

Cooperative Learning And Its Effects On The Development Of Problem Solving Skills In Secondary School Students, Callao

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Abstract

This article entitled: Cooperative learning and its effects on the development of problem solving skills in students of 2nd grade of secondary education of the I.E. "Sor Ana de los Ángeles". Callao. Its main objective was to determine to what extent the application of cooperative learning referred to basic strategies, influences the development of problem solving skills in students of 2nd grade of secondary education of the selected educational institution. This is an explanatory-causal study, of a basic type, with a quasi-experimental design, of longitudinal cut; the study sample corresponds to 90 students selected for this purpose. The survey and the respective research instruments or questionnaires were applied as a technique. The study was developed under the quantitative approach and the hypothetical-deductive research method was applied. The results showed that the coefficient of determination, represented by the R^2 , had a value of 0.757, which indicates that cooperative learning has a 76% influence on the development of problem-solving skills in 2nd grade students of the I.E. "Sor Ana de los Ángeles", Callao.

Key words: Cooperative learning, problem solving skills, basic strategies, basic education.

1. Introduction

The education in the world is in a process of constant change, and according to the latest international assessment of school performance, PISA (2018), the results continued to be negative for Peru, despite the improvement of 3 points on average over the results achieved in 2015. In this regard, Peru ranks 64th out of 77 participating countries in all the evaluations applied in this regard. Hence, according to the indicated report, it has that, in the reading comprehension and mathematics test, Peru went up 3 points, reaching an average of 401 and 400; being the averages of 2015, (398 and 387) respectively. In Science, 404 units were achieved, having risen 7 points with respect to the average of the previous exam, which was 397. In this sense, this forces us to look for new and better strategies to face this harsh reality that afflicts the national education system. One of them is cooperative learning, which, as indicated by Blaya (2019), allows bringing into play a set of fundamental skills and abilities to foster the development of key competencies for learning throughout human existence.

For this reason, Peru is engaged in the development of a reform that seeks to improve the quality of education for Peruvian children and young people. But it is known that this process of improvement

initiated with the PLANCAD, followed by the pedagogical proposal called Nueva secundaria and the subsequent baccalaureate did not bear the expected fruits in our country, in spite of the new educational approach that supported the pedagogical practice, moving from the paradigm of teaching to the paradigm of learning. This implies that they forgot that knowledge of reality is a determining variable for the generation of great changes in the educational field. Therefore, the proposal of a new school curriculum, the deficient teacher training, the limited implementation of educational materials, among other things, were not enough. In addition, this process revealed the need to develop an educational quality evaluation system capable of providing relevant, fresh and timely information for correct decision-making in educational policy.

In addition to seeking highly functional didactic strategies, it should be kept in mind that, in any evaluation system, learning is operationally defined in terms of academic performance. For this reason, researchers Paba-Barbosa, Lara-Gutiérrez and Palmezano-Rondón (2008) pointed out that academic performance is the result of several variables and that in order to define it, the grades obtained by students through different evaluations are taken as a reference, thus indicating the quality and quantity of mathematical knowledge that they have managed to develop.

Thus, in Peru, it is estimated that part of the origin of the low results achieved by students could be linked to the use of inadequate or routine methods, the lack of basic prerequisites for learning mathematics, in addition to the lack of materials appropriate to the needs of students and the reality from which they come. Therefore, we are interested in knowing how the use of Cooperative Learning influences the development of problem-solving skills in students of a sample selected for the proposed purpose.

Cooperative Learning is a generic concept referring to the selection and use of a set of teaching procedures that allow the organization of students in small, mixed and heterogeneous groups, and is characterized by teamwork, organized in a coordinated manner, among themselves, to solve academic tasks and deepen their own learning. According to (Abellán, 2018) one of the most productive strategies is the educational practice called cooperative learning; it is currently considered as a highly functional methodological tool that gives the educational act the ability to respond to the most diverse needs presented by individuals of this century.

According to Orozco, Ruiz, & Vivar (2018), cooperative learning has a philosophy of social work and a way of understanding teaching and consequently learning, since it organizes and systematizes each and every one of the elements involved in the teaching-learning process. That is why it is necessary to apply cooperative learning methods to optimize the academic performance of students in the area of mathematics. In this sense, Slavin (2014) considered the existence of three fundamental factors for cooperative learning methods to surpass traditional methods in efficiency and effectiveness: (a) That the rewards offered are identical for all team members, but that in their application of these the individual performance of the participants is taken into account (meritocracy) and not group productivity; (b) That personal responsibility is strengthened and valued, both for one's own learning and that of others; and (c) Finally, that in the development of teamwork everyone enjoys the same possibilities of participating and making their contributions to the success of the group.

This type of learning takes into account the importance of other mediating factors such as: use of interpersonal skills, group processing, review of the degree to which goals are being achieved, among others. Perhaps the most complete theoretical framework for analyzing these mediating elements is provided by the theoretical construction of cooperative learning. Therefore, this type of learning developed in the classroom is an effective way to encourage participation and inclusion of all students. Therefore, cooperative learning is characterized by the didactic use of cordial and dynamic small groups in which students join efforts and work together to maximize their own learning and that of the other participants. In other words, it seeks to develop common objectives; in a cooperative situation, individuals seek to obtain results that are beneficial to themselves and to the other members of the team.

One of the skills required in this competitive society is that people are able to work in groups and maintain positive and fluid relationships with their peers, to such an extent that a person runs a serious risk of not entering the labor market if he/she is not minimally competent to relate and collaborate with others. In this sense, the dimensions to be taken into account are the first dimension of the relationship with the teacher, with classmates, their personal involvement and interest in the area in which interpersonal relationships are sought to be strengthened, associating it with the most affective part of knowledge.

The second dimension of the time dedicated to the subject and its use, which is associated with the acquisition of competencies and responsibility for the results obtained by the group. It includes indicators such as: (a) It is a way to make better use of the time in the classroom; (b) I think the classes are more practical and have more collaborative work; (c) You found the time spent adequate; (d) As a member of the team you were aware that you are responsible for the success of the group; and (e) The competencies acquired were adequate.

The third dimension of student-centered learning refers to accountability, assessment and a "secondary" role for the teacher. It comprises the indicators: (a) The "what" and "how" to study has depended less on the teacher and more on myself; (b) You think that in the team each member has developed his/her individual responsibility; (c) You thought the time dedicated was adequate; and (d) In the group, reflection and work evaluation activities have been developed.

Finally, the dimension of preference for cooperative learning strategies, this factor being composed of only two basic aspects, which differ from the others both in their content (comparison of two teaching methods) and in their formulation (it is the only one in which the lower the evaluation, the more favorable the student is to cooperative learning). Consequently, summarizing their perception of the use of cooperative learning strategies, this comprises the indicators: (a) You prefer the traditional teaching system in which the teacher explains the contents in class, although less time to perform collaborative activities; and (b) You consider that by applying cooperative learning strategies you have improved your learning in the area of mathematics.

According to the study, problem solving consists of a set of mental and behavioral activities, while

also involving factors of a cognitive, affective and motivational nature. Thus, problem solving is a process that requires the student to act and think mathematically in situations of quantity; to act and think in situations of regularity, equivalence and change; to act and think mathematically in situations of form, movement and location; and to act and think mathematically in the management of data and uncertainty.

Table 1. Stages of problem solving

Stages	Scopes
Preparation	This is the phase in which the problem solver analyzes the problem, tries to define it clearly and gathers facts and information relevant to the problem.
La incubation	The phase in which the problem solver analyzes the problem unconsciously.
La inspiration	The phase in which the solution to the problem emerges unexpectedly.
La verification	This is the phase that involves reviewing the solution.

Note: author's own elaboration

After the analysis of the problematic reality, the general problem was formulated: To what extent does the application of cooperative learning (basic strategies) influence the development of the ability to solve mathematical problems in students in the 2nd grade of secondary education? The specific problems being: (i) To what extent do the relationship with the teacher, with peers and their interest in the area as basic strategies of cooperative learning influence the development of the ability to solve mathematical problems in students of 2nd grade of secondary education? (ii) To what extent does the time devoted to the subject and the use of it, as basic strategies of cooperative learning, influence the development of the ability to solve mathematical problems in students in the 2nd grade of secondary education? (iii) To what extent does student-centered learning, as basic strategies of cooperative learning, influence the development of mathematical problem solving skills in 2nd grade secondary school students? (iv) To what extent does the preference of cooperative learning strategies influence the development of mathematical problem solving skills in 2nd grade secondary school students?

The general objective was also formulated: To determine to what extent the application of cooperative learning (basic strategies) influences the development of the ability to solve mathematical problems in students of 2nd grade of secondary education. The specific objectives are: (i) To determine to what extent the relationship with the teacher, with peers and their interest in the area as basic strategies of cooperative learning influence the development of the ability to solve mathematical problems in students of 2nd grade of secondary education; (ii) To determine to what extent the time devoted to the subject and the use of it, as basic strategies of cooperative learning, influences the development of the ability to solve mathematical problems in students of 2nd grade of secondary education; (iii) To determine the extent to which student-centered learning, as basic strategies of cooperative learning, influences the development of mathematical problem solving skills in students in the 2nd grade of secondary education; and (iv) To determine the extent to which the preference of cooperative learning strategies influences the development of mathematical problem solving skills in

students in the 2nd grade of secondary education.

2. Méthods

The present research had a quantitative approach of applied type, seeking to provide a solution to the study problems. In addition to a quasi-experimental design of explanatory-causal level with longitudinal cut (Hernández & Mendoza, 2018). It was a quasi-experimental design, due to the fact that the groups on which the research was carried out were determined as intact groups given the level of the research: control group and experimental group. In this process, the changes produced in the dependent variable were analyzed in the group in which the intervention was carried out and compared with the group in which it was not carried out. It is longitudinal because the data were collected at different times. The inductive method was applied, with the objective of discovering generalizations from systematic observations of reality. Given the characteristics of the research, sections F and G (intact groups) of the 2nd grade of secondary education of the I.E. Sor Ana de los Ángeles del Callao were assumed as study groups, because they were in similar conditions in terms of academic performance and because they met the minimum requirements for the longitudinal development demanded by the research. To measure the Cooperative Learning variable, the survey technique was used and its instrument was a dichotomous questionnaire, which was applied in two moments; to measure the Mathematical Problem Solving variable, the examination technique was used, and the instrument was a knowledge test, an entrance test and an exit test were applied.

Table 2. Official sample of the research

Cycle	Section	Sample	Percentage
Experimental group	G	45	50%
Control group	F	45	50%
	Total	90	100%

Note: author's own elaboration

3. Results

According to the findings of the study, as shown in Table 2, we worked with a sample of 90 students from the educational institution, which yielded the results indicated below:

Table 3. Cooperative learning-Experimental group

	Low	Regular	High	Total
Entrance test	6,67%	51,11%	42,22%	100%
Exit test	6,67%	11,11%	82,22%	100%

Note: author's own elaboration

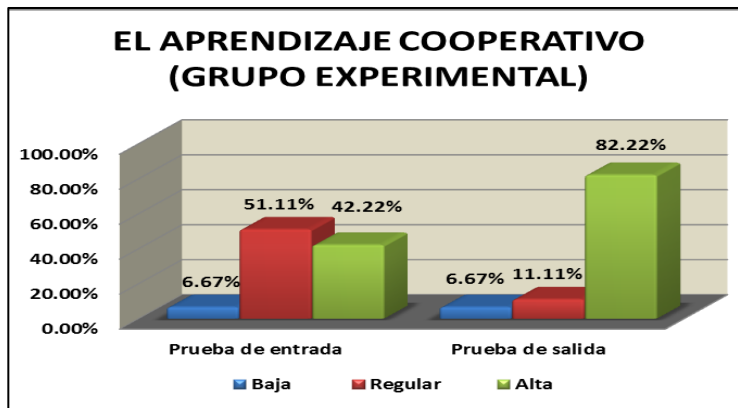


Figure 1. Cooperative Learning (Experimental Group).

Interpretation: Table 3 and Figure 1 show the existence of significant improvements in the results obtained in the entrance test compared to the exit test. It can be seen that in the entrance test 51.11% present a regular level of cooperative learning, 42.22% present a high level and only 6.67% present a low level. In the exit test, improvements can be seen because the regular level decreases to 11.11%, increasing the percentage of high level to 82.22%.

Table 4. Development of problem solving skills (Experimental group)

	Low	Regular	High	Total
Entrance test	8,89%	73,33%	17,78%	100%
Exit test	8,89%	17,78%	73,33%	100%

Note: author's own elaboration

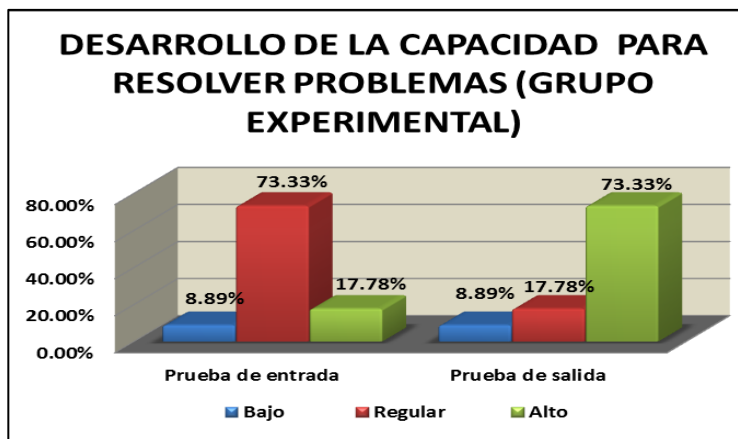


Figure 2. Development of problem solving skills (Experimental group).

Interpretation: Table 4 and Figure 2 show the existence of significant improvements in the results obtained in the entrance test compared to the exit test. It can be seen that in the entry test 73.33% present a regular level of development of the ability to solve mathematical problems, 17.78% present a high level and only 8.89% present a low level. In the exit test, improvements can be seen because the regular level decreases to 17.78%, increasing the percentage of high level to 73.33%.

Table 5. Cooperative learning (Control group)

	Low	Regular	High	Total
Entrance test	6,67%	48,89%	44,44%	100%
Exit test	4,44%	35,56%	60,00%	100%

Note: author's own elaboration

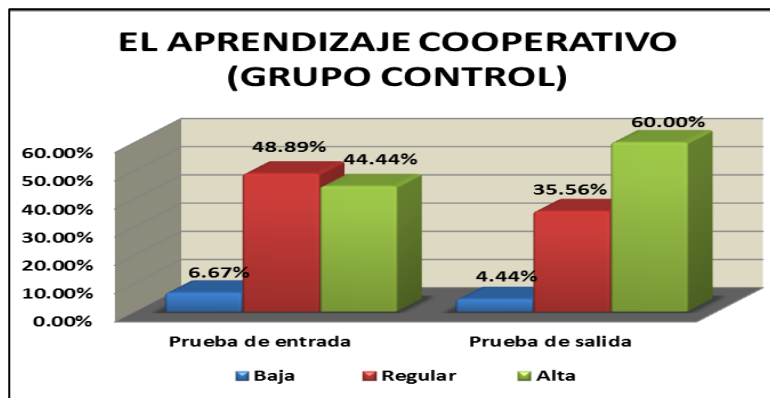


Figure 3. Cooperative learning (Control group).

Interpretation: Table 5 and Figure 3 show the existence of significant improvements in the results obtained in the entrance test compared to the exit test. It can be seen that in the entry test 48.89% present a regular level of cooperative learning, 44.44% present a high level and only 6.67% present a low level. In the exit test, improvements can be seen because the regular level decreases to 35.56%, increasing the percentage of high level to 60%.

Table 6. Development of problem-solving skills (Control group)

	Low	Regular	High	Total
Entrance test	8,89%	53,33%	37,78%	100%
Exit test	2,22%	46,67%	51,11%	100%

Note: author's own elaboration

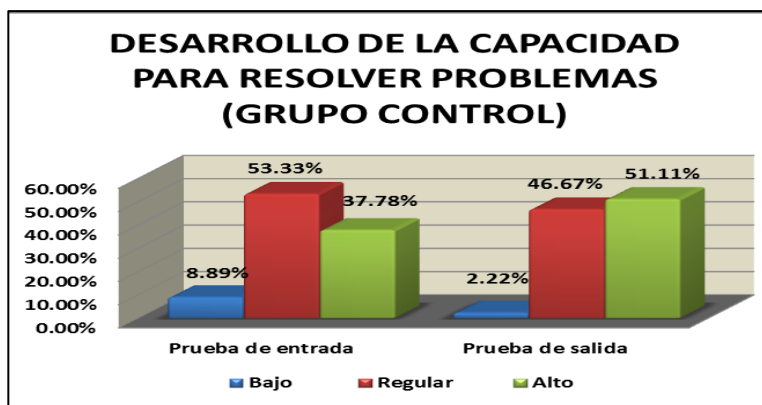


Figure 4. Development of problem-solving skills (Control group).

Interpretation: Table 6 and Figure 4 show the existence of significant improvements in the results obtained in the input test compared to the output test. It can be seen that in the entry test 53.33% present a regular level of development of problem solving ability, 37.78% present a high level and only 8.89% present a low level. In the exit test, improvements are seen because the regular level decreases to 46.67%, increasing the percentage of high level to 51.11% and decreasing the low level from 8.89% to 2.22%.

General Hypothesis Test:

H0: Cooperative learning does not positively influence the development of the ability to solve mathematical problems in the students of the 2nd year of the I.E "Sor Ana de los Ángeles", Callao - 2021.

HG: Cooperative learning has a positive influence on the development of the ability to solve mathematical problems in the students of the 2nd year of the school "Sor Ana de los Ángeles", Callao - 2021.

Table 7. Model Summary

Model	R	R squared	R squared Adjusted	Standard error of the estimate
1	,870 ^a	,757	,752	,32137

a. Predictors: (Constant), V1. Cooperative learning

Interpretation: The summary table shows that it was had as Pearson's multiple correlation coefficient represented by (R) the value of 0.870, this allows demonstrating the existence of a high degree of correlation between the variables cooperative learning and development of the ability to solve mathematical problems. On the other hand, taking as a reference the coefficient of determination, represented by the R2, the value was 0.757, which indicates that cooperative learning has a 76% influence on the development of the ability to solve mathematical problems in the students of the 2nd year of the I.E "Sor Ana de los Ángeles", Callao - 2021.

Table 8. Statistical test ANOVA^a

Model	Sum of squares	gl	Mean squared	F	Sig.
1 Regression	13,870	1	13,870	134,298	,000 ^b
1 Residual	4,441	43	,103		
Total	18,311	44			

a. Dependent variable: V2. Development of problem-solving skills.

b. Predictors: (Constant), V1. Cooperative learning

Interpretation: With respect to the ANOVA table, the F statistic is 134.298, and the significance level is equal to 0.000, less than 0.05, these results allow us to demonstrate that the null hypothesis should be rejected and accept that cooperative learning has a positive influence on the development of the ability to solve mathematical problems in the 2nd year students of the I.E "Sor Ana de los Ángeles", Callao - 2021.

It has been evidenced in practice that cooperative learning through the application of its basic strategies positively influences the development of the ability to solve mathematical problems in the

students of the 2nd year of the I.E "Sor Ana de los Ángeles", Callao - 2021, as evidenced by the Pearson's multiple correlation coefficient represented by (R) whose value obtained is 0.870, which shows us the existence of a high degree of correlation between the variables cooperative learning and development of the ability to solve problems. In addition, being the R^2 equal to 0.757, we can point out that the influence is 76%.

The statistical results of the study allow us to show that the relationship with the teacher, with classmates and their interest in the area of mathematics as basic strategies of cooperative learning influence the development of the ability to solve problems in students of 2nd grade of secondary education of the selected educational institution, being the Pearson's multiple correlation coefficient represented by (R) equal to 0,740 and the R^2 with a value 0.548, which indicates that the dimension relationship with the teacher, with classmates, their personal involvement and interest in the area influences 55% in the development of the ability to solve problems in the students of the 2nd grade of the I. E "Sor Ana de los Ángeles", Callao - 2021.

Likewise, it is evident that the time dedicated to the subject and the use of it, as basic strategies of cooperative learning, influences the development of the ability to solve problems in the area of mathematics, The Pearson's multiple correlation coefficient represented by (R) equals 0.654 and the R^2 with a value of 0.428 which indicates that the dimension of time dedicated to the subject and the use of it influences in 43% in the development of the ability to solve problems in the students of the 2nd year of the secondary school I. E "Sor Ana de los Ángeles", Callao - 2021.

In relation to the third specific objective, it was found that student-centered learning, as basic strategies of cooperative learning, influences the development of the ability to solve problems in students of 2nd grade of secondary education of the selected educational institution, also the Pearson's multiple correlation coefficient represented by (R) equal to 0.718 and the R^2 with a value 0.515, which indicates that the dimension student-centered learning influences 52% in the development of the ability to solve problems in the students of the 2nd year of the I. E. "Sor Ana de los Ángeles", Callao - 2021. E "Sor Ana de los Ángeles" Callao - 2021.

Finally, it is necessary to point out that the preference of cooperative learning strategies influences the development of the ability to solve problems in students of 2nd grade of secondary education of the selected educational Institution, in addition the Pearson's multiple correlation coefficient represented by (R) equal to 0.919 and the R^2 with a value of 0.845, which indicates that the dimension preference of cooperative learning strategies influences 85% in the development of the ability to solve problems in the students of the 2nd grade of the I.E "Sor Ana de los Angeles" Callao - 2021.

4. Discussion

Johnson & Johnson (2009), argue that cooperation is to work together with the purpose of achieving common goals, in the cooperative context learners seek to obtain a result that is beneficial to all team members. In addition, cooperative learning has as a strategy the didactic use of small groups of students who work harmoniously to maximize their own cognitive development and that of others. Likewise, Prieto

(2007) explained that cooperative learning has a close relationship with Piagetian constructivism, since the teaching and learning processes are more structured by the teacher, while students have a specific commitment that they then share with the members of the study team, this interaction benefits everyone in learning, since cooperative learning implies working in an interactive and supportive team.

According to research conducted about cooperative learning provides students with support in the development of their cognitive abilities and skills; that is why, Linares (2017) precise that, cooperative learning positively influences academic performance in the area of mathematics in students in the first year of secondary education of the Educational Institution "San Juan Bautista de la Salle"; As shown by the results of the Student's t-test, in relation to the 50.0% of the control group, 17.5% are at the beginning, while 0.0% of them are at an achieved level, and 32.5% of them are in the process; in relation to the 50.0% of the experimental group, 15.0% of them are in the process. 0% of the experimental group, 15.0% of them are at the beginning, 10.0% are at an achieved level, and only the remaining 25.0% are in process.

Thus, by means of the findings found, these will allow a strengthening in the learning process of the students in an optimal and effective way; that is why Ruíz (2012) stated that the conventional transmissive method, based on this sequence, represents stereotyped models and requires globalizing methodologies, among which is the cooperative method. Likewise, the teacher feels that the students have modified their attitude during their teaching and learning process by "being more in class" attending, participating and developing the tasks in a more interesting way; in that sense, the students perceive an increase in their participation in the classroom as a result of the cooperative intervention, going from a 6.78 to a 7.32 the score of the students in the control group.

According to the results obtained will allow the elaboration of a set of didactic strategies that contribute to the comprehensive training of students; in that line of idea Vargas, Gámez & Cuadros (2017) pointed out that, in these circumstances and current expectations, the relevance of cooperative learning is proposed as a strategy that from its conception, characteristics and fundamental components provides the possibilities of an interactive model of teaching comprehensive reading articulating the capacities and cognitive skills of students. That is why, in the dynamics and application of cooperative learning techniques, as an opportunity for the development of communicative skills, they favor teamwork to learn and confront knowledge achieved; as well as the appropriation of the components of cooperative learning by the students, favoring the disposition and reality of heterogeneity and diversity in the classroom for an approach to a reading process coherent with the possibilities of reader-text and reader-reader interactivity.

It is understood that through cooperative learning the level of participation and cohesion in the classroom is enhanced and this will favor an improvement in academic performance and communicative skills; that is why, La Rosa (2015) indicated that, social skills are related to cooperative learning as it successfully favored the achievement of fundamental learning for life; in this regard the evidence shows that of the low level was 1.67 %, good and medium is related in 46.67 %, low and medium 3.33 %; very good and medium is related 10.00 %; very good and high 28.33 %; good and high is related 6.67 %; low and high is related 1.67 %. Consequently, the results provide essential support to affirm that Cooperative

Learning influences the development of social skills in university students significantly with a $p = 0.00 < 0.05$.

Consequently, it is had that cooperative learning contributes favorably to achieve learning achievements in students; so that, Bazán (2019) pointed out that, cooperative learning is related to the academic performance of Science, Technology and Environment area of high school students being this relationship high ($Rho=0.729$; $p=0.000<0.05$); positive interdependence is related to the academic performance of Science, Technology and Environment area of high school students being this relationship high ($Rho=0.748$; $p=0.000<0.05$); individual responsibility is related to the Science, Technology and Environment performance of high school students being this relationship high ($Rho=0.739$; $p=0.000<0.05$) and finally interpersonal skill is related to the academic performance of the Science, Technology and Environment area of high school students being this relationship high ($Rho=0.778$; $p=0.000<0.05$). Orozco, Ruiz, & Vivar (2018), indicated that, cooperative learning, possesses a philosophy of social work and a way of understanding teaching and consequently learning; since, it organizes and systematizes each and every one of the elements comprised in the teaching-learning process.

5. Conclusiones

1. After the treatment and analysis of the data, cooperative learning through the application of its basic strategies has a positive influence on the development of the ability to solve problems in the students of the 2nd year of the I.E "Sor Ana de los Ángeles" Callao - 2021, with Pearson's (R) equal to 0.870 and the R^2 equal to 0.757, which allows us to point out that the influence is 76%.
2. With respect to the relationship with the teacher, with peers and their interest in the area as basic strategies of cooperative learning influence the development of the ability to solve problems in students of 2nd grade of secondary education of the I.E "Sor Ana de los Angeles" Callao - 2021, being the (R) of Pearson equal 0.740 and the R^2 equal 0.548, which allows us to point out that the influence is in 76%.
3. In relation to the time dedicated to the subject and the use of it, as basic strategies of cooperative learning, it is evidenced that this influences the development of the ability to solve problems in students of 2nd grade of secondary education of the I.E "Sor Ana de los Ángeles" Callao - 2021, being the (R) of Pearson equal 0.654 and the R^2 equal 0.428, which allows us to point out that the influence is in 43%.
4. Similarly, in the present study it has been found that student-centered learning, as basic strategies of cooperative learning, influences the development of the ability to solve problems in students of 2nd grade of secondary education of the I.E "Sor Ana de los Angeles", Callao - 2021, being the (R) of Pearson equal 0.718 and the R^2 equal 0.515; which allows us to point out that the influence is in 52%.
5. Finally, it is concluded that the preference of cooperative learning strategies influences the development of the ability to solve problems in students of 2nd grade of secondary education of the I.E "Sor Ana de los Angeles" Callao - 2021, being the (R) of Pearson equal 0.919 and the R^2 equal to 0.845, which allows us to point out that the influence is in 84%.

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