




Development of scientific inquiry, from an authentic task with the petroglyph of the Wak'a of Suyo

Desarrollo de la indagación científica, desde una tarea auténtica con el petroglifo de la Wak'a de Suyo

Desenvolvimento da investigação científica, a partir de uma tarefa autêntica com o petróglifo do Wak'a de Suyo


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ORIGINAL ARTICLE

KEYWORDS

Science, competition,
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ABSTRACT. The purpose was to develop the competence investigates through scientific methods with content analysis, to build new knowledge in the area of science in three groups of teachers with the task of authenticating "possible explanations of the message of the Wa'ka de Suvo petroglyph". Using basic research teaching-learning methodology. Developing in three stages: initiation with the field visit for motivation, measurements, and interviews; development with the scientific inquiry of content analysis; completion to expose and discuss the validation of your guesses. The result of the astronomical aspect explains the analogy of the circles with binary star

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systems, the meteorological aspect explains the similarity with the cloud-earth and earth-cloud rays and with the ascending rays, of the biological aspect of conjecture reproductive cells does not reach similar findings. The development of the competence was achieved from the inquiry by content analysis motivated by the authentic task.

PALABRAS CLAVE

Ciencia, competencia, indagación científica, wak'a de Suyo.

RESUMEN. El objetivo fue desarrollar la competencia "indaga mediante métodos científicos con el análisis de contenido", para construir nuevos conocimientos en el área de ciencias en tres grupos de docentes con la tarea auténtica "posibles explicaciones del mensaje del petroglifo de la Wa'ka de Suyo". Usando metodología de enseñanza-aprendizaje por investigación de tipo básico. Se desarrolló en tres etapas: iniciación con la visita de campo para la motivación, mediciones y entrevistas; desarrollo con la indagación científica de análisis de contenido; finalización para exponer y discutir la validación de sus conjeturas. El resultado del aspecto astronómico explicó la analogía de los círculos con sistemas estelares binarios, del aspecto meteorológico explicó la similitud con los rayos nube-tierra y tierra-nube y con los rayos ascendentes, del aspecto biológico de conjetura células reproductivas no alcanza hallazgos similares. Se logró el desarrollo de la competencia desde la indagación por análisis de contenido motivados por la tarea auténtica.

PALAVRAS-CHAVE

Ciência, competição, investigação científica, wak'a de Suyo

RESUMO. O objetivo foi desenvolver a competência "inquirir através de métodos científicos com análise de conteúdo", para construir novos conhecimentos na área das ciências em três turmas de professores com a tarefa autêntica "possíveis explicações da mensagem da petróglifo dos Wa ' ka de Suyo". Utilizando metodologia de ensino-aprendizagem de pesquisa básica. Foi desenvolvido em três etapas: iniciação com a visita de campo para motivação, medições e entrevistas; desenvolvimento com a investigação científica da análise de conteúdo; conclusão para expor e discutir a validação de seus palpites. O resultado do aspecto astronômico explicava a analogia dos círculos com sistemas estelares binários, o aspecto meteorológico explicava a semelhança com os raios nuvem-terra e nuvem-terra e com os raios ascendentes, o aspecto biológico das conjeturas de células reprodutivas não atinge similar descobertas. O desenvolvimento da competência foi alcançado a partir da investigação por análise de conteúdo motivada pela tarefa autêntica.

1. INTRODUCTION

The National Curriculum of Basic Education of the Ministry of Education of Peru (CNEB, 2017, pp. 120-123) mentions that competence 20 must be developed "inquire through scientific methods to build their knowledge. In association with authentic tasks as a way to build and use knowledge in a real and situated context (Pedreira & Marquez, 2016), which involves the participant in their resolution and activities from their interest and need (Pedreira & Cantons, 2017; Jalo & Perez, 2016). His own evaluation implies active participation because they are significant, experiential activities (Monereo, 2003; Ramirez & Artunduaga, 2018), which, aligned with the guidelines for the development of competencies (CNEB, 2017), acquire a weight due to their analogy with a project-based learning which requires the mobilization of capacities to obtain an evidence or product (Botella & Ramos, 2019).

For which, a historical archaeological resource is available, the petroglyphs of the Wak'a de Suyo in one of which are four figures carved in the stone whose representation and message still do not have a clear explanation, the symbols carved in the Rock are figures of rays and circles in high and low relief, these can have significant representations from the religious, cultural, artistic, functional or enigmatic since this monolith and Andean deity has pre-Inca origin (Caballero-Jiron, 1987).



The research topic is the development of scientific inquiry competence to produce knowledge that can explain the symbols of Suyo's Wak'a, being able to be argued from the cultural, religious, astronomical, meteorological and other aspects, by scientific procedures and attitudes curiosity and interest (CNEB, 2017).

The development of competencies by students requires that the teacher himself be able to develop them in order to understand the process and exemplify (Hernandez-Suarez, Pablo-Galan, & Prada-Nuñez, 2017), that is why it is proposed to investigate nature, representation, symbolism and the possible message that the symbols of low and high relief of the Wak'a de Suyo petroglyph had that the ancient inhabitants of the region were able to express with said monolithic stele, we need to generate valid and argued knowledge from the scientific investigation of the possible messages, understandings of the symbols in the petroglyph since they may have knowledge associated with natural, religious and cultural phenomena that should not be lost, seeking explanations to the enigma of the symbols.

Inquiry as a potential benefit for learning is reported by Romero-Ariza (2017), this methodology promotes competences from the exploration and argued discussion of results. García and Ladino (2008) point out that seeking learning by inquiry places teachers and students in the role of scientists who develop scientific competencies from experimentation and collaborative work.

The study from archaeological-historical remains is always interesting because of the enigmatic touch when facing them, Gracia-Ruiz (2020) mentions that in the construction of the pyramids the high degree of relationship with the constellations and the proof of climate change even though there are mysteries for to find out. The investigation with historical remains has pedagogical importance due to the component of identity and local interest. Urbano (2010) indicates in his study on geometry in sculptures that it is important to identify the degree of scientific development of ancient cultures with mathematics and science, and that these are structured to propose learning experiences.

Studies on prehistory and its remains (Ramos-Gil, 2017), seek explanations about the evolution of mathematical thinking of prehistoric groups since time has been aware of the quantity and symbols concluding that this is prior to written language and the real power of evolution.

On the development of learning from physical phenomena such as lightning and electric discharges, Porras and Reyes (2019) indicate that using the method of learning based on phenomena highlights the authentic collaborative and experimental inquiry work, generating significant learning and reflective contributions of the phenomenon. There is no better way to achieve scientific skills than developing with successes and mistakes, meteorological phenomena are excellent resources (De Álvaro, 2017). The explanation of phenomena such as drought and natural phenomena in geography are approached from school learning experiences, acquiring contextualization (Morote, 2021; Olcina, 2017; Martínez & Olcina, 2019).

The scientific investigation of petroglyphs and their relationship with astrology is enough, we have the report by Carreño-Collatupa (2018) in his study of petroglyphs in Raqch'i, a place a few kilometers from the Wak'a de Suyo, which indicates that the petroglyphs are reused for ceremonies of payment to the Pachamama land. The finding of Tantalena (2013) with the petroglyphs of the Mala valley and their materialistic interpretations as social products of productive utility. Corrado's study (2018) that exposes the archaeo-astronomical location of the Inca



site "El Shingal de Qumivil" as a waka with similarities in position to Inca monuments in Cusco. The report by Falcón (2013) in the petroglyphs of Vigirima (Venezuela) with archaeo-astronomical techniques shows the representation of the total solar eclipse of 577 BC. and socio-cultural configurations.

A study referring to the relationship between pre-Columbian art with fertility and astronomy reported by Ianiuszewski-Rojas (2016) mentions that the remains found suppose tribal cohesion by religious and fertility rites in observation of the sun and the moon, and others conceived as divinities from the dualistic conception. In the same approach, Fernández (2007) relates prehistoric rock art with fertility and rain, as well as the relationships of agricultural fertility, the monkey and other symbols in ancient cultures such as the Nahuas in Mexico (Echeverría, 2015). From mythological studies such as that of Lorente (2017), the thunder myths that are disseminated in different ethnographies related to different natural phenomena, relating them to deities and their incidence in ecological environments, still remaining enigmas to study.

There are investigations on didactic and learning proposals with astronomy, Galindo (2014) proposes the use of the Stellarium software in a project to identify and position the stars. The development of scientific competences in teachers from everyday astronomical phenomena as reported by Galperin, Alvarez and Prieto (2019) have difficulty understanding since the information is not from a topocentric reference system, thus improving the link with the celestial environment. Indigenous knowledge about the constellations in Faulhaber's (2012) finding indicates that knowledge of the sky in its depth from its mythology ensures the survival of the Tikuma Indian tribe. And even the proposal of undertakings to revalue archaeological sites from the recognition of astronomical elements and their importance (Minchong & Zuñiga, 2018).

The problem is formulated with the questions: What do the symbols in Suyo's Wak'a represent? What is the message of the symbology in Suyo's Wak'a? Does it have representation, astronomical, religious, cultural, biological or mixed? How can we make conjectures about the meaning of symbology? Can scientific inquiry skills be developed to explain the message of the symbols? Since it was a pre-Inca monolith, it must have had a meaning for the indigenous people of that time and that in light of current knowledge, possible arguments that explain the nature of the symbols can be hypothesized from different contexts (religious, astronomical, biological, and cultural, etc.).

It is important to have such knowledge as a cultural identity and an intentional construct, which will be possible by mobilizing the capacities to: problematize situations to make inquiries, design strategies, generate and record data, analyze information, evaluate and communicate the result of the inquiry (Espinoza & Calva, 2020).

The objective of the study was to develop the competence investigated through scientific methods with content analysis, to build new knowledge in science with possible argued explanations about the message and meaning of the representation of symbols in Suyo's Wak'a, making use of the capacities and competence of scientific inquiry, carried out by three groups of mathematics and science teachers.

2. METHOD AND MATERIALS

Before pointing out the methodology and materials, it is appropriate to describe the context of the research, due to the health emergency of COVID-19, no more physical experimentation in the field or laboratory or personal



or group interviews can be done other than the essential ones, and this must be ingeniously conducted research to face the current pandemic crisis (Hernandez, 2020).

Likewise, the role played by teachers in their eagerness to solve the problematic situation was to emulate the performance of scientists, aware of their limitations and with the expectation of results according to their performance as teachers in the areas of science and technology, as well as mathematics (Garcia & Ladino, 2008), guaranteeing the use of all available resources and maximizing scientific bibliographic inquiry (Gomez-Luna & Fernando-Navas, 2014) regarding the problem.

The inquiry in the school and its bibliographic research strategy is very old (Cañal de Leon, 1999), maintaining common characteristics until the most recent studies such as the one reported by Romero-Ariza (2017) and, in the case of science, Suarez-Machin and Garrido-Carralero (2016).

A qualitative approach was applied for the study, because in the methodological process we use information, speeches, images, and other qualitative data (Guerrero, 2016), which are necessary to investigate and present the results.

The methodology used was that of teaching and learning by research (Torres, Ladino, & Zapata, 2003; Garcia & Ladino, 2008; Canayo, 2019), which has three stages: the beginning where the on-site visit was carried out, for the Purposeful thinking, involvement and motivation. Another of its own development of the inquiry and approach to the state of the art and the problem solution from the hypothetical formulation, information record and proposal of solution arguments (Rojas & Sanabria, 2017). Finally, the closing or termination where the socialization, presentation of results, argumentation of conclusions took place and a fundamental aspect that of proposing application to new situations and posing new problematic situations that generate further investigation (Rivadeneira & Silva, 2017).

The research corresponded to a basic type, because it generates new theoretical knowledge without contrast with the experimental from a theoretical framework (Muntane-Relat, 2010), this aspect is crucial since the arguments of the results could not be verified experimentally.

The design was non-experimental, because variables were not manipulated (Guerrero, 2016), in the present study we do not experiment with variables, but rather it is a bibliographic inquiry, like Yaranga (2015) with the inquiry for the area of science and technology.

The Wak'a de Suyo stela or petroglyph (Caballero-Jiron, 1987) is found in the community of Suyo, Sicuani district, one of the monoliths with symbolic engravings as shown in figure 1. It has two lightning-like shapes (large and small) facing opposite sides and two circles almost of similar size. The techniques were: the unstructured interview and its note book instrument; unstructured direct observation and field diary instrument; the documentary and content analysis and file instruments, registration tables, information classifiers (Hernandez, Placencia, Indacochea, & Quimis, 2018; Escudero & Cortez, 2017).

The unstructured focused interview (Díaz, 2011) used was validated by expert judgment and was carried out according to the guidelines of Martinez (1998) and Diza-Bravo et al. (2013).



The procedure for the execution of the investigation and development of the competence investigates through scientific methods, was to form 03 groups with two teachers each, both in the area of science and technology as well as mathematics for each group. The beginning stage was carried out with the on-site visit to the Suyo wak'a for observation and measurements, as well as the execution of the interview. In this stage, the authentic task and the involvement of the research teachers are shown; then the development with the bibliographic research of the documentary and content analysis in which each group virtually shares and analyzes information to solve the problematization; finally, the closing stage where the three groups shared and discussed their results with bibliographic scientific arguments.

3. RESULTS AND DISCUSSION

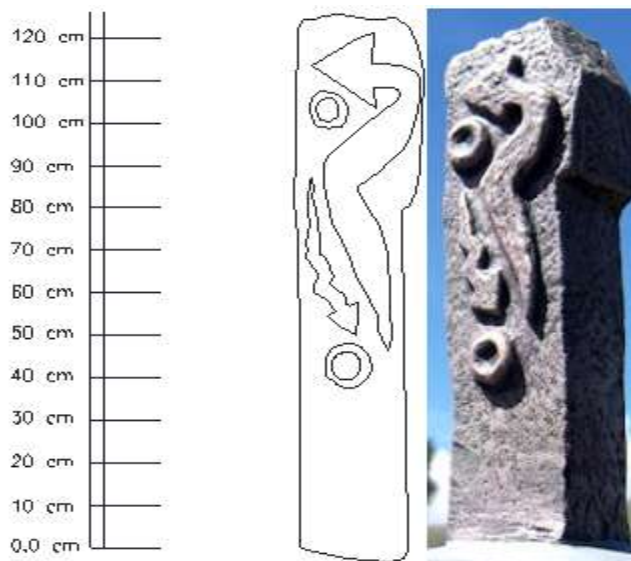
The research findings are not scientifically rigorous, unless they can be corroborated from experimentation. However, each group gave a proposal to explain the conjectures made, within the scope of the inquiry with the content analysis and the review of the specialized literature (Romero-Ariza, 2017).

According to the customs of the area, before the visit in the field, the payment was made to the land requesting permission from the Apus tutelares (Andean religious divinity) was made by an Andean priest (Pacco), this because the monolith represents a deity respected in this study (Chara, 2017), this ritual is also suggested by the studies of Arana (2018). It is also necessary to mention the difficulties due to social isolation due to COVID-19, which did not allow direct socialization and discussion, as well as the problem of poor management of bibliographic managers for the organization of information in research as mentioned (Gallegos, Peralta & Guerrero, 2017).

The monolith measures 123 cm. high, 34 cm. wide and 26 cm. in depth, approximately, it has shapes of low and high relief, two similar circles on the heads of the arrows or thunders, one larger and one smaller in opposite directions looking up and down, according to figures 1 and 2.

Figure 1

Petroglyph "Wak'a de Suyo" and its referential measurements.

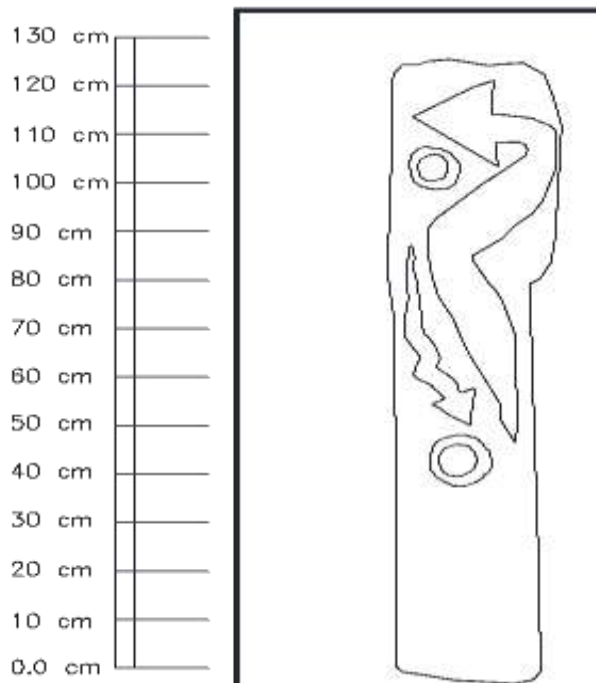


Note. Own elaboration, measurements and drawing are approximate in centimeters.

Each group of teachers was able to make their own measurements, annotations that they considered necessary from their previous knowledge to gather information, the interview was carried out with residents at three opposite points equidistant from the monolith, prior organization (Moreira, 2017).

Figure 2

Measurements and observation of the "Wak'a de Suyo" petroglyph.



Note: own elaboration, photograph taken during the field visit (12 September 2020).

The systematization of the interview is shown in table 1.

Table 1

Possible meanings of Suyo's Wak'a symbols.

Appearance	Meaning and Message
Astronomical	The circles represent the stars of the universe, the sun, the moon and the earth, the thunder arrows the location of the stars or the direction of the stars towards the earth.
Meteorological	The directed arrows represent the natural phenomenon of lightning associated with thunder and lightning and the circles of raindrops from heaven to earth, which together represent a scene of a rainy storm.
Biological	The symbols refer to fertility, the ray to the male and the circle to the female, linked to the generation of human life and productivity in the fields and animals.
Religious	The four symbols together represent the nature of the community, which is why it represents a local deity that is remembered in the Andean New Year.

Note: systematization of the interview carried out by the researchers.

Each group took one aspect as a line for scientific inquiry, trying to comply with the pedagogical guidelines for the development of competences (CNEB, 2017), the participating teachers considered that the situation is significant, challenging that requires mobilization of capacities (Lopez, Alzate, Echeverri, & Dominguez, 2020),

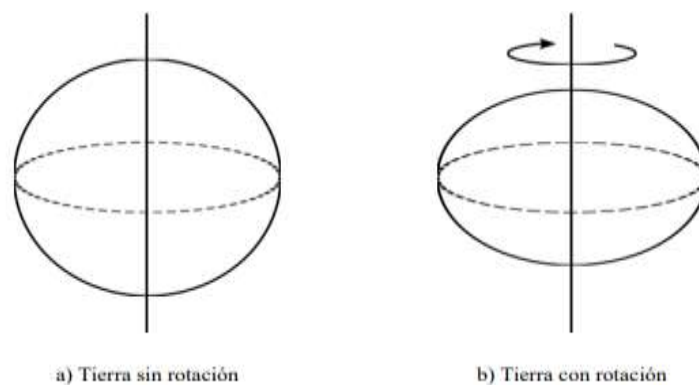


the interest and attitude to undertake learning was noticeable and expectant, ensuring willingness to research and learning (Chrobak, 2017), said motivation is due to the use of an enigmatic local resource of deep identity cultural and historical, which is ideal for a situated and anchored activity (Mattar, 2018; Guadagna, Herrero, Yozzi, & Mastrocola, 2018).

In the astronomical aspect, it was started from the conjecture that the circles represent the celestial stars of the sun, earth, moon or other planets, having uniform circles would not be concordant to the flattened shape at the poles by rotational movement (Pineda-Lozano, 2020) as shown in figure 2, in addition to the almost similar diameters as shown in figure 3, they would not have a size / volume relationship with the aforementioned stars (Lopez-Gomez, 2016), since the relationships would be close to sun / earth / moon: 430/4/1 as reported by Kartutunen et al. (2017).

Figure 3

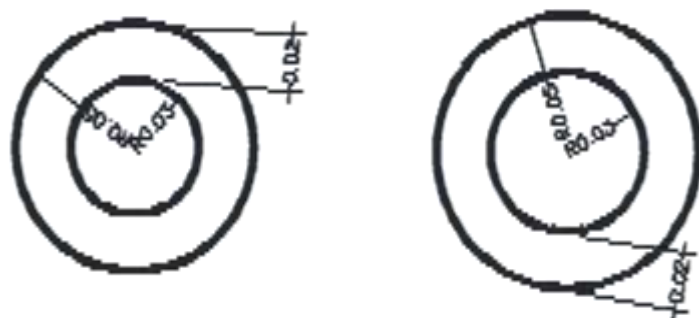
Shape of a planet with rotational motion



Note: obtained from Pineda-Lozano (2020).

Figure 4.

Sizes of the circles of Suyo's Wak'a.



Note: own elaboration based on approximate measurements

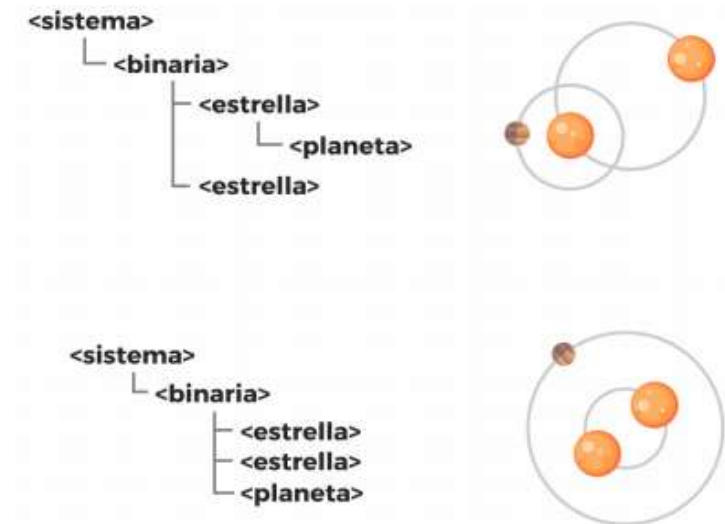
According to Figure 4, the upper circle is on the left and the lower one on the right, both circles almost similar (0.05 m. Approximate diameter) do not represent different celestial stars from the modern understanding as Ricra (2019) indicates that the sizes of the bodies Celestial are differentiated by the amount of mass they possess due to their initial formation from concentration accumulations of gaseous particles that solidify.

The ancient men, inhabitants of Suyo, could represent the stars from their original idea of thought, as mentioned by Ramos-Gil (2017), many prehistoric remains have only circles and stars to represent the celestial stars, including lines with a circle for comets. (Escacena-Carrasco, 2018).

With their similarity in size, they can be binary stars, an important finding is that the similarity of the circles shows similarity with the theory of binary planetary formation according to their circumstellar or circumbinary orbit as reported by Pablo-Cerioni (2020), that the stars can have configuration binary in its formation and position in the universe, we can see it in figure 5.

Figure 5

Scheme of two binary systems type S and P



Note: Type S is at the top and P is at the bottom. Source: Pablo-Cerioni (2020).

Being able to explain that the circles of Suyo's Wak'a represent two binary stars or stellar components (similar, parallel) in the S-type, the earth is within one of the two-star systems, since these planets orbit only one component stellar. Otherwise, the earth does not orbit any star, but it orbits the binary stellar system corresponding to a type P (Pablo-Cerioni, 2020). In the binary system S, the symbols of the arrows or rays of the petroglyph acquire meaning, the smaller ray would indicate the vector of the minimum stellar orbit and the larger the vector of the orbit to the farthest opposite star system. It should be taken into account that the oral account of knowledge lacks stability that must be the support of science, therefore it is limiting to seek primitive contributions of science as indicated by Rivel and Herrera (2017) in their study on the contribution of astronomy and mathematics in prehistory, mention that ancient men saw in the infinite sky useful elements for their survival and that this knowledge still remains closed to current eyes, therefore any conjecture is valid and validates their study, it is possible that the circles of the Celestial bodies in the Wak'a represent important roles that we cannot yet decipher and that the Andean worldview still has as secrets, as suggested by Chara (2017).

A key element is the cleft of the circles that shelter a circular region, it could have been intentionally carved, leaving future investigations to study, for example, if these circles were to come together, they would form a spherical body similar to a celestial star.

In the astronomical aspect of the message of the petroglyph symbols will remain an enigma, studies must be constant to clarify this conjecture in order to clarify this aspect. For the moment, the explanations that are presented from binary parallel star systems are important to support an astronomical approach to the symbols of Suyo's Wak'a.

The second group that worked from the meteorological aspect, starts from the conjecture that the symbols represent rays and the circles raindrops. Soriano (2020), Porras and Reyes (2019) mention that lightning is electric discharge that occurs between clouds in the sky or between clouds and the earth, lightning is the light sparks that occur when electric charges are directed towards the sky from cloud to cloud or from cloud to earth, after a few seconds after the lightning occurred, the loud noise that expands in the air is thunder, then the symbols of the Wak'a would correspond to the lightning.

The lightning bolts in the petroglyph can very well be supported from the theory of the type of lightning as electric discharges according to its direction, according to table 2, the symbols of the Wak'a represent the lightning "goblins" that start in the clouds strata, cumulus and cumulus strata and go to the upper atmosphere of the altocumulus and alto-stratus including the cirrocumulus (Soriano, 2020); for minor lightning that occurs in stratus and cumulonimbus clouds toward the earth's surface.

Table 2

Types of rays according to their origin and direction.

Type	Origin, direction and characteristics
Cloud to sky "goblins"	Discharge into the atmosphere, much higher than the clouds.
Cloud to ground	Discharge from the cloud to the ground, are the typical spectacular rays, the ones that cause the most damage to the ground
Intra clouds	Discharge within the cloud itself appear with lightning and thunder
Interclouds	Discharge from one cloud to another with great thunder.

Note: prepared based on Soriano (2020).

The symbols can represent the descending and ascending rays respectively (Arcioni & Gimenez, 2019), basically according to the movement of electrons and the electric charge of the cloud and the earth in certain conditions, also referred to by the Andean worldview on the energy of the earth. Suggested by Ponce (2017), as in figure 6.

According to figure 6, the minor ray of the Wak'a corresponds to the negative and positive cloud-earth ray and the symbol of the major ray would be positive and negative earth-cloud rays, this knowledge is widely known and disseminated (De Alvaro, 2017; Kartutunen et al., 2017).

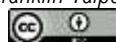
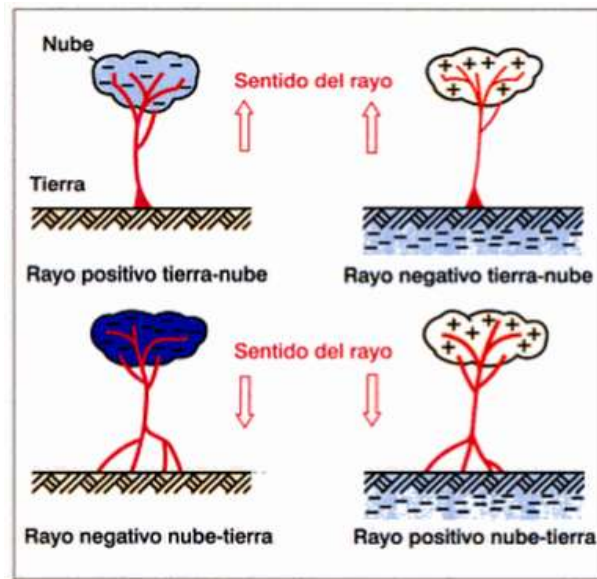


Figure 6

Rays to and from the earth.

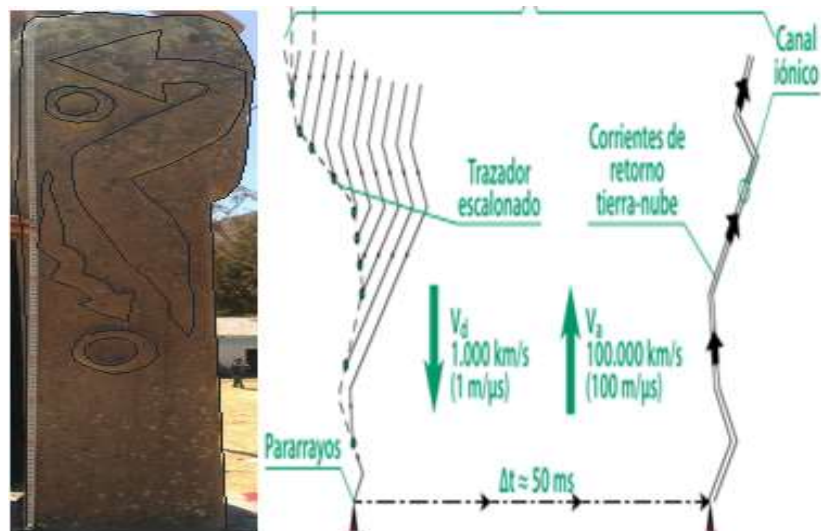


Note. Illustration of the directionality of the rays [illustration], by Ecometa Association, 2021, Curious World (<http://www.eltiempodelosaficionados.com/MundoCuriosoRayosCaenySuben.html>)

With reference to the size of the symbols, an important finding is the relationship between a cloud-ground initiating (tracer) ray and its corresponding ground-cloud ascendant (return). Arcioni and Gimenez (2019) mention that the speed is much higher and therefore powerful of the ascending ray, which is related to the carving made by Suyo's men, we can see it in figure 7, it must also be understood that the cloud ray -earth, traces a guide path for the earth-cloud ray, signifying a close relationship like the one represented in the petroglyph.

Figure 7

Symbol size and lightning power ratio.

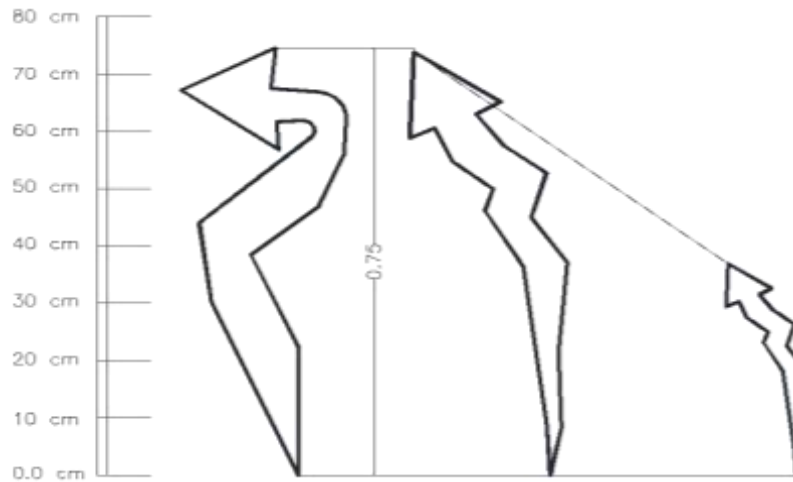


Note: Taken from Arcioni and Gimenez (2019).

For the intentional carving of the figures, they had to know physical phenomena that we can only determine with precision today using modern technology; it is impressive that if we superimpose the image of the smaller ray on the larger one, the ratio is slightly higher than double as can be seen in the figure. 8.

Figure 8

Major and minor ray symbol size ratio.

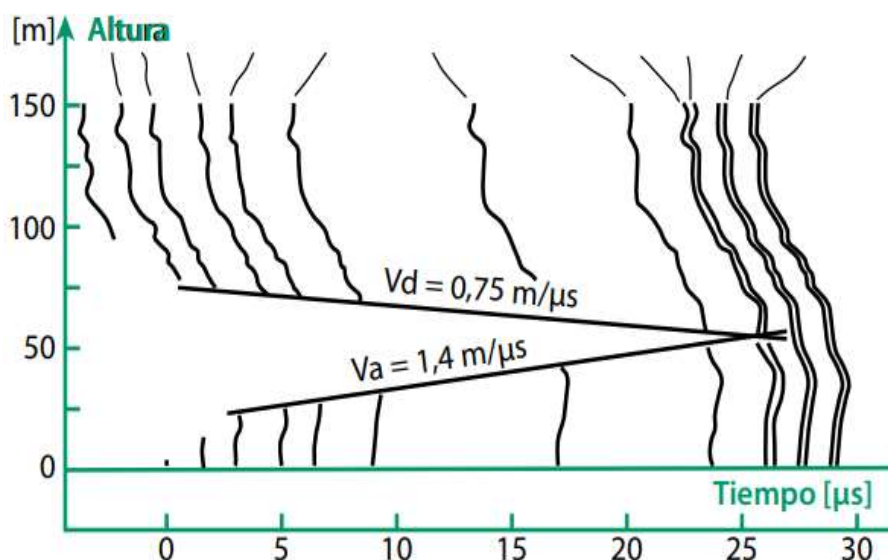


Note: own elaboration based on measurements

Having a similarity with the speed of action and reaction of lightning as a phenomenon, from an experimental fact reported by Arcioni and Gimenez (2019), that reports on the impact of a lightning strike registered in Japan with the ALPS system of the CRIEP (1990), where the speeds have the relation of the carving in the petroglyph, the speed of the ascending ray is $V_a = 1.4 \text{ m} / \mu\text{s}$ and the descending one is $V_d = 0.75 \text{ m} / \mu\text{s}$, which is almost double, as can be seen in the figure 9.

Figure 9

Cloud-ground initiator lightning strike and ground-cloud ascent lightning strike velocities.



Note: Taken from Arcioni and Gimenez (2019)

Another finding is the one referred to the rays of pure ascent that are like immense electric jets directed towards the ionosphere from the earth or from low clouds, these ascending rays are difficult to observe, they only originate in storms and due to their nature of traveling towards the exterior of the atmosphere towards less dense layers its expansion is much greater producing spectacular light spectra, as reported by Lui et al. (2015), these rays could be seen by the inhabitants of Suyo who carved the stone.

According to the Andean worldview and the content of the interviews, the meaning that the locals have about the nature of the rays is that when they descend from the sky they collide with the earth and an impact of two energies is produced and the earth returns the ray of the sky with a lightning bolt towards the sky, in his words "the lightning rises from the earth", this notion is related to the studies of Quijano (2020) and Ponce (2017).

Regarding the conjecture that the circles represent drops of water, it has a similarity with (Escacena-Carrasco, 2018), which reports raindrops in the Los Aulagares petroglyph in Andalusia Spain, it can be seen in figure 10.

As can be seen in figure 10, the symbology for raindrops would have a favorable argument as it is next to the lightning that originates in storms that cause rain, as is also corroborated by the study by Fernández (2007) when he indicates that some symbols Ethnographic data are associated with agricultural fertility as survival (Tejera & Jimenes, 1991; David & Kramer, 2001).

The absence of experimentation is limiting, due to technical and material considerations that are not available.

Further studies are interesting from the content analysis with respect to the temporal periodicity, especially with the ascending rays, and its relationship with the season of excessive rains or droughts, these could be related to world events experienced in prehistory (Lorente, 2017).

Figure 10.

Raindrop symbols in Suyo's Wak'a and Los Aulagares petroglyph.



Note: on the left raindrops from Los Aulagares, on the right raindrops from Suyo's Wak'a.

Regarding the findings of the second group, there are important collaborations for the scientific and explanatory construct of the symbology in the Wak'a, the verification that they are rays in both directions and that they correspond to their experimental speeds and represented sizes is of interest.

The third group that started from the conjecture that the symbols represent the male and female union for fertility, as a biological aspect, archaeological and ethnographic studies report many stone carvings and other materials regarding this detail of symbolism from prehistory in human groups very old, the observation of copulation and mating in animals and in their own species are subjects of rock and graphic representation (Gellon, 2019). Del Valle (2020) mentions that it is difficult to find prehistoric symbology related to the reproductive cells themselves, but abundant material such as sculptures and others from sexual figures in mating and copulation, which Jaruf (2017) emphasizes.

The symbols of the Wak'a are also known as Quilcas, which are iconographic figures in other geographical places whose messages contain important information about how those men thought (Gomez, 2018).

The lightning bolt symbol compared to a male sperm and the circles as female ovules is difficult to relate them from the knowledge of modern cellular microbiology from the size of both cells that would not have correspondence, to such specific biological elements (Garcia-Llompart, 2020).

The thought of the man from Suyu at the time that he carved the stone, could not have had scientific knowledge about reproductive cells in detail, but if he was right that life was generated from the union of male and female components, this explanatory contribution it is supported by the ideas of Velasco and Biber (2020) in their study on the ideas of the ovum and sperm based on stereotypes of the masculine and feminine that could represent the components of reproduction and fertility.

The absences on the analysis of the content for this aspect could be because there really are no elements to argue the initial conjecture, because there is no access and research techniques from the management of scientific databases and less in other languages or simply because not there is any relationship.

It is suggestive that the symbols of the petroglyph can be analyzed with those of other human groups in the world and similarities can be found. The importance of facing scientific inquiry is vital because it not only empowers the argument to discuss an idea, but also because it makes it possible not to sustain arguments without theoretical and experimental bases as is recommended (Porrás & Reyes, 2019; Chrobak, 2017).

To end in the closing phase, the groups were able to share, argue and discuss their results in a virtual plenary session, the experience was enriching from many aspects, highlighting the products of the inquiry, the importance of assuming collaborative work in virtuality, the satisfaction of specify a saved challenge, and above all find knowledge that has a lot of relationship and connectivity and that these can become an experience to transfer it to meaningful school activities from situated tasks (Gallegos, Peralta, & Guerrero, 2017; CNEB, 2017; Garcia & Ladino, 2008; Cañal de Leon, 1999). In this last phase of the methodology used, the groups of mathematics and science secondary education teachers expressed their interest in continuing the scientific investigation not only from separate aspects but from the holistic, including the religious aspect, since knowledge can be linked and better structured if you have the general vision of the components and at the same time a global construct with a greater argument (Chrobak, 2017; Garcia & Ladino, 2008; Cañal de León, 1999).



4. CONCLUSIONS

The teamwork of teachers has achieved its objective by developing scientific inquiry competencies with content analysis to build new knowledge about the possible explanations of the symbols of Suyo's Wak'a. In the astronomical aspect, the comparison of the circles with binary parallel star systems and of the rays as vectors from the stellar origin to the earth, represent an explanatory knowledge of the symbology in the petroglyph.

For the meteorological aspect, the symbology makes sense in its first comparison with the cloud-ground and ground-cloud rays, then the real proportion of its construction with the experimental speed, as well as with the behavior of the ascending rays compared to the common rays. The symbol of the drops of water is logical and acceptable due to its comparison with other petrographic manifestations.

Regarding the biological aspect, it is the one that reports the least construct, not finding evidence and content analysis that relates the symbols to male and female reproductive cells.

The development of skills in teachers allowed the incorporation of bibliographic inquiry techniques, interest in available and unavailable databases, as well as collaborative work from virtuality. We found that in the closing phase the commitment was reached to continue the investigation in a holistic way, including the religious component.

The lack of bibliographic resources, the impossibility of visiting libraries and having only the bibliographic review online, did not represent limitations for the work with which it was found that knowledge can be built from an authentic activity, with a local historical resource and guided by the work that develops skills, these practices generate in teachers attitudes and skills that can be transmitted to their students for work by skills.

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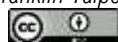
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