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Research Article

Cooperative learning and notions of geometry in 5-year-old children in educational preschool institutions.

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Abstract: Cooperative learning has become a fundamental teaching-learning strategy for the social construction of knowledge. This methodology is ideal for preschool students in regions such as Latin America and the Caribbean, where the effects of learning poverty condition socioeconomic development. Therefore, the objective was to assess the incidence of cooperative learning in the teaching of geometry in 5-year-old students of educational preschool institutions in the three natural regions of Peru. This research was qualitative and descriptive-correlational. Two data collection instruments were applied to 78 students who served as a sample. The Spearman's Rho was used to analyze the relationship between the variables, which confirmed the positive relationship between them; therefore, the influence of incorporating this type of learning has an impact on the logical development of children. A quality education with optimal learning strategies will lead these students in the future to a good level of performance in academic tests such as PISA.

Keywords: Cooperative Learning, Geometric Notions, Education, Learning Strategies

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1. Introduction

Education in Latin America and the Caribbean is not unrelated to the perceived quality of teaching **(World Bank, 2021)**. This is reflected in aspects such as infrastructure, methodology, quality of the teaching personnel, and inadequate use of learning strategies developed by the institutions. Considering the aforementioned information, it is demonstrated that teaching in the region is going through a crisis, especially in subjects as mathematics. Clearly, the approach of teaching used in the first levels of education is the basis of future learning since it must be aimed at developing the students' logical skills. Their development is important in the general training of children since it promotes observation, interpretation, analysis, and comprehension at an early age **(León et al., 2016)**.

Currently, the educational research in Latin America and the Caribbean has been focused on the development of teaching-learning methodologies based on cooperative learning since it produces in the students the necessity to keep learning and, at the same time, reinforces the innate knowledge of each one of the members. This idea is reinforced by comparative studies between the different types of learning, where the results obtained about the cooperative, competitive, and individualistic learning methods are corroborated. It supports the idea that cooperative learning generates better performance, positive relationships, and mental health **(Johnson et al., 1994)**. It is worth mentioning that applying the cooperative learning method does not mean it annuls personal development; on the contrary, the resources, knowledge, and skills of each one of the members are used better since it seeks the collective construction of knowledge. Therefore, with the implementation of this teaching-learning technique, it is possible to achieve a positive interdependence in children by giving them the opportunity to socialize with each other and in general as well as the necessary tools to develop high academic performance **(León et al., 2016)**.

Currently, the implementation of new methodologies in learning leads the teachers to include the inclusive teaching in their pedagogical structure in order to get the student to develop in a personal, social, and professional field so that they can face new challenges in the future **(Herrada & Baños, 2018)**. Since the cooperative movement started, there was a close relationship between the cooperative society and education since it is

considered the basis of comprehensive development **(Mata, 2018)**. Cooperative learning is an educational practice that has been carried out with success in the last decades **(Azorín, 2018)**. Therefore, it is considered a methodological tool that can solve the different necessities of 21st-century societies. The definitions of cooperative learning vary according to the approach, for example, if we talk about a conditional approach, it is related to the way of working together, on the condition that both members have to achieve their goals to accomplish the objectives. As this type of approach, there are four types more that are focused on the group, relational, motivational, and inclusive work **(Azorín, 2018)**.

The implementation of this learning in the classrooms allows the organization of the activities so that they create academic and social experiences. According to **Rodríguez (2020)**, this basically happens since this learning is focused on the collective or group work. The student will be able to acquire and develop their skills by applying this method. At the same time, this technique allows them to use better the tools to achieve the academic objectives. Cooperative learning in children of preschool is the basis for them to learn to respect and get along with their classmates as they are acquiring knowledge. The teachers' strategy to achieve this objective is forming little diverse and mixed groups to foment a harmonious coexistence between them. There are benefits of applying this methodology in 5-year-old children such as the level of individual and collective responsibility since the group work awakens empathy and commitment to their classmates to solve problems. The improvement in the children's social skills makes them learn to hold and express an opinion and, at the same time, respect the opinion of each member of the group **(Uranga et al., 2016)**.

Besides that, the implementation of the cooperative language in preschool allows children to think positively and accept diversity more easily. Children, from an early age, start to develop different types of thinking. One of them is the logical-mathematical one, which is developed from 6 months after birth with the recognition of the object. When the kid is between 4 and 5 years old, he already recognizes geometric shapes despite the changes in the visual space **(Rivera, 2018)**. Then, children, in the first stage, only recognize geometric shapes by their shape or appearance generally. Recognizing shapes by their sides, apexes, and angles is not one of their skills yet. However, children can make graphical representations of what they perceive or see.

Regarding that, it is fundamental to reinforce the logical thinking the kid already acquired during the first years of life. His mathematical skills will serve him to develop in situations in a logical way. A study, that selected 20 children between 4 and 5 years old, was carried out in a preschool (Osorno, Chile) to observe the mathematical problem-solving process during a program of logical-mathematical relations and quantification, with didactic techniques to solve problems through games. The results showed that children significantly answer questions when didactic strategies were applied to attract their attention, which allowed them to have a greater concentration skill during the problem-solving. Also, the study demonstrated that children had some skills to solve problems orally expressed. They understood the procedure of the activity, even though there was not an optimal result. They analyzed other options through reasoning.

During the development of that program, children could connect numbers with quantity. When they were asked how many tires two cars have, continuous games were used to solve that question, which allowed them to acquire cognitive skills and abilities during the solution **(León et al., 2016)**. In the Peruvian context, it was observed that the education system is aimed at developing an individualistic education. Generally, teachers are focused on giving concrete answers to questions but do not foment scenarios where the student can develop their potential. In order to correct this situation, some educational institutions and teachers decided to include educational technologies as strategies in the teaching-learning processes, considering their benefits in terms of the students' motivation. Nevertheless, it could be evinced it was developed in a wrong way, which resulted in a very different scenario from what was expected since, far from improving the learning sessions, it became a distractor between teacher and student. That happens because it is still implemented under education models that are only focused on teachers **(Rojas, 2016)**.

This situation has consequences at national level, which are reported in the assessments of academic performance. For example, in 2017 and 2018, the Programme for International Student Assessment (PISA) demonstrated that Peru gets ranking number 64 of knowledge related to reading, mathematics, and natural sciences. Although the punctuation reached was better than the results obtained in 2015, there are still elements that must be considered to improve. According to that assessment, the performance in mathematics increased 13 points compared to the previous year; language arts and science had an improvement too, between 3 and 7 points respectively **(MINEDU, 2018)**. According to the previous approach, there is a question: Is there a relationship between cooperative learning and notions of geometry in 5-year-old children? Therefore, the objective established was to assess the incidence of cooperative learning in the teaching of geometry in 5-year-old students of educational preschool institutions in the three natural regions of Peru (Costa, Sierra, and Selva). For this purpose, it is necessary to consider that the different educational indicators are often influenced by the socio-economic characteristics according to each region **(MINEDU, 2016)**.

2. Methodology

The paradigm used for the development of the research was the quantitative one, with descriptive and longitudinal. Its design was pre-experimental in order to compare the cooperative and notions of geometry through a pre and post-test.

2.1. Population and sample

The universe was composed of students of preschool from 5 years old of three educational preschool institutions, which are geographically located in three natural Peruvian regions. The institutions selected for the research were the preschool "Educational Institution 022" in San Vicente de Cañete, Lima; the Educational Preschool Institution "Divino Niño de Jesus" in Chupaca, Junin; and the Educational Preschool Institution "243 Virgen de las Mercedes" in Tushmo, Pucallpa, Ucayali, from Costa, Sierra, and Selva, respectively. The sample selected in each institution was composed of 28 students from Costa, 26 students from Sierra, and 24 students from Selva, with a total of 78 children on condition of turning 5 years old in the first quarter of the 2019 school year. This distribution was supported by the theory of Otzen & Manterola (2017) because the accessible cases that accepted to be included were selected, based on the convenient accessibility and proximity of the students for the researcher.

2.2. Instrument

In order to apply the research instrument, the informed consent of the principals of those three educational institutions was necessary. The aforementioned instruments were observation forms and the checklist, which is a descriptive instrument that assesses children's skills and knowledge since it is possible to determine the kid's observable behavior during an activity. The indicators were:

- Identify basic geometric shapes: Triangle, circle, and square.
- Difference geometric shapes such as circle - square, square - triangle, and circle - triangle.
- Recognize the geometric shapes in objects of the environment such as windows, sun, etc.
- Explore and reproduce the shapes produced by the mix of them such as Tangram.
- Use shapes such as squares, circles, triangles to reproduce objects that come from the imagination.

These indicators were assessed using the following criteria:

- Expected accomplishment: When the student evinces the achievement of expected learning in the determined time.
- In process: When the student is on track to achieve the expected learning, for which accompaniment is necessary for a reasonable time to achieve it.
- Beginning: When the student is starting to develop the expected learnings or evince difficulties to develop them, so he needs more teacher's accompaniment and intervention according to his rate and style of learning.

Those criteria of assessment are regulated by the regulations given by Peru's Ministry of Education for the students of preschool in Peruvian territory (MINEDU, 2006). The observation form is the instrument where the children's behavior is registered systemically in order to assess that information. This form will allow us to assess the different learning styles of boys and girls of the aforementioned institutions, the grades of these will be measured according to the information mentioned in the checklist. Some of the indicators to be assessed are:

- Take responsibilities as a team.
- Show tolerance to the ideas of the rest of the team members.
- Share knowledge with the rest of the members of the team/classroom.
- Use the materials properly.
- Express ideas with clarity.

Both instruments must be validated by Conbrach's Alpha, so they can be applied to the students of the three preschool institutions that compose the research. Both instruments were applied in two stages (post - pretest). The first stage of the assessment was in the first two months of the 2019 year, and the last assessment according to the instruments was in the last two months of the same year.

2.3. Data processing

In order to process the data, after validation of instruments, the SPSS software version 25 will be used. As the first step of the statistical analysis of data, the Kolmogorov-Smirnov test will be applied to determine the normality of the variables: cooperative learning and notions of geometry. In the second place, the relationship between the aforementioned variables will be tested by applying the Spearman Rho's, which must be calculated to determine a possible correlation between the variables and determine if there is a relationship with the incorporation of cooperative learning in preschool institutions and notions of geometry of boys and girls under study.

3. Results

According to de la Barra Van Treek (2016), knowledge acquisition is better in an environment of cooperative learning since all the members of the class contribute directly or indirectly to increase the knowledge previously acquired. The structure of this type of learning is focused on the model teacher-student and student-student since there is work as a tea to achieve the objectives established in the organization. This type of environment of work in the classroom allows the performance of an inclusive education, which allows to provide an education of quality to all the students. Considering the aforementioned information, it is possible to say the key for the kid's intellectual development is having a proper model of learning that enhances the knowledge and inherent logical skills.

After that, it is possible to start analyzing the results of the research carried out on 5-year-old children to know if there is a relationship between the learning they receive and the development of the notions of geometry. The result of the instrument's validation, using the Cronbach's Alpha, demonstrated 96.9 % of approval and 98.7 % of validity. Regarding those favorable results, the influence of the aforementioned variables will be measured. The assessment carried out in the first two months of the 2019 year shows that 9 children are still in the stage of initial learning of geometrical knowledge, and 17 of them are still assimilating the methodology of cooperative work (Table 1). It is worth mentioning that 56.4 % of boys and girls under study already develop some notions of geometry in terms of identification and differentiation of shapes (Table 2).

Table 1. Cooperative learning in 5-year-old children of educational preschool institutions - pretest.

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Expected achievement	15	19.2	19.2	19.2
	In process	46	59	59	78.2
	Beginning	17	21.8	21.8	100
	Total	**78**	**100**	**100**	**100**

Table 2. Notions of geometry in 5-year-old children of educational preschool institutions - pretest.

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Expected achievement	25	32.1	32.1	32.1
	In process	44	56.4	56.4	88.5
	Beginning	9	11.5	11.5	100
	Total	**78**	**100**	**100**	**100**

In the pretest of the correlation of variables, there was a statistically significant, moderate, and directly proportional linear relationship between cooperative learning and notions of geometry in 5-year-old children of preschool ($r = 0.395$, $p < 0.05$).

Table 3. Correlation test for the variables "Cooperative learning" and "Notions of geometry" - pretest.

Spearman's Rho	Cooperative learning - Pretest	Correlation coefficient	1.000	0.395**
		Sig (bilateral)		0.000
		N	78	78
	Notions of geometry - pretest	Correlation coefficient	0.395**	1.000
		Sig (bilateral)	0.000	
		N	78	78

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

Source: Own elaboration.

In the pretest of the correlation of variables, there was a statistically significant, moderate, and directly proportional linear relationship between cooperative learning and notions of geometry in 5-year-old children of preschool ($r = 0.395$, $p < 0.05$). On the other side, after the assessment in the last two months of the 2019 year to observe the changes made according to the development of learning methodologies in the study population, these are the results according to the measurement instruments used. Table 4 shows the consolidated of the variable "Cooperative learning" obtained from the research carried out on 5-year-old children of three educational preschool institutions. The data analyzed from the observation form shows that the majority of children are still in the process of incorporation of cooperative learning, 4 of them are participating in a class made with this type of teaching, whereas 35.9 % of the total is already learning using this model.

Table 4. Cooperative learning in 5-year-old children of educational preschool institutions - posttest.

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Expected achievement	28	35.9	35.9	35.9
	In process	46	59.0	59.0	94.9
	Beginning	4	5.1	5.1	100
	Total	**78**	**100**	**100**	**100**

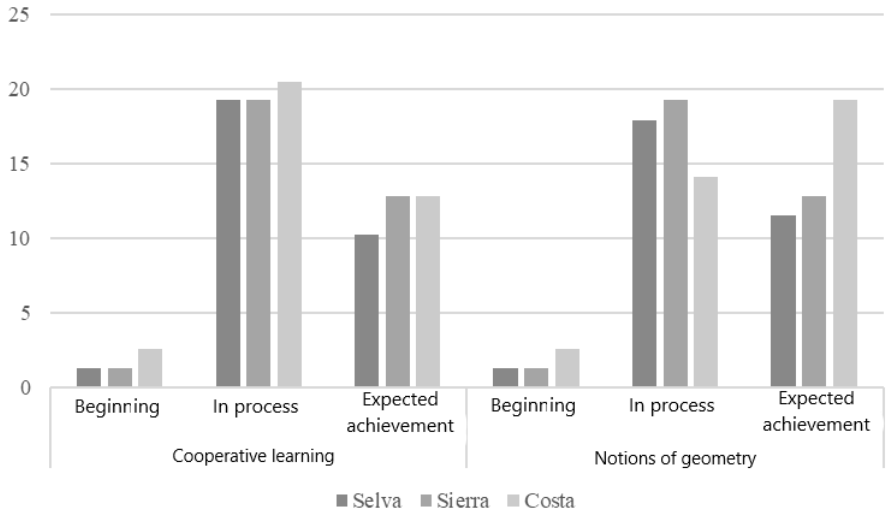
Thanks to the children's evolutionary process in different areas of knowledge, their reasoning skills allow them to relate geometric shapes and compare numbers. Considering the above-mentioned premise, the students' notions of geometry will be analyzed. According to the data from the checklist (Table 5), 43.6 % of children that participated in the study have notions related to geometry, whereas 5.1 % of the total of the aforementioned survey respondents are in the "beginning" total corresponding to the variable "notions of geometry".

Table 5. Notion of geometry in 5-year-old children of educational preschool institutions - posttest.

		Frequency	Percentage	Valid percentage	Cumulative percentage
Valid	Expected achievement	34	43.6	43.6	43.6
	In process	40	51.3	51.3	94.9
	Beginning	4	5.1	5.1	100
	Total	**78**	**100**	**100**	**100**

After a general comparison of both variables (Figure 1), the more outstanding percentages related to the children's notions of geometry show that 19.23 % of the 78 children of educational preschool institutions are already developing this knowledge. In the second place, the region Sierra shows that 19.23 % are in the process to acquire the basic notions of geometry.

Figure 1. Comparison of the study variables



Regarding the methodology of cooperative learning, it is already implemented in the Costa and Sierra in 12.82 % each. In the Selva of our country, this methodology has not been implemented yet as in the other regions (19.23 %). Finally, after analyzing Table 6, it is possible to observe there is an optimal level of correlation between the variables (0.830), which is a value close to 1. However, it is possible to affirm there is a very strong positive correlation between them, which means both variables increase at the same. Children will be able to develop better the notions of geometry they learn at home as long as teaching by cooperative learning is implemented in more preschools.

Table 6. Correlation test for the variables "Cooperative learning" and "Notions of geometry" - posttest.

Spearman's Rho	Cooperative learning - Pretest	Correlation coefficient	1.000	0.830**
		Sig (bilateral)		0.000
		N	78	78
	Notions of geometry - pretest	Correlation coefficient	0.830**	1.000
		Sig (bilateral)	0.000	
		N	78	78

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

Source: Own elaboration.

Considering test the level of significance, it is possible to observe the result was ($p = 0.000$), which means there is a real relationship between the variables ($p < 0.05$). From a general perspective, it is impossible to deny the existence of a direct relationship between cooperative learning and knowledge acquired by the students. Regarding the logical development, it is being supported to solve the mistake caused by the bad educationstructure. Although children go to school with some notions of geometry, the reinforcement of knowledge will allow the students to develop their skills to the maximum.

4. Discussion and conclusions

The traditional learning introduced years ago in schools only caused a delay in the development of children's skills and abilities. Receiving an education focused on teaches annuls the kid's intention of comprehensive development; therefore, some of them showed insecurity with time due to the individualistic way of work that entails shyness and low self-esteem. The implementation of a good learning methodology in preschool institutions would open the possibility of an education of quality, which will enhance the children's innate knowledge. Cooperative learning is one of the methodologies that would contribute to the children's educational, social, and personal performance since the way of working covers more areas that currently have difficulties.

In this sense, Vega & Hederich (2015) stated that cooperative learning shows up as an option to fix the deficiencies produced within competitive and individualistic structures, where the learning goal is achievable only if the other students of the group achieve it; this is known as positive interdependence. This is the case study in geometry learning in preschool students since the group's goals prevail over the individual ones, considering knowledge socialization as a fundamental basis for cooperative learning.

Regarding the general objective, it was determined that cooperative learning is correlated in linear dependence with the 5-year-old children's notions of geometry of educational preschool institutions in the three natural regions of the country. That learning was optimized, so children could reduce their difficulties to pass the grade; therefore, cooperative learning is a strategy that allows children to perform without difficulty and encourages them to keep learning. A similar case happened in a study carried out in Chile, where the importance of motivating attention was confirmed; attention is a principal source for the development of the activities. All this process leads the children to solve problems more easily (León et al., 2016). The results reliably show that the implementation of this learning methodology in the classrooms contributes to the development of teachers' competencies since they have more tools at their disposal to teach. Regarding the aforementioned information, it allows a proper communication in the way of working. The structure applied in that learning is teacher-student and student-student; therefore, it develops reasoning and critical thinking when children work as a group and explore new knowledge (Muñoz & Cordero, 2018).

In the research, it was possible to determine that children's notions of geometry improved thanks to the methodology of learning. In the second assessment, more than half are in an intermediate process of learning, whereas only 4 of them still need teacher and institution support in order to overcome those difficulties in their learning. From another perspective, 5-year-old children reflect a greater capacity of social and personal development in the last stage of the research, like in the study carried out in Chile, where students achieved a better performance to solve the posed problems thanks to the methodologies applied. Definitely, children are who command their process of learning. Also, virtuality related to the use of a more accessible language would be

considered. It is possible to say that children work in the same cognitive and emotional level (area of common development), according to Azorín (2018).

In conclusion, these findings in the groups of preschools do not represent randomness. On the contrary, they were designed according to the level and rate of each student's learning in a collective way and using didactic strategies and socialization. These findings, measured in the communication level, coincide with the results of the exploratory research into preschool carried out by Cuida et al. (2020), who are rotating the work teams to boost relationships between them. Even when the results correspond to the longitudinal approach and differ from the learning process of geometry in the current research. Both have evinced that these groups benefit communication between the students. Therefore, it proved the significant relationship between cooperative learning and the notions of geometry in 5-year-old children.

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