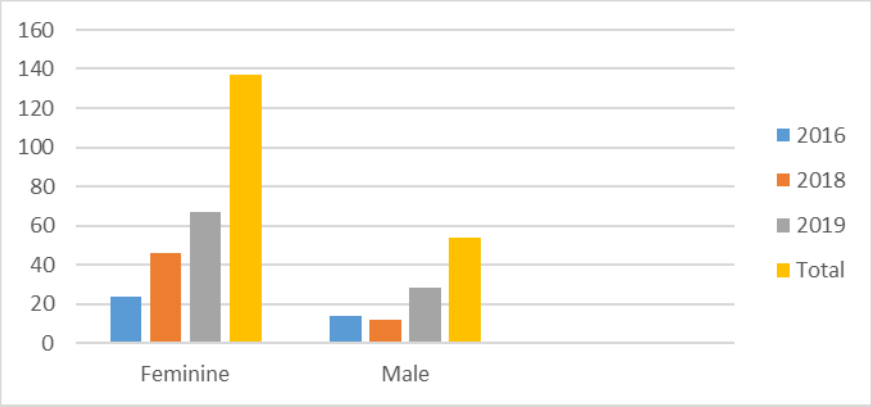
1. Introduction

The first stage of university education is fundamental in the life of the adolescent, being this stage of life that runs between childhood and adulthood, a stage of change, growth and imbalance (Vargas and Barrera, 2002; in Gaxiola, 2012); The passage from basic education to higher education level makes the student develop a cognitive maturation that allows him to achieve learning strategies for better academic performance. In the undergraduate university training stage, it is necessary for the student to learn to select information based on previous knowledge, making use of strategies that allow them to improve the level of learning (Alulema and Amancha, 2020). However, there are still

limitations in some university students in their academic activities, the problems of low performance and failure in studies, demonstrate that the application of learning and teaching strategies play a decisive role in the learning process of students (Ureña and Marroquín 2020); This is the reason why the interest of the research arises, because the problems of low performance of university students continue, which is possibly due to the limitations in their activities, operations and cognitive resources when faced with a certain task. (Byrne and Flood, 2008; Entwistle and Tait, 1996). For its evaluation, the ACRA learning strategies scales of Román and Gallego (2001) were used in its four scales: acquisition of information with 20 items, information coding with 46 items, information retrieval with 18 items and processing support with 35 items.

Regarding the academic performance of the students, we worked with the final grades for the period 2016 - 2019, of the third academic semester of students in the area of Health Sciences; shows that it is characterized by having a student population more representative of the female gender, as shown in figure 1. For its evaluation, the ACRA learning strategies scales of Román and Gallego (2001) were used, which allowed to relate the strategies of learning most used by students and the result of academic performance, taking into account the indicators (table 1) that associate the study variables

Figure 1: Distribution by gender according to chronological year



Source: Department of Statistics of the university

Table 1: Indicators of the ACRA scale applied to university students

Scale ACRA	Indicator	N° Ítems
Information acquisition	Strategies that favour control and definition of care, is divided into attentional and repetition strategies	20
Information encoding	Prior knowledge is integrated into broader meaning structures, which they constitute the knowledge base. Transform and reconstruct the information	46
Recover of information	The student optimizes the processes recovery or recall. They are subdivided into mnemonicization, elaboration and organization strategies.	18
Processing support	Nature processes metacognitive that optimize or, also, can hinder the functioning of learning strategies. The motivational factor is	35

	important to achieve search strategies and response generation (Román y Gallego, 2001)	

Source: Adequate information from Román y Gallego

1.1 Cognitive maturation - learning strategy

From the epistemological point of view, the ability of human beings to construct a meaningful mental representation of their relationship with the world is a complex process and students who are in a stage of life that runs between infancy and childhood. adulthood is a stage of change, growth and imbalance (Vargas and Barrera, 2002; in Gaxiola, 2012). Role transitions such as the culmination of education and the assumption of marriage and parenthood, have recently been defined between 10 years to 24 years of age (Sawyer et al, 2018). Kinghom et al (2018) propose to classify this stage into three age groups, from the point of view of the application of interventions and policies in global health: young (10-14 years), medium (15-19 years) and late (20-24 years), Table 2.

Table 2: Distribution by age group

Group	Medium							Late						Total
Age	17	18	19	20	21	22	23	24	25	26	27	31	39	
Fr%	7.3	34.0	30.0	11.5	6.3	2.1	3.7	1.6	1.0	0.5	0.5	0.5	0.5	100

Source: Statistical Office of the Public University

On the other hand, this sociocultural maturation, however, corresponds to a biological one, with regard to brain maturation: during adolescence, unique patterns of brain activity are verified between two regions of cognitive and motivational behavior, with a different speed of Circuit maturation manifesting the risky behavior of the adolescent (immature capacity for cognitive control, of the prefrontal cortex) while showing a special sensitivity to extrinsic motivation signals (earlier maturation of the striatum). The maturation of the prefrontal cortex ends around the third decade of life (Knapp, 2013); In it the centers of planning, concentration, behavioral inhibition, flexible thinking are located; that is, self-regulation. Learning, according to Robert Gagné, is considered a permanent but modifiable response of the interaction between the person and the environment, determined by biological maturation and repetitive experiential experience. Therefore, enter the information through the senses in the presence of high or low motivation; it is processed, stored in memory, and retrieved when needed. They are important factors that influence this processing, emotions and motivations.

It is important to identify the ways how does the student learn? with the purpose that teachers improve their strategies in order to facilitate the learning process, and students acquire knowledge to improve their academic performance (Ruiz, et.al, 2019). At the university level, didactics are adapting to the learning styles of students and considering not only knowledge, but also the affective and social part of the learning process is very important; and neuroscience as a discipline contributes in this aspect related to the functioning of the brain (Tacca, 2019). Astudillo, H., Maldonado, H. & Torres, M. (2018), affirm the learning strategies used are insufficient, mainly focused on the acquisition and codification of information without association with academic performance.

1.2. Academic performance of students

To measure the result of the academic performance of the university student, and to identify the most used learning strategies, the ACRA was considered, whose indicators are measured in order for the teacher to apply new methodological teaching strategies, depending on the learning style of the student, and the understanding of content is achieved (Mayorga, 2019). The learning result can be evidenced in the construction of new knowledge (Wong et al., 2019). When studying, students use various techniques and skills that are defined as cognitive learning strategies (Valle, Barca, Gonzales y Nuñez, 1999). Students who make use of a greater variety and better learning strategies obtain better grades compared to those who are in the middle; likewise, those with low performance do not use planning as a metacognitive strategy. The association found between cognitive aspects, affective and motivational components, as well as between metacognitive components, all directly related to academic performance is highlighted (Roys, J. and Pérez, A., 2018).

In other words, a strategy implies planning, ordering, organizing or directing a series of actions towards the achievement of an end; In learning, we refer to the set of tactics consciously organized and used by the learner in order to solve a problem (Ortega, 2017) and according to Ortega F .; Muñoz M .; Vasquez D .; and Espinoza, D (2017) students who manage to develop metacognition, assimilate in a conscious way, applying correctly and at the right time the appropriate strategy for learning. For the student to achieve knowledge depends on many factors, one of them is the performance of the teacher, however, it must be taken into account that for deep learning it is necessary that you self-manage their learning (Turmino, et.al; 2018)

The purpose of this study is to analyze cognitive maturation, learning strategies used by students in the Health Sciences Area, and academic performance in the first stage of university training.

2. Development of work:

Material and methods

The applied research design was descriptive, retrospective, correlational and cross-sectional. The study population was made up of students from the third academic semester, from the periods 2016 I, 2018 II and 2019 I, belonging to the Area of Health Sciences, of the Public University of the city of Ica - Peru. For the study, three (3) groups were formed (table 3) , considering the development of the stage of life, being established as follows:

- i. Young group: adolescents, 16-year-old

- ii. Middle group: adolescents 17, 18, 19 years old

- iii. Late group: adolescents / adults 20 years of age and older

Table 3: Distribution by age groups

Group	Medium			Late									Total
Age	17	18	19	20	21	22	23	24	25	26	27	31	39	

Total	**14**	**65**	**58**	22	12	4	7	3	2	1	1	1	1	**191**
Fr (%)	**7.3**	**34.0**	**30.4**	11.5	6.3	2.1	3.7	1.6	1.0	0.5	0.5	0.5	0.5	**100**

Source: Statistics section and university enrollment

The Medium group are adolescents who correspond to 71.7% of the total group under study. There is an absence of a young group (16 years of age). The ages of 18 and 19 are the most frequent (f = 123). The sample was also grouped by gender, as shown in the table 4.

Table 4: Gender, greater and lesser frequency of use of learning strategies and their relationship with academic performance, 2016 I-2019 I

Gender and academic performance	**Frequency of use**	**More frequency**	**Less frequency**
Feminine academic performance	Cognitive process Sub strategy	Support Social interactions 10.90909091	Coding Diagrams 11.03448276
Male academic performance	Cognitive process Sub strategy	Support Motivational 11.125	Coding Diagrams 10.30769231

Source: Statistics section and university enrollment

The variables under study were the age of the students (independent variable), learning strategies and academic performance (dependent variables). In the case of the learning strategies variable, the name adopted by Román and Gallego (2001) of the cognitive processes that occur in learning is considered, to name the different learning strategies: Acquisition, Coding, Recovery and Support for processing of the information and for the variable academic performance, the grades obtained at the end of the subject of specific studies are considered, in the vigesimal system made up of the interval [0 - 20]. Likewise, 2 groups were considered, one of High Level; which corresponds to the top 10% of the registered qualifications, that is, from 14 to 20 and the Level Not high; corresponds to grades below 14; that is, from 0 to 13.

The instrument for data collection was the registration form, for the academic performance of the students, which once the subject was concluded and their semester grades averaged were used to analyze the correlation of the variables under study. A data sheet was also used to record the age, gender and code of the student.

For data interpretation, a matrix was designed, as shown in table5; of frequency ranges, of the use of learning strategies based on the scores obtained in the application of the questionnaires, in order to facilitate interpretation and analysis.

Table 5: Use of strategies based on scores obtained

Age	**Scale**	**Proportion**
23	Acquisition	3.66%
25	Acquisition	1.05%
26	Acquisition	0.52%
27	Acquisition	0.52%
17	Support	7.33
18	Support	34.03

19	Support	30.37
22	Support	2.09
24	Support	1.57
39	Support	0.52
20	Recovery	11.52
21	Recovery	6.28
31	Recovery	0.52

Source: Result obtained from the application of the instrument

STRATEGIES	FREQUENCY OF USE (fc)				
	Very low 10%	come down 20%	Half 40%	high 20%	Very high 10%
Acquisition	37-42	43- 49	50-57	58-62	63-74
Coding	75-90	91-101	102-119	120-131	132-163
Recovery	27-40	41-44	45-53	54-58	59-70
Support	53-79	80-89	90-103	104-119	120-135

To students in the area of Health Sciences, prior to the application of the instrument; the procedure was explained to them, as well as the purpose ofi t to have reliable results that guarantee the results obtained.

Results

After having applied the ACRA scale to the selected sample, the result was the following: in relation to the learning strategy most used by the students, the support strategy predominates, with 34.03% and 30.37%; followed by the recovery strategy with 11.51%, the others vary between zero (0) and seven (7) percent; as can be seen in table 6. It is very important to bear in mind that the sample is third semester students, and that they develop subjects that correspond to specific studies.

Table 6: Use of strategies based on scores obtained

Source: Results after applying the instrument

In relation to the academic performance of students, according to age group (table 7); It is obtained that the middle group, made up of adolescents between 17 and 19 years of age, the grades are concentrated between 11 and 14, with a frequency of 82 students with a passing grade up to the high level and for grades between 14 and 17, it is a small group of 13 students scoring up to the high level. In the case of the late group, made up of adolescents / adults aged 20 to over; grades are concentrated between 11 and 14, with a frequency of 30 students with passing grades up to the high level and a student with grade 16 being placed at the high level. Los resultados explican que los estudiantes que usan mejor las estrategias de aprendizaje, son los que obtienen mejores resultados en su desempeño académico, y sustenta la importancia para lograr un aprendizaje significativo. The results explain that students use learning strategies better, are the ones who obtain better results in their academic performance, and support the importance of achieving meaningful learning.

Table 7. Age groups and their relationship with Academic Performance, 2016 I-2019 I

Academic performance	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Middle group (f)	1	4	1	1	1	2	5	5	6	10	15	34	21	18	9	2	1	1	0	0	0	137
Late Group(f)	1	0	1	0	2	0	0	2	6	4	7	20	6	3	1	0	1	0	0	0	0	54
Total (f)	2	4	2	1	3	2	5	7	12	14	22	54	27	21	10	2	2	1	0	0	0	191
%	1	2.1	1	0.5	1.6	1	2.6	3.7	6.3	7.3	12	28	14	11	5.2	1	1	0.5	0	0	0	100

Frequency of students with passing grade up to the high level
Frequency of students with high marks

Frequency of students with passing grade up to the high level
Frequency of students with high marks

In relation to gender, an analysis was carried out on the use of learning strategies and their academic performance, taking into account the frequency of use, table 8:

Table 8: Gender, greater and lesser frequency of use of learning strategies and their relationship with academic performance, 2016 I-2019 I

Gender and academic performance	Frequency of use	More frequency	Less frequency
Feminine academic performance	Cognitive process Sub strategy	Support Social interactions 10.90909091	Coding Diagrams 11.03448276
Male academic performance	Cognitive process Sub strategy	Support Motivational 11.125	Coding Diagrams 10.30769231

Source: Statistical with data obtained from the application of the instrument.

For the study, the sex of the university students was also considered, as shown in table 9; sample made up of 137 female students and 54 male students.

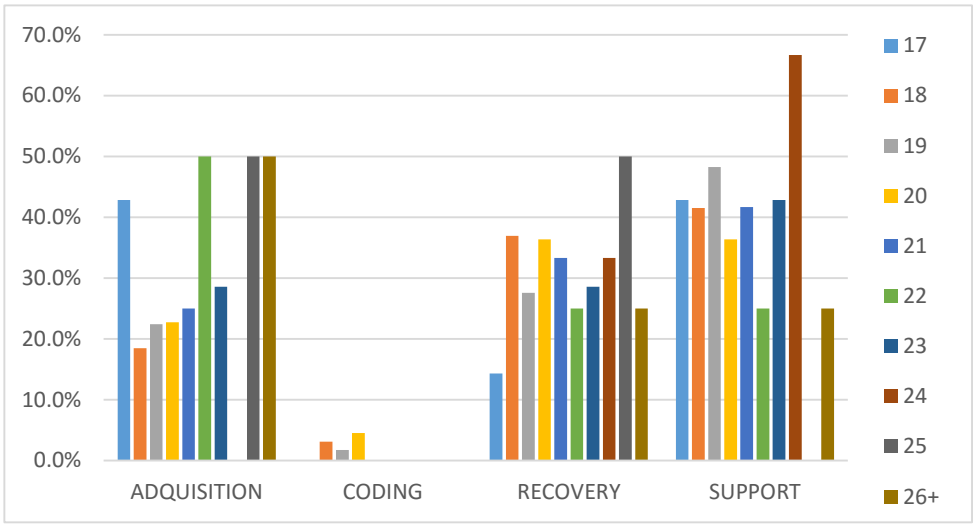
Table 9: Distribution by gender, according to chronological year, 2016 I - 2019 I

Gender	2016	2018	2019	Total
Feminine	24	46	67	137
Male	14	12	28	54
Total	38	58	95	191

Source: Statistical with data obtained from the application of the instrument.

As can be seen in figure 2, Support strategies are the most frequently used by all age groups in the study, with a predominance of older students (almost 70%). On the other hand, the coding strategies are used by student aged 18 and 20, in a percentage less than 10% of the total sample in this work.

Figure 2. Distribution of predominant scales according to age

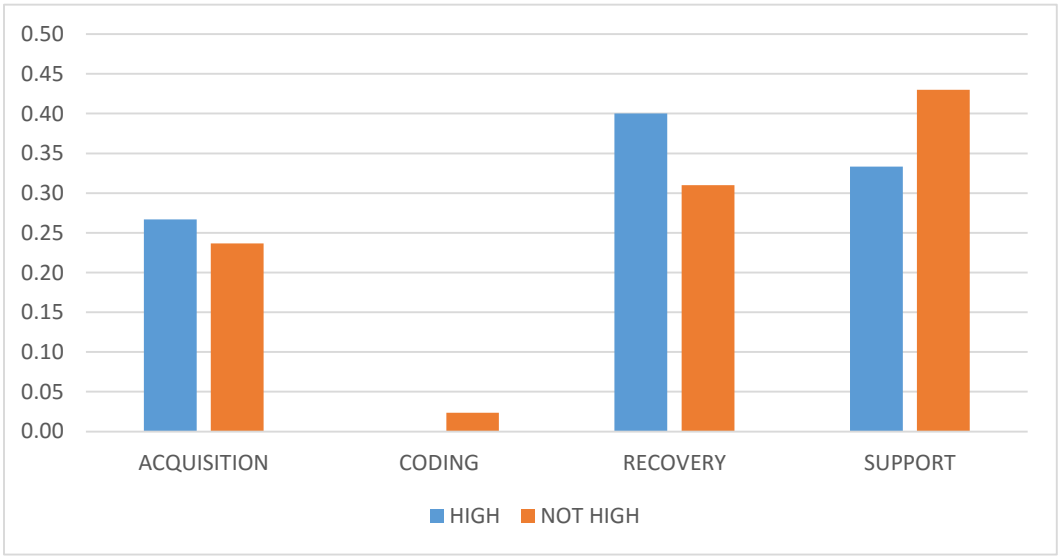


Source: Statistical with data obtained from the application of the instrument.

The ACRA scale, which was the measuring instrument for student academic performance, considers the support strategies, metacognitive strategies and socio-affective strategies. The first of these is the one that students have of their own knowledge process, that is, of what to do: declarative knowledge; how to do it: procedural knowledge and when or why to do it: conditional knowledge; and for socio-affective strategies, it is associated with an interest in learning.

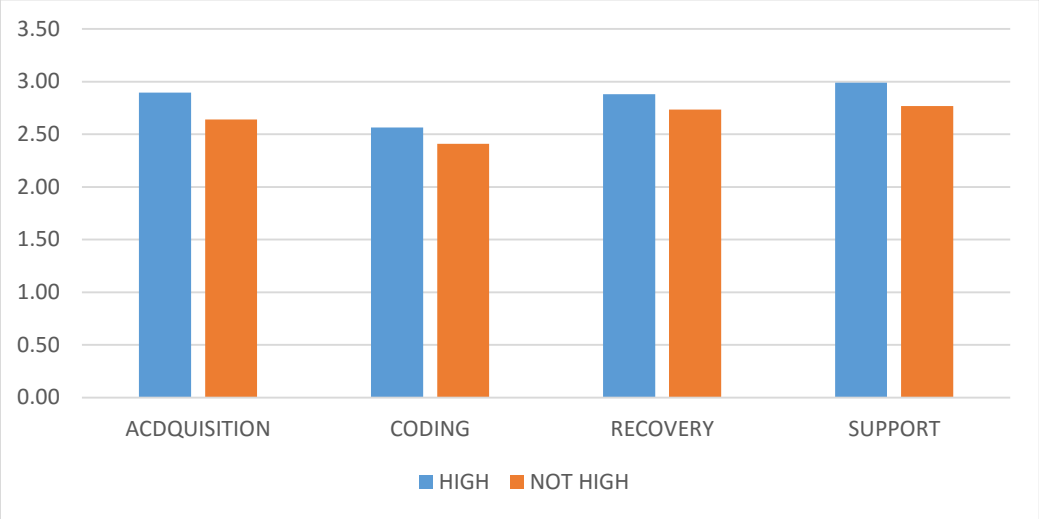
According to academic performance groups, figure 3 shows the distribution of the predominance of use of learning strategies.

Figure 3. Average predominance of use of Scales according to academic performance high/not high.



According to academic performance groups, Figure 4 shows the mean value of the learning strategies scales: Acquisition, coding, recovery and support.

Figure 4. Average value use of the learning strategy scales according to academic performance groups



3. Discussion

Considering Sawyer et al. (2018) in which adolescence is currently defined between 10 to 24 years of age according to the sociocultural function performed by the individual, and with Kanpp (2013) in which according to the process of brain maturation of a person this stage culminates around the In the third decade of life, the group that corresponds to the present study are mostly adolescents, the ages of 18 and 19 being the most frequent (f = 123), corresponding to the Medium group of classification. It is at these ages where the practice of learning strategies is most diverse.

The adolescents in the study show that the cognitive process where they most frequently use learning strategies is Support for information processing (75.91%), with motivational strategies being the predominant ones in both age groups; Likewise, it is confirmed that in women learning predominates where they use strategies of social interactions and in men those related to motivation (extrinsic, intrinsic and / or escape); possibly these, for the Medium group according to the literature, respond more to those of an extrinsic nature (Knapp, 2013) and as a result obtain passing grades more frequently; while for the Late group to those of escape motivation (in order to end a stimulus that causes rejection, such as an exam or evaluation for example). Both types of motivation can be used to benefit learning, hence the importance of making diagnoses about how the learner learns. Coding is the least worked process since it shows little frequency of use of strategies of this type both at the level of gender and in age groups; It is important to know how to "translate" the information that enters the brain into understandable codes, this is directly related to the level of attention in the learning object and this, in turn, in the motivation of the learner (intrinsic motivation).

The entire group studied has a deficiency in the organization of information. This is a sample of little work on the use of self-regulation mechanisms and therefore, autonomous learning (Núñez, J. Solano, P .; González-Pienda, J. and Rosario, P., 2006); it is necessary in the formative processes.

In relation to the group of qualifications obtained, Coding strategies are the least frequently used, and their use is not recorded in the group of High qualifications. This means that the marks obtained possibly respond to temporary learning (retention). In relation to the average value of its use in the age groups, it is observed that for the four cognitive processes, the strategies used more frequently occur in the students of the Middle group than the Late, agreeing with Roy and Pérez (2018) since Furthermore, this Medium group corresponds to the one with the best grades, from which it could be inferred that the use of a variety of learning strategies is directly related to academic performance.

It differs from that reported by Bertel and Martinez (Colombia, 2012), who report for their study with young people between the ages of 16 and 24 the most frequent use of Acquisition strategies (42%) and secondly those of Support (30 %).

It is agreed with the same ones that in the last place of frequency of use is the Codification (30%). Likewise, it differs with Pineda, (Chile, 2018) since they state that the highest scores in the tests correspond to a better performance in the management of Recovery actions; In the present work, these strategies are ranked second in the average frequency of use (18.32%). Likewise, it agrees with Roy and Pérez (2018) for the present study the Medium group made up of adolescents between 17 and 19 years of age use a greater variety of strategies, in direct relation to better grades; in addition, it is not recorded, as does them, use of metacognitive strategies; the result about the direct relationship between affective and motivational components and academic performance is shared. Likewise, it is stated that the most frequently used strategies correspond to the dimensions of support for learning and study habits. There is a limited use of cognitive and learning control strategies. Considering the time of their educational journey, the results showed that students with higher grades do not necessarily require more strategies during learning than students with lower averages. (Rossi, et. Al, 2010). According learning styles represent an important component in the process of learning at any educational level, considering that it represents the differences in the way an individual copes with the learning task; for this reason It is essential that the teacher learns to identify the type of learning style that have their students, in order to establish teaching strategies according to the student profile he manages (Mayorga, 2019).

4. Conclusions

During the teaching-learning activities, the student performs a whole cognitive process to learn, create their own styles and strategies, which the teacher must take advantage of to incorporate new knowledge from the collection of previous knowledge of the student. The detailed analysis of the data collection, has allowed to obtain the following conclusions:

- The differences established in relation to the use of knowledge strategies in the groups of students according to their age (middle group, late group) provide the support to affirm that there is a relationship between age and learning strategies and these with academic performance, results that they were evidenced in the grades of the subjects.

- The acquisition strategy reveals a direct relationship with academic performance, that is, students focus their attention on relevant information and the way they review the contents of the subjects.
- The learning strategy, more frequent are those to support information processing with 75.91%. It was observed that it has to do with the development of the learning session by the teacher; When it takes into account the learning styles and strategies of its students, developing new methodologies in the teaching process, it allows students to also develop new strategies for the incorporation of knowledge. It is important to bear in mind that factors associated with study behavior, the motivational part, are involved, where feelings related to personal growth and development are involved and also consider the social part, that is, how to request support in the face of difficulties, such as the relationships with their fellow students at the time of integration in a work team.
- The effectiveness of the strategies is scarce in relation to their academic performance. It complements what has been explained above, for the student to achieve good academic performance, he needs to self-regulate his learning, know his learning process, the degree of effectiveness he has achieved in his evidence of results, and identify the difficulty to face new challenges with greater possibilities of success.
- Adolescence is the ideal age to train him in the use of learning strategies applied in his life. Entering the first stage of university training is essential in the professional training of the student; Due to the difference that exists in the teaching process at the higher university level, even more so in the Health Sciences Area, which has been the subject of study, where theoretical-practical knowledge is required, essential for their professional training. Therefore, it is necessary for the teacher to support this process of change in the training of university students.
- As a final conclusion, the study carried out will serve for subsequent research, even more so than in the Peruvian university system, based on University Law No. 30220, it establishes mandatory general, specific and specialty studies, the same as those that are They take them gradually and that the student must incorporate for each one effective learning strategies that respond to their academic performance, according to the results obtained and shown in previous lines. Likewise, university teachers need to implement new strategies in the development of their teaching practice, focused on the learning subject, creating conditions for students to appropriate knowledge and students to act independently, creatively and committed, acquiring or improving learning strategies.

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