

## **Problem Based Learning as strategy for the development of competences in secondary education students**

### **Aprendizaje Basado en Problemas como estrategia para el desarrollo de competencias en estudiantes de educación secundaria**

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#### **ABSTRACT**

The methodological strategies Plough to set of activities that allow learning to be achieved and make activate and dynamic teaching possible taking into account the needs of the context, the Problem Based Learning (hereinafter ABP), is to strategy that starts from to problem to generate student learning, in that sense, the objective of this research was to determine the ABP strategy, that allows to develop competences: inquire through scientific methods to build knowledge and explains the physical world based on knowledge about living beings, matter and energy, biodiversity, Earth and universe of the area of Science, Technology and Environment in secondary level students, during the 2016 academic year. The methodology used was of an Experimental type with quasi-experimental design, with qualitative and quantitative dates, 177 students were taken ace to population and the study sample was made up of 56 students, who have been selected through non-probabilistic sampling, to whom the pre test and post test. The results of this research show that the ABP strategy in the development of skills improves student learning achievement. For the calculated  $Z = 13,51$  and the tabulated  $Z = 1,645$ . It is concluded that with the application of the ABP strategy, it improves the development of skills and the achievement of student learning. It is concluded that with the application of the ABP strategy, it improves the development of skills and the achievement of student learning.

**Keywords:** learning, problem-based learning, capacities, competences, strategy.

#### **RESUMEN**

Las estrategias metodológicas son conjunto de actividades que permiten lograr aprendizajes y hacen posible una enseñanza activa y dinámica teniendo en cuenta las necesidades del contexto, el Aprendizaje Basado en Problemas (en adelante ABP), es una estrategia que parte de un problema para generar aprendizajes en los estudiantes, en ese sentido el objetivo de esta investigación fue determinar la estrategia ABP, que permite desarrollar competencias: indaga mediante métodos científicos para construir conocimientos y explica el mundo físico basándose en conocimientos sobre seres vivos, materia y energía, biodiversidad, Tierra y universo del área de Ciencia, Tecnología y Ambiente en estudiantes de nivel secundario durante el año académico 2016. La metodología utilizada fue de tipo experimental con diseño cuasi experimental, con datos cualitativos y cuantitativos, se tomó como población a 177 estudiantes y la muestra de estudio estuvo conformado por 56 estudiantes, quienes han sido seleccionados mediante el muestreo no probabilístico, a quienes se les aplicó la pre prueba y post prueba. Los resultados de esta investigación muestran que la estrategia ABP en el desarrollo de competencias mejora el logro de aprendizaje en los estudiantes. Por lo que La  $Z$  calculada = 13,51 y la  $Z$  tabulada = 1,645. Se concluye que con la aplicación de la estrategia de ABP, mejora el desarrollo de las competencias y el logro de aprendizajes en los estudiantes.

**Palabras clave:** aprendizaje, aprendizaje basado en problemas, capacidades, competencias, estrategia.

## INTRODUCTION

The Learning Based in Problems constitutes a of the most important strategies for the development of competitions in the students during the process of educational training, his application determines the bases for the necessary qualitative changes in the task educative that the society require, in that sense Méndez, Bolívar & Méndez (2017) indicates that education has to implement changes that result effective in the process of education learning, in where the students sean the centre of process, there fore the educational have to be trained with new strategies such as ABP to teach how to solve problems through inquiry, fostering skills, to provide comprehensive education that generates the motivation to learn by doing.

This study justifies because, in the current joint educational one of the problems is the deficient application of methodological strategies of some educational, during the development of the sessions of learning, that allow to develop learnings of active and dynamic way, with an education that attend the problems and needs of the context (Ministerio de educación Peru, 2015). For the development of competitions requires of conditions that make possible to the students the learn doing (Delors, 1994), for the solution of a specific problem, wants to say that an education based in the exhibition of the educational, is insufficient so that the student purchases performances or performances of ideal way, thus one of the alternative to improve optimum learnings is the application of the strategy ABP.

The ABP as a strategy was carried out for the improvement in the development of collaborative work and the promotion of significant learning in students, enhancing their skills, autonomy, logical reasoning and new knowledge (Ayala & Ayala, 2018; Villalobos, Ávila & Olivares, 2016), The application of the ABP has shown improvements in the development of competencies, to face and solve various environmental problems faced by students (Fernández & Duarte, 2013; Mariño, Alderete, & Escalante, 2014).

According to the Ministerio de Educación de Perú (2015), the ABP is a highly motivating strategy, which consists in presenting students with a challenging situation; for Díaz Barriga (2006), the ABP is a practical pedagogical experience, intended for research and resolution of problems related to the real context, which should encourage active

learning from a multidisciplinary perspective. For Navarro, Illesca & Cabezas (2009), the ABP is a strategy of learning by doing, where the teacher presents a problem and the students explore in teamwork the knowledge to solve a challenge; The study of Sastoque, Ávila & Olivares (2016) complement that the ABP, in addition to teamwork, is evidenced in the motivation and commitment of the students to provide an effective, coherent and creative solution, which provides the prominence of their own learning.W

The development of the competitions in the students, makes possible to training in the investigation to access to better conditions of social welfare, economic, and development of the science and technology and improvement of the educational quality Hernández et al. (2018), the development of competitions involves also a construction of constant and deliberate way that propitiate the educational and that gives along the school stage. Whereas lace capacities are knowledge, skills and attitudes that the students use to face a challenging situation (Ministerio de educación Perú, 2016). Besides development of competitions can be generated by the ABP in the students through collaborative work, showing interpersonal skills, that are indispensables in his life (Ochoa, 2017). The development of competitions and capacities comports to the management of the knowledge, where the student assimilates, processes, transforms the information for his learning of distinct way through strategies of learning (López et al., 2018).

The application of the strategy ABP, has a high impact in the development of competitions, the attainment of learning of the students and the innovation of the role of the educational in the application of strategies to resolve a concrete problem (Calvopiña & Bassante, 2016; Gil-Galván, 2018), teaching for understanding, learn to learn that, are actions of the constructivist process, where the protagonist is the student to develop autonomy and self-regulation (Ramírez & Navarro, 2015), in such sense a good methodological strategy that applies during the pedagogical work, generates in the student an optimum learning, which allows a suitable interaction between the educational and student (Ayala & Ayala, 2018).

The investigation was aimed objective of the research was to determine the efficiency of the ABP strategy, which allows the development

of competences: investigate through scientific methods to build knowledge and explain the world based on living beings, matter and energy, biodiversity, Earth and universe in the area of Science Technology and Environment onwards (CTA), for the achievement of learning in fourth grade students of the “Glorioso San Carlos” Puno Secondary Educational Institution, during the 2016 academic year. Likewise, the organization of the research content is as follows: First part corresponds to the introduction of the research, then the bibliographic review related to the subject of study is disclosed; the third part corresponds to research methodology, in the fourth place, the results and discussion of the research are shown, where aspects of ABP strategies and the development of competencies in high school students are approached, finally the study conclusions are presented.

**Theoretical frame or bibliographic review / literature**

**Learning Based in Problem.**

The origin of the ABP strategy begins at the end of the 19th century in the United States, with Professor Kilpatrick (1918) in his book *The Project Method* as an alternative to the traditional methodology applied at that time; strategy that was redesigned based on the traditional ABP proposal in the modern era, originated in Canada, the Netherlands and the United States (Villegas, 2017). The ABP consists in the approach of a problematic situation, where its elaboration, analysis and solution constitute the central axis of the experience and the teaching process that consists in promoting the development of the process of investigation and resolution of the problem (Díaz-Barriga, 2006). The ABP is a methodological learning strategy in which the student is the protagonist of their own learning, interacting in teams under the guidance of the teacher (Vogt, 2007), the application of this strategy enhances the development of skills, in students, achieving high levels of skills compared to the application of traditional methods (Villalobos et al., 2016).

The Ministerio de educación Perú (2015:8) it affirms:

The ABP is a strategy that splits a problem to generate determinate learnings in the students, by means of processes of investigation and analysis.

With this methodology, the student assumes a leading role as he same is the one who identifies what needs to learn to solve the problem posed by the professor. (p.8)

On the other hand Díaz-Barriga (2006) indicates that the ABP like strategy of education requires of the preparation and presentation of real or mock situations that are linked with the construction of the knowledge to resolve problems and integrate interactive learnings in the students. In this sense since the constructivist approach Varela (2016) mentions that the ABP is a new strategy in the process educational, where the main leading is the student. The strategy ABP incorporates to the paradigm of innovation of interactive way, promoting the thought systemic, to resolve complex problems, by means of the horizontal communication and productive open dialogue integrating the tacit knowledge to the dynamic process of learning of the students (Villegas, 2017).

The problematic situation has to demand to the students to interpret of individual way and in team to visualize the problem from diverse perspectives and activate his critical and creative thought and develop skills, knowledge, attitudes Ministerio de educación Perú (2015); therefore during the application of the strategy ABP exists roles for the educational and student, that to continuation details:

Role of education	Role of student
- It formulates problems and stimulating for the students.	- It decides the contents concerning which goes to deepen.
- It stimulates to organize the work, help and resolve his differences.	- It chooses which texts of which has proposed the professor requires to read
- It motivates to propose hypothesis, select information and plan steps to resolve the problem.	- It investigates useful information to resolve the problem.
- It promotes the taking of decisions and preparation of trials with base in the investigated.	- It processes the information and shares it in group.
	- It formulates ideas on solutions and argues with his mates to take decisions.

Source: *Minedu Perú*

**Competition and capacity**

In the education report it contains a treasure Delors (1994) states that education meets four essential pillars: knowing how to know, knowing



how to do, knowing how to live and knowing how to be, considered indispensable competences that students must develop through the educational process. The Ministerio de educación Perú (2016) defines competence as the faculty that an individual has to combine a set of skills and achieve specific purposes in a given situation, acting with relevance and with an ethical sense. The development of student competences is a constant, deliberate and conscious construction, fostered by teachers in educational institutions, development that occurs throughout life (Robles, 2013).

The skills are resources to act competently, these resources are the knowledge, attitudes, skills that students use to face a challenging situation (Ministerio de educación Perú, 2016).

### **Competition: Inquire by means of scientific methods to build knowledge**

This competition in the area of Science, technology and environment (in ahead CTA) is based on the fact that the student is able to build their knowledge about the functioning and structure of the natural and artificial world that surrounds it, through science procedures, reflecting on what they know and how they have come to know. putting into play attitudes such as curiosity, amazement, uncertainty (Ministerio de educación Perú, 2016).

The execution of this student's competence implies the combination of abilities: Problematizes situations, Design strategies to make inquiries, Generates and records data or information, Analyzes data and information, Evaluates and communicates the process and results of its inquiry.

### **Competition: Explains in the physical world basing in knowledge on the living beings, matter and energy, biodiversity, Tierra and universe.**

It is another competence of the CTA area, where the student is able to understand scientific knowledge related to natural phenomena, their causes and relationships with other phenomena, building representations of the natural and artificial world. Representation of the world that allows you to evaluate situations where the application of science and technology are in debate, to build arguments that lead you to interact, reflect and make decisions, improving your quality of life, conserving the environment (Ministerio de educación Perú, 2016). This competence implies

the combination of capabilities: Understands and uses knowledge about living beings, matter and energy, biodiversity, Earth and universe; Evaluate the implications of knowledge and scientific and technological work.

## **METHODOLOGY**

The investigation corresponds to the quantitative approach, of experimental type, with design quasi experimental with pre and post proof, according to Hernández, Fernández, & Baptista (2014) mention that it characterizes by the deliberate manipulation of the variable independent to observe his effect on the dependent variable with the end to generate determinate changes in to dependent variable.

The study population consisted of a total of 177 male students of the "Glorioso San Carlos" Secondary Educational Institution of the city of Puno, and from these a non-probabilistic sample was made up of 56 students between 15 and 16 years of age. Fourth grade: 30 students (experimental group) and 26 students (control group), for which a pre test and post test was applied. The results of this research show that the ABP strategy in the development of competences: investigates through scientific methods to build knowledge and explains the world based on living beings, matter and energy, biodiversity, Earth and universe, improve student learning achievement. So the calculated  $Z = 13.51$  and the tabulated  $Z = 1.645$ .

The independent variable of the research was the application of the ABP strategy, during the development of the learning sessions, according to the teacher's role and the student's role, which consists of: formulation of challenging questions, stimulation to organize teamwork, motivation to propose hypotheses, promote decision-making, formulate critical conclusions and judgments based on what has been investigated, applied with 10 sessions, which have been developed in an appropriate manner. The dependent variable was the development of skills: investigate through scientific methods to build knowledge and explain the world based on living beings, matter and energy, biodiversity, Earth and universe of the CTA area for the achievement of learning.

The information collection techniques that were used were observation and examination, the data collection instruments were the observation sheet



and rubrics that have been used to collect evidence of student performance in the activities developed during the experimental treatment. to achieve the development of the two CTA area competences, mentioned above, and the written test, which was applied was to measure the level of knowledge that the student achieved in the teaching-learning process. These instruments were validated through expert judgment, demonstrating validity. The statistical analysis applied was in the difference of means with calculated Z distribution ( $x^2$ ), with a confidence level of 95% and a significance level of 5%.

With the application of the ABP strategy, the development of competencies was identified: investigate through scientific methods to build knowledge and explain the world based on living beings, matter and energy, biodiversity, Earth and universe of the CTA area and therefore the achievement of High school student learning. The data were tabulated, analyzed and interpreted according to the measures of central tendency and dispersion, finally the manipulation of the independent variable (cause) on the dependent variable (effect) was tested, where the arithmetic mean of the experimental group notes is greater than the arithmetic average of the notes of the control group, obtained in the exit test, through the

calculated Z. Table 1 describes the samples used in the investigation.

**Table 1.**

*Distribution of sample of students of the 4° degree of the Secondary Educational Institution "Glorioso San Carlos" - Puno, 2016.*

grade and section	Sample of students	Group
4° D	30	Experimental
4° F	26	Control
Total	56	

## RESULTS AND DISCUSSION.

For the organisation of the results obtained, used the following scale:

Qualitative scale	Quantitative scale
Start	[0-10>
Process	[11-13>
Planned attainment	[14-17>
Attainment stood out	[18-20]

It applied a proof of entrance to the students of the fourth degree of secondary education, to 1 experimental group with 30 students and group control with 26 students, before the application of the strategy ABP.

**Table 2.**

*Proof of entrance applied to the students of the 4° degree of the group control and experimental of the to Secondary Educational Institution "Glorioso San Carlos- Puno, 2016.*

Nivel Of attainment of learning	Notes	Pre Pro of			
		Experimental group		Group control	
		Fi	%	Fi	%
Start	[0-10>	27	90%	15	62%
Process	[11-13>	3	10%	11	38%
Planned attainment	[14-17>	0	0%	0	0%
Attainment stood out	[18-20]	0	0%	0	0%
Total		30	100%	26	100%

In the table 2 observes that, in the experimental group obtained notes between 0 to 10 points 27 students (90%) locating in the level of start and of 11 to 13 points obtained 03 students (10%), situating in the level of process, while that the group control obtained notes between 00 to 10 points 15 students (62%) of the total, situating in the level of start and of 11 to 13 points, obtained 11 students, (38%) show the level of process in the pre proof.

The results show that, before the experimental treatment with the strategy ABP 76% of students of 1 group control and experiences have obtained the level of start, in the pre test, wants to say that no evidence the attainment of learning in the mentioned students. Results that resemble the studies carried out by Pantoja & Covarrubias (2013) where conclude that it does not exist significant differences between the experimental group and group control regarding performance before the

application of the ABP. Another study Villalobos et al (2016) arrives to results where indicate that in the application of the pre test in the diagnostic of the level of competitions of critical thought,

the value obtained was of 0.3537 finding very underneath of the value of reference in the tables, indicating that there is not significant difference between the groups control and experimental.

**Table 3.**

*Results of measures of central tendency and dispersion of the pre tests applied to the students of the 4° degree of the experimental group and control of the Secondary Educational Institution “Glorioso San Carlos- Puno, 2016.*

Estadígrafo	Pre Proof	
	Experimental group	Group control
Arithmetical average (average of notes)	$X_{and} = 8,00$	$X_c = 8,5$
Variance	$S^2 = 2,39$	$S^2 = 2,40$
Standard deviation	$S = 1,64$	$S = 1,56$
Size of the sample	$n_{And} = 30$	$n_c = 26$

The results obtained evidence that both groups found in similar conditions before applying the experimental treatment with the strategy ABP (table 3), where observes that the arithmetical average of the notes of the experimental group ( $X_{and} = 8.00$ ) and the notes of the group control ( $X_c = 8,5$ ) are similar obtained in the pre proof, on the learning and development of competitions of the area of CTA, that is to say the experimental group requires the application of the strategy of the ABP, which improve substantially the attainment of learning of the students, of the same way observe the similarities of the variance and standard deviation in both groups, resulted that they are similar to Pantoja & Covarrubias (2013) where conclude that it does not exist significant differences between the experimental group and group control regarding performance before the application of the ABP, resulted that it was of  $t_{obt} -$

0.130, minor to the level of significancia ( $\alpha=0.05$ ) that fuand of  $t\alpha -2.05$ , by what:  $t_{obt} = - 0.130 / < / t\alpha = -2.05$ .

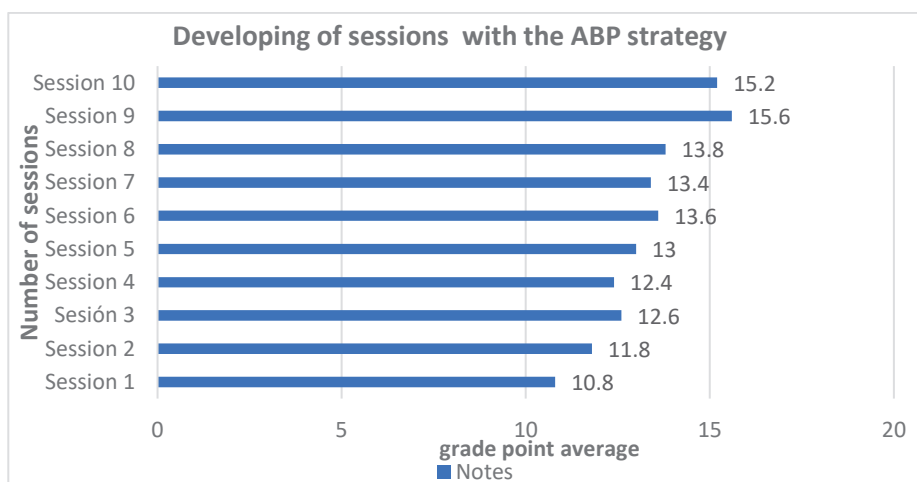
To validate the results of the table 3, sand shows the statistical treatment of the arithmetical average (average of notes) experimental group and group control of the pre tests applied.

**Experimental group  
Arithmetic average**

$$\bar{x}_e = \frac{\sum_{i=1}^n x_i}{n} = \frac{240}{30} = 8,00$$

**Control group  
Arithmetic average**

$$\bar{x}_c = \frac{\sum_{i=1}^n x_i}{n} = \frac{221}{26} = 8,5$$



**Figure 1.** Results ofl development of sessions of learning with the strategy ABP applied to the students of the 4° degree of the experimental group of the Secondary Educational Institution “Glorioso San Carlos”- Puno, 2016.

In the figure 1, show the results of the average of notes of the 10 sessions with the application of the strategy ABP, which the students have attained to develop competitions: inquire by means of scientific methods to build knowledge and explains the world basing on living beings, matter and energy, biodiversity, Tierra and universe of the area of CTA, and the attainment of the learnings, for this has observed the performance of the students through the file of observation and rubrics during the 10 sessions. And development of sessions were: 05 sessions for the competition inquire by means of scientific methods to build knowledge, in which the students with the application of the strategy ABP, developed the capacities: problematic situations, design strategies to do inquire, genera and registers data or information, analyze data and information, evaluate and communicates the process and results of his inquire, to collect the performance of the students of the 05 sessions used the file of observation and the average achieved for this competition were: (10,8; 12,6; 13; 13,4; y 15,6) as it observes the performance that show the students in the first session were of 10,8 points, sand sample that in the performance of the session

number 09 the average was of 15,6 points, that is main to the performance of the previous sessions. Indicating that the students when applying this strategy ABP the learning has improved through the performance to attain the development of competitions.

Likewise to attain the development of the competition explains the world basing on living beings, matter and energy, biodiversity, Tierra and universe, applied in 05 sessions with to strategy ABP, in this competition, students developed two capacities: first, they understand and use knowledge about living beings, matter and energy, biodiversity, Earth and universe, and second, they evaluate the implications of scientific and technological knowledge and work, to observe the students performance, he used the rubric whose results of the grades obtained were (11.8, 12.4, 13.6, 13.8 y 15.2), observing that there was improvement from the first session from 11.8 to 15.2 in session 10 of this competence, it is affirmed that the students when applying the ABP strategy in the development of competencies in the area of CTA have progressively improved.

**Table 4.**

*Proof of exit applied to the students of the 4° degree of the group control and experimental of I to Secondary Educational Institution "Glorioso San Carlos"-Puno, 2016.*

Level of attainment of learning	Notes	Post Pro of			
		Experimental group		Group control	
		Fi	%	Fi	%
Start	[0-10>	0	0%	12	46%
Process	[11-13>	3	10%	14	54%
Planned attainment	[14-17>	13	43%	0	0%
Attainment stood out	[18-20]	14	47%	0	0%
Total		30	100%	26	100%

The results show similarity with studies found by Jesús y Huamaní (2018) where they mention that ABP as a strategy shows effectiveness in a progressive way in the experimental group, improving their learning in the area of CTA, it also indicates that there is a difference between the two control groups and experimental.

Afterwards of the experiment, of a sample of 30 students evaluated (Table 4), observes that, in the experimental group 47% of students have attained to analyze notes between 18 and 20 points that corresponds to the level of attainment stood out,

a 43 % of students obtained notes between 14 to 17 points that corresponds to planned attainment, results that show, that with I to application of the strategy ABP in students of the fourth degree secondary level made possible the development of competitions: inquire by means of scientific methods to build knowledge and explains the physical world basing in knowledge on living beings, matter and energy, biodiversity, Tierra and universe of the area of CTA; and the improvement of the learnings in the mentioned students. Results that are similar to the found by Villalobos et al (2016), where conclude that there were positive

changes in the experimental group in results of the post test, reflecting a difference between averages of 1.72 of the pre to the post test, summarizing that the dimension associated with the interpretation and the analysis of the information is associated to the application of the strategy ABP, which refer to the activation and investigation, improving the development of the critical thought in Chemistry. Another study that is similar, where evidence improvements in the competitions by means of the application of the ABP, and that relate to the solution of real problems, through the socialization of students (Fernández & Duarte, 2013), Likewise using the strategy of ABP are satisfactory to the improvement of studies in students that developed an experience with said strategy of study, that comports to the active participation and work collaborative (Varela, 2016). Therefore, the competitions developed by means of the ABP consider with a high degree of impact in the attainment of learning of the students, purchasing capacities, knowledge in base to the resolution of problems (Gil-Galván, 2018).

For Silva & Ortiz (2018) the strategy ABP, generate in the new students knowledge, development of scientific competitions and skills; of the same way Sastoque et al (2016) conclude that the strategy ABP posed to the students, allowed to recognize the levels of critical thought in the sub competitions of evaluation, inference and explanation, expressing his ideas of creative form, in comparison with the traditional methodology. Likewise Busquets, Silva, & Larrosa (2016); Rock, Reguant, & Canet (2015) complement

that the strategy ABP demand a high dedication by part of the students, improving the academic performance, once that they familiarize with the procedures of this strategy, improve the self-reception for the development of his competitions. Finally, Chaparro & Barbosa (2018); Sepulveda, Cabezas, García, & Fonseca-Salamanca (2019), showed that with the application of this strategy ABP, attained of significant way the activation and development of scientific competitions, that oriented to the attainment of learning in the students, building and integrating his knowledge through work s in team.

The resulted for the group control were that 54% of students obtained notes between 11 to 13 points, situating in the level of process, without the application of the strategy ABP., resulted that it is similar to the found by Villalobos et al (2016), where indicates that the value of the average varies slightly of the pre test to the post test, concluding that there were not considerable changes regarding the dimension of the critical thought for the group control.

The data presented in the table 2 and table 4, consider that there was an improvement between the proof pre proof and post proof in the development of competitions: inquire by means of scientific methods to build knowledge and explains the physical world basing in knowledge on living beings, matter and energy, biodiversity, Tierra and universe of the area of CTA, in the students of the fourth degree of the secondary level, before and after having applied the strategy ABP.

**Table 5.**  
*Results of the measures of central tendency and dispersion of the post tests applied to the students of the 4° degree of the experimental group and control of the Secondary Educational Institution “Glorioso San Carlos- Puno, 2016.*

Estadígrafo	Post Pro of	
	Group experiencesl	Group control
Arithmetical average (average of notes)	$X_{and} = 16,27$	$X_c = 10,46$
Variance	$S^2 = 2,69$	$S^2 = 2,42$
Standard deviation	$S = 1,64$	$S = 1,56$
Size of the sample	$n_{And} = 30$	$n_c = 26$

The results presented in the Table 4 restate the said, in the table 5, where observes that the arithmetical average of 1 average of the notes obtained of the experimental group ( $X_{and} = 16,27$ ), is main that the arithmetical average of the notes of the group control ( $X_c = 10,46$ ), obtained in the proof of exit,

after the application of the ABP like strategy in the development of competitions: inquire by means of scientific methods to build knowledge and explains the physical world basing in knowledge on living beings, matter and energy, biodiversity, Tierra and universe of the area of CTA, indicating



that the experimental group has main average that the group control, wants to say that the group experimental has improved substantially in the attainment of learning, by means of the development of competitions, results that resemble with Pantoja & Covarrubias (2013) those who indicate that with the application of the proof of Kolmogorov Smirnov to the experimental group in the post proof, obtained a Pobt of 0.94, values that were above the level of significance ( $=0.05$ ) that it was of  $P \alpha 0.31$ , whereas for the group control in the post proof obtained a Pobt of 0.51, value that was by on top of the level of significance ( $\alpha=0.05$ ) whose value was of  $P 0.29$ , then if:  $Pobt \geq P\alpha$  accepts the  $H_{or}$ , that is to say between the experimental group and group control present significant differences in the notes of pre proof and post proof, where observes that the experimental group improved in his exert academic with the application of the ABP Another study that relates to our investigation, is those who affirm that the ABP applied like strategy is effective for achieve social competitions in the students like social skills, work in team, the interaction, the communication, leadership (Ochoa, 2017).

It shows the statistical treatment of the arithmetical average of the experimental group and group control of the post proof, of agreement to results showed in the table 5, applied to the students.

**Experimental group**  
**Arithmetic average**

$$\bar{x}_e = \frac{\sum_{i=1}^n x_i}{n} = \frac{488}{30} = 16,27$$

**Control group**  
**Arithmetic average**

$$\bar{x}_c = \frac{\sum_{i=1}^n x_i}{n} = \frac{272}{26} = 10,46$$

**Statistics of proof with the Z calculated.**

$$z_c = \frac{\bar{x}_e - \bar{x}_c}{\sqrt{\frac{s_e^2}{n_e} + \frac{s_c^2}{n_c}}} = \frac{16,27 - 10,46}{\sqrt{\frac{2,64}{30} + \frac{2,42}{26}}} = \frac{5,81}{0,43} = 13,51$$

The results of the pre proof and post proof so much in the experimental group and group control have been tested by means of the Z calculated ( $Z_c$ ) to test the hypothesis the arithmetical average of the notes obtained by the experimental group is main

that to the average of the notes obtained in the group control, afterwards of the application of the strategy ABP, where the result of the  $Z_c = 13,51$ , therefore the determination of the Z tabulated = 1,645.

**Determination of regions: Z tabulated = 1,645**

Regarding the rule of decision the Z tabulated = 1,645 falls in region of rejection, wants to say that it accept the hypothesis alternate to where the arithmetical average of the notes obtained by the experimental group is main that to the average of the notes obtained in the group control, afterwards of the application of the strategy ABP, where the result of the arithmetical average is = 16,27.

## CONCLUSIONS

It exists an improvement in the development of competitions: inquire by means of scientific methods to build knowledge and explains the physical world basing in knowledge on living beings, matter and energy, biodiversity, Tierra and universe of the area of Science, Technology and Environment, with the application of the strategy ABP, and determined positive effects in the attainment of the learnings, of the students of the secondary level afterwards of the treatment in the experimental group, due to the fact that it exists a significant promotion in the development of the sessions and in the proof of exit with regard to the proof of entrance.

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