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School Learning from the Seeding Project in the Context of Child Care

Aprendizaje escolar del proyecto de siembra en el contexto del cuidado infantil

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Abstract
The research proposed to develop scientific learning and research skills, developing in the pre-experimental method. We executed a seeding program with cognitive and cultural exchange in 250 individuals from a Children's Assistance Complex. In this sample, urban schoolchildren (without knowledge of the use of natural resources) and of Andean origin (with knowledge of sowing and harvesting) participated. The experiment was based on the application of four didactic phases: (1) intercultural organization, (2) collaboration for analysis, (3) experimentation, (4) scientific argumentation. We found an increase in scientific learning in the sample and their abilities to formulate problems, formulate hypotheses, argue and formulate results. The proficiency and cognitive interrelation allowed this improvement, being the main contribution of the study to the science area.

Keywords: Educational Interrelation; School Science Project; Scientific Learning; Scientific Skills; Sowing Project.

Resumen
La investigación propuso desarrollar el aprendizaje científico y sus habilidades de investigación, desarrollándose en el método pre experimental. Ejecutamos un programa de sembrío con intercambio cognitivo cultural en 250 individuos de un Complejo Asistencial Infantil. En este muestra intervinieron escolares citadinos (sin conocimiento del uso de recursos naturales) y de origen andino (con conocimiento de sembrío y cosecha). El experimento se basó

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en la aplicación de cuatro fases didácticas: (1) organización intercultural, (2) colaboración para el análisis, (3) experimentación, (4) argumentación científica. Encontramos incremento del aprendizaje científico en la muestra y sus habilidades para formular problemas, plantear hipótesis, argumentar y formular resultados. La proeficiencia e interrelación cognitiva permitieron esta mejora, siendo la principal contribución del estudio al área de ciencias.

Palabras claves: leadership distribution; pragmatic leadership; smart institutions; visionary leadership; talent training.

Introduction

The pedagogy of science skills presents current problems that aggravate educational methodologies, teaching systems and evaluation. This problem is crucial, since it must start from the student's curiosity to promote their motivation and their disposition towards science. The pedagogy for the scientific method focuses mainly on questions and assumptions about the phenomena observed in the environment, from experiences through training in investigative autonomy, which formalizes scientific skills in Higher Education. Algunos estudios evidenciaron que los estudiantes entre cuatro y seis años demuestran competencias científicas con determinados niveles de desarrollo al participar en proyectos interactivos con los recursos naturales, un ejemplo claro es el cultivo de habilidades científicas, esto ha ocurrido tanto en la educación básica como en la inclusiva utilizándose el análisis de la flora y fauna (Daphne, 2015; Taylor et al., 2018). Sin embargo, en estas modalidades de aprendizaje, la curiosidad y actitud exigen que el docente domine didácticas inclusivas e interculturales. That is, to know the origin of the students and the resources with which they relate better. Other studies introduced the educational project based on chemistry, to demonstrate how to promote scientific literacy to awaken interest in materials and substances worthy of scientific study (Cahyono et al., 2016; Rodríguez et al., 2015).

Some reports show that 40% of children develop a low level of learning in science, but it is surprising to know that 0.6% developed tasks at a high level (UNESCO, 2016; OECD, 2016). The Local Management Unit of sector 04 (2014), located in the capital, reported that 36.8% of its students reach a low level in learning natural sciences and scientific argumentation, only 2% obtained a satisfactory level . This implies certain weaknesses in all areas of educational training, the need to adapt the curricular programming by integrating other areas such as communication and mathematics, arises after the search to obtain achievements of competences to autonomously develop inclusive scientific inquiry (Álvarez, 2015; Hardianti & Kuswanto, 2017). In this context, we consider that scientific competences must be inclusive to integrate the use of reflective skills from mathematics and reading as well as analytical from the area of communication.

Two important resources also play a role here: (a) educational games (b) the use of technology (Al-Tarawneh, 2016; Cerda & Tineo, 2017; Izquierdo, 2016; Song & Kong, 2014). Despite the fact that this requires economic investment and monitoring of resources, the use of current didactics can significantly increase the possibilities of learning through projects such as school planting, taking advantage of the land closest to the students in their own schools (Cabrera, 2016; Kärkkäinen et al., 2016; Leibovitz et al., 2015; Marín & Santa, 2017; Ortega, 2017). Therefore, crops, in addition to increasing scientific skills, promote student environmental attitudes; they also generate greater motivation to investigate natural elements unknown to themselves.

The didactic method and scientific skills

Scientific skills are human reasoning skills or mental processes that support, analyze, extrapolate, and empower scientific principles. The steps of the scientific method allow the student to develop skills that facilitate the procedure to reach rational thinking, in order to solve problems and reach the knowledge of the truth (Ramírez, 2010). In this regard, we can consider the scientific method as a link between knowledge and the investigating subject; from its didactic duality it integrates two meanings: (a) method (praxis), and (b) pedagogical approach (theory). Therefore, they guide the teaching of science and the self-regulation of thought, before these two processes the student examines and verifies the natural laws (Bayarre & Horsford, 2014; López, 2017).

The scientific method, developed in the teaching of elementary school children, implies planning the execution of each scientific inquiry activity (Sanmartí & Márquez, 2017), although the scientific inquiry that students carry out will depend on the time each proposed pedagogical situation lasts. In other words, cognitive processing for the scientific method must be accompanied by the necessary attitudes (interest, reflection, self-government) to keep the cognitive skills involved in using scientific skills activated. Some structuring dimensions of scientific competence are the skills for formulating problems, posing hypotheses, the moment of testing and the presentation of results. The scientific knowledge acquired allows the student to understand the phenomena that occur in their natural environment, so much so that they are able to reflect on the methodical steps of the investigation. Science is a conglomerate of knowledge, through which an attempt is made to give explanations and foundations to the phenomena of reality; in addition, it seeks to master the steps that explain the causes and effects in natural phenomena.

The theory that Bruner raises about learning by discovery (cited in Soto & Navarro, 2005), corresponds to the constructivist model, which conceives learning as the construction of knowledge, with the active cognitive process being responsible for the acquisition of learning. In that sense, if we apply this concept to the development of scientific skills, the progressive discovery of knowledge through trial-and-error experiments would allow reflection and discernment before natural events given in nature or caused by it. In this case, the seeding project can lay the foundations for acquiring the capacity for analysis and organization in the pragmatic application of knowledge in reality.

Experience since the production of crops

Productive education from the school curriculum allows for benefits in the scientific learning of schoolchildren (ANDECHA, 2015; Macedo, 2012; Ministry of National Education of the Republic of Colombia, 2012). The importance of productive projects lies in the complementation of formal education with productive work in the environment, so that it integrates and opens the way for meaningful learning in the area of science. In this sense, it is considered as the opportunity to involve different scientific experiences that also imply the use of educational interculturality (FONDEP, 2015; Macedo, 2012). The projects from the productive education from the pedagogical inclusiveness require the search for interrelations between the students from Andean contexts, with knowledge of unknown regions for the capital students.

This experience allows the students of the capital to transfer more common knowledge in city life, since scientific pedagogical processes are generated in the search for the truth of both contexts. Here, the proposal starts from the elaboration of intercultural crops, since it guides the teaching as the construction of the student from different contexts and the guiding teacher to encourage comprehensive education and productive work. In research, the intercultural sowing project is a proposal aimed at strengthening the competencies and skills of the scientific method in primary school students, through the cultivation of seeds of different origin, direct experience with the environment (soil, air, water), it should be noted that productive work also has favorable implications in the development of scientific socialization through interaction between peers.

The study by Chávez (2018) exemplifies the model of this experience based on seed sowing projects for the development of the scientific method. This allowed us to carry out an investigation with similar characteristics, including a larger sample quantity, since it was interesting to try to validate their pedagogical processes involved in the development of science at the school stage, considering the vulnerable context in a district of the capital, from Peru. The hypothesis that emerged was: School scientific learning is increased through the application of the seeding project in schoolchildren of a Child Care Complex.

Other studies that precede this experience (Leblebicioglu et al., 2017), report the work of schoolchildren with samples of similar characteristics, in the immediate environment, specifically with flora and fauna, outdoors and in camps, improving skills scientific studies, the use of school methods in experimental science and attitudes towards their belief or investigative determination, after including in their activities some methods of guided inquiry. On the other hand, Martín & Santa (2017), involved the development of ecological spaces in the learning programming of the scientific inquiry competence, as well as in the identification of natural phenomena; therefore, the structuring and development of seedbeds also influenced student environmental education.

Method

The research has a quantitative approach, pre-experimental design (Tamayo & Tamayo, 2015). The population was characterized by 1290 students from four Municipal Assistance Centers located in Lima. They received classes by grades or by levels of attention (academic cycles), which were homologated to the age characteristics required by the Ministry of Education of Peru with respect to its regular basic education system. We included as part of the sample 250 sixth grade students from a Child Care Complex of a district with social and economic vulnerability located in Lima (*male* = 55%; *female* = 45%; M = 10.9 years of age). The selection criteria allowed the integration of students from Andean regions with others from institutions located in the capital of Peru, at the Children's Assistance Center. The empirical origin caused the replication of similar studies developed in this context; we used the Skills *Test of the scientific method* (PHMC) by Chávez (2018), which is a performance test with 36 polytomous-type items with an option of open responses.

Table 1
Cronbach's Alpha Index of the PHMC instrument

Component	Denomination	α
Variable	Competencies of the scientific method	,971
Dimensions	Problem formulation	,981
	Statement of hypotheses	,901
	Testing moment	,897
	Results presentation	,901

Source: Data base of Investigation

The validity of the instrument was considered after obtaining agreements averaged 98.5% acceptance. This was declared by 10 experts in science and technology didactics from schools and universities in the country. The reliability of the instrument corresponded to the test-subtest correlation analysis higher than r = 8.98 (p <.001). Table 1 shows the Alpha index of the instrument, which was considerable for our study.

Procedure

The Children's Assistance Center is an institute for the care of judicialized or abandoned children from their parents. To achieve internalization in this context, the informed consent of the tutors and coordinators responsible for this institution was requested, since they were the representatives in charge of said student population. To start the research, 536 learning sessions of the Sowing Project were consolidated based on the experience of intercultural sowing of Chávez (2018). All pedagogical activities were based on Brunner's discovery work and J. Dewey's proposals. The teachers applied the phases of the children's scientific method in four didactic moments: (1) intercultural organization, (2) collaboration for analysis, (3) experimentation, (4) scientific argumentation. The activities were adapted to the context of the students in the Complete Child Care Center, in order to provide as much time as possible for the development of scientific skills and their usual activities. An advantage of the development of this project was that the boys and girls lived in the center, which facilitated a daily practice of scientific activity in their own field, favoring in turn, in the interrelation of students with different ethnic origin and cultural.

Moment 1: intercultural Organization

Moment 2: collaboration for analysis

Moment 3: experimentation

Moment 4: scientific argumentation

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Figure 1. Didactic moments of the seeding project.
Note: Exemplification from the use of the images located in Chávez (2018).

Figure 1 describes the steps for the teaching of the scientific method in students of the Children's Assistance Complex in collaboration to achieve scientific skills. We were able to homologate the seeding project to that of Chávez's intercultural seeding (2018). Our activities had the use of 1800 resources for the activities: (a) stationery materials, (b) multimedia, (c) organic compost, (d) cultivation tools, (e) seeds, (f) fruits, (g) natural seeds, (h) water, (i) farmland; among others. The experience was developed during a year, being directed by the pre-professional practice in Primary Education of a private university during the year 2019. Finally, to assert the effectiveness of the project, dynamic activities were carried out that aroused the interest of the students, as well as the theme it implied a good degree of theoretical and practical content.

Results

The competence of the school scientific method

Regarding the hypothesis initially raised, it was corroborated that the seeding project favored the competence of the scientific method in students of the sample, since in the comparison of the pretest and posttest measurements, positive scores prevailed for this support (W (+) = 38; Rp = 19.50; Sr = 741.00). In turn, the difference between both tests was significant (Z = -5.221; p <.05). The differences are also located in figure 2, from which the increase greater than 50% in the outstanding achievement is deduced, as well as the decrease greater than 30% in the lowest level (without achievement).

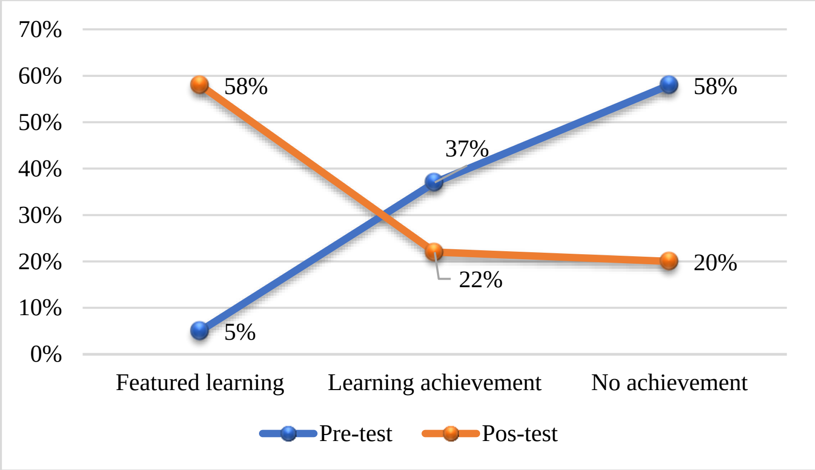

Figure 2. Percentages of the school scientific method.

Scientific method skills

The evidence of improvement established in Table 2 was also reflected in descriptive results, presenting these results in the problem formulation dimension, with improvements in 35 % of all students who reached the outstanding learning level, 53 % at the level of of learning achieved. In the hypothesis-setting dimension, 45 % reached an outstanding learning level; In relation to the time of the test, 43 % reached the same level and 48 % achieved learning. Finally, in the dimension presentation of results, 44 % reached outstanding learning and 34 % reached the level of learning achieved.

Table 2
Pretest and posttest comparison in scientific method skills

Skills	Ranks	*(n)*	Average rank (sum of ranks)	*Z*	*Sig.**
Problem formulation	Negative	0			
	Positive	36	18,5 (666,00)	-5,252	,000
	Ties	4			
Statement of hypotheses	Negative	0			
	Positive	37	19,0 (703,00)	-5,317	,000
	Ties	3			
Test moment	Negative	0			
	Positive	36	18,50 (666,00)	-5,247	,000
	Ties	4			
Results presentation	Negative	0			
	Positive	31	15,10 (702,00)	-5,410	,000
	Ties	9			

Source: Research database.

Nota: **p* <.001.

Regarding the indicators derived from the dimensions (table 2), the reports showed important differences in the analysis of the context of the problem (M = 2.3; p <.005), and in the analysis of the context of ideas or proposals (M = 2.5; p <.005). Regarding the classification of antecedents, causes and effects [relative to the hypothesis statement dimension], the differences in the mean were low (*M* = 1.031), but they were significant (p <.005). We also found differences in indicators such as the execution of experiments (*M* = 3.41; p <.005), verification of beliefs (*M* = 2.49; p <.005) and causal experimentation (*M* = 3.4; p < .005). Finally, regarding the dimension presentation of results, indicators such as verbalization of responses (*M* = 2.51; p <.005) and critical comment (*M* = 3.47; p <.005), were the most outstanding in the analysis.

Discussion

The findings found so far on the school scientific method showed significant differences in the comparison of evaluation scores, these evidences being similar to that of Leibovitz et al. (2015), who increased the knowledge, understanding and procedural skills through the analysis and exploration that the experimental individuals carried out on marine biodiversity, so that the work with the ecosystem and its particularities improve the process of the school scientific method (Álvarez, 2015; Cabrera, 2016; Martín & Santa, 2017). These improvements were also pronounced in the sample that we integrate, favored by the activities of analysis of the earth's ecosystems and the use of seeds for the crops achieved in the productive projects that we applied.

The investigative process was favored thanks to the participation in activities that led to new scientific experiences, such as the experience with natural environments: compost, gardens, orchards or other environments of nature. These activities were the causes of playful incentives to acquire the scientific and exploratory attitude, the generation of curiosity in the students who, with the adoption of a better perception of the specific phenomena, also learned to establish their own position through scientific argumentation. Regarding this development, Bruner's theory is accepted (cited in Soto & Navarro, 2005), from which scientific learning is conceived as a construct that develops through experience, in intermediate processes in classroom learning. Due to its experimental nature and autonomous construction, this allows the student to direct their learning process to promote their findings through scientific knowledge in a stage of writing in the stage of construction of results in the classroom.

Regarding the aspects of the scientific method, hypothesis statement and formulation of the problem, the evidence of statistical improvement found was similar to that found by Dejonckheere et al. (2016), who demonstrated that spontaneous play is an important didactic method to assess children in understanding causal events (cause and effect) and understanding scientific reasoning. Regarding the dimensions of the test moment and the presentation of

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results, some similarities were found that are still not clear with the study by Kärkkäinen et al. (2016), who reported significant improvements in the interpretation of contextual situations, by promoting such activity in a natural park, trying to obtain some progress in the observation and description of problems in visits to natural landscapes of their research. Although these effects have been similar, it has not yet been determined whether the effects on exploration, observation and analysis have been due to the diversity of landscapes integrated in the experimentation, which occurs in a similar way in the study we conducted. Although in the sowing project, we implement different modalities, as well as different resources for a good harvest (seeds, fertilizer), we do not evaluate the improvement of scientific skills longitudinally, perhaps to achieve evidence of particular improvements with respect to unit activities or groups of activities that sustain positive effects based on the variety of natural environments.

Certain similarities were found with other studies focused on environmental attitude as a means to recognize and analyze problems in productive orchards through reasoning (Huamán et al. 2015; Daphne, 2015), which confirmed the improvement in the development of environmental attitudes in regarding the recognition and determination of the problems that arise in their environment, through the implementation of productive bio-gardens. Regarding the results on the hypothesis statement, test moment and presentation of results, these were similar to the conclusions found in studies, in which the experimenters sought to generate hypotheses in the student, contribute in their verification through formal scientific reasoning and informal (Chen & She, 2015; Wu et al., 2016). Some studies managed, on the contrary, to develop experimentation through the design of guided experiments under the domain that the study presented (Asuad & Vázquez, 2014; Song & Kong, 2014), although in our research we proposed another didactic format, rigorously scientific but with freedom in the development of the scientific method applied by the students themselves. This reduced the obligation to follow routes, which could skew part of our results by influencing more vertical activities with other more liberating ones. The reason was due to the fact that science in the school environment is not only aimed at research classes within the classroom, so we decided to avoid placing students in contexts in which the applied research schemes would be intuited, this allowed to obey to Brunner's approach to discovery learning.

The limitations of the study were related to the sample, since economic difficulties did not allow finding significant differences that could be extended to two larger populations such as the regional or provincial one. In turn, another of the limitations presented was oriented in not having access to a control sample, which limited to obtain better indications about its effectiveness under comparisons from the start of the study.

Conclusions

As a first response to our objective and hypothesis, it was shown that the learning of scientific method skills as part of school scientific learning, improved due to the differences found between the scores of the pretest and posttest measurements were, being significant. Here it is worth adding that once the activities of the seeding project were developed, the skills such as the exploration of information, hypothesis and contrast that are born in the scientific process appeared in this group from the didactic interaction to which we subjected among students of the Children's Assistance Center and those that came from different Andean origins. The mechanisms to improve the sowing from the beginning of its plantation, allowed developing the capacity of inquiry, observation, contrast and analysis in the experimental group, although the questions in the knowledge generated by the hypotheses caused in student interrelations remaining open, which can be important empirical options for purely experimental methodological studies. The increase in the general scores in the subsequent measurement, allowed demonstrating the improvement of the dimensions; many of the subjects of the experimentation learned to understand certain scientific situations, establish theoretical relationships to reality, question the phenomena of the activity, propose explanations based on assumptions and argue the hypotheses according to convergent or divergent scientific knowledge.

Finally, we can conclude that the strategies (1) intercultural organization, (2) collaboration for analysis, (3) experimentation, (4) scientific argumentation, allowed students to develop the skills they acquired in school, but also adopted the of their peers with proficiency styles applied during sessions that involved cognitive interaction. In this sense, they developed cognitive tools to guide themselves in the execution of the school scientific method, without having to be individualistic. This allowed to conclude that the consequences of the execution of science also improves learning as well as their own academic attitudes towards research at an early age.

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