



Teaching competence in mathematics, science and technology when solving a context problem with the Inca archaeological complex of Raqchi, Cusco - Peru

Competencia docente en matemática, ciencia y tecnología al resolver un problema de contexto con el complejo arqueológico inca de Raqchi, Cusco – Perú

Competência docente em matemática, ciências e tecnologia na solução de um problema contextual com o complexo arqueológico inca de Raqchi, Cusco - Peru


Franklin Taipe¹

Universidad Nacional de San Antonio Abad del Cusco, Cusco, Perú

 <https://orcid.org/0000-0002-3639-3892>
franklin.taipe@unsaac.edu.pe


Noemy Mamani

Universidad Nacional del Altiplano, Puno, Perú

 <https://orcid.org/0000-0003-3244-977X>
nmamanim@unap.edu.pe


Mónica Huamani

Universidad Nacional de San Agustín, Arequipa-
Arequipa, Perú

 <https://orcid.org/0000-0003-4873-6618>
monica.huamani@unsaac.edu.pe


Delio Merma

Universidad Nacional de San Antonio Abad del
Cusco, Cusco, Perú

 <https://orcid.org/0000-0001-5266-2098>
delio.merma@gmail.com

Prudencio Quispe

Universidad Nacional de San Antonio Abad del
Cusco, Cusco, Perú

 <https://orcid.org/0000-0002-8140-3789>
p.quispe@gmail.com

DOI (Generic) : <https://doi.org/10.35622/j.rie.2022.02.001>
DOI (Document in English) : <https://doi.org/10.35622/j.rie.2022.02.001.en>
DOI (Documento en español) : <https://doi.org/10.35622/j.rie.2022.02.001.es>

Received 07/09/2021/ Accepted 30/12/2021 Published: 31/12/2021

KEYWORDS

science, competition,
mathematics, Raqchi

ABSTRACT. Competencies in math and science should be developed in teachers to exemplify students. For example, the archaeological complex of Raqchi or temple of the God Weracocha are ruins of the Inca culture. The objective was to find how many inhabitants the Inca citadel of Raqchi housed with mathematical competence, solve problems of quantity and science, investigate through scientific methods in secondary education teachers. The study was qualitative, with a content review and analysis methodology; four teachers from the Canas and Canchis Local Educational Management Unit were formed who solved the problem from virtual collegiate meetings. The result

¹ Bachelor of Education in the specialty of Social Sciences. **Correspondence:** franklin.taipe@unsaac.edu.pe



PALABRAS CLAVE

ciencia, competencia, matemática, Raqchi

of the first group indicates 7538 inhabitants based on the number of Qolcas and the function of the work camp. The second concerning its military role mentions 5308 inhabitants, and the third on the hypothesis of an Inca temple indicates 291 inhabitants. Concluding that the competencies above were achieved according to the National Curriculum of Peru, autonomy, virtual collegiate work that promoted the continuous training of teachers.

RESUMEN. Las competencias en matemática y ciencias deben desarrollarse en los docentes para ejemplificar a los estudiantes. El complejo arqueológico de Raqchi o templo del Dios Weracocha son ruinas de la cultura Inca. El objetivo fue resolver encontrar cuántos habitantes albergó la ciudadela Inca de Raqchi con la competencia matemática resuelve problemas de cantidad y de ciencia, indaga mediante métodos científicos, en docentes de educación secundaria. El estudio fue cualitativo, con metodología de revisión y análisis de contenido, se formaron tres grupos de cuatro docentes de la Unidad de Gestión Educativa Local de Canas y Canchis que resolvieron el problema desde reuniones colegiadas virtuales. El resultado del primer grupo indica 7538 habitantes basado en el número de Qolcas y la función de campamento de trabajo. El segundo con referencia a su función militar menciona 5308 habitantes y el tercero sobre la hipótesis de un templo Inca indica 291 habitantes. Concluyéndose que se lograron las competencias mencionadas según el Currículo Nacional del Perú, la autonomía, el trabajo colegiado virtual que potenció la formación continua del profesorado.

PALAVRAS-CHAVE

ciência, competição, matemática, Raqchi

RESUMO. As competências em matemática e ciências devem ser desenvolvidas nos professores para exemplificar os alunos. O complexo arqueológico de Raqchi ou templo do Deus Weracocha são ruínas da cultura Inca. O objetivo era descobrir quantos habitantes a cidadela inca de Raqchi abrigava com competência matemática, resolve problemas de quantidade e ciência, investiga por meio de métodos científicos, em professores do ensino médio. O estudo foi qualitativo, com metodologia de revisão e análise de conteúdo, foram formados três grupos de quatro professores da Unidade de Gestão Educacional Local de Canas e Canchis que resolveram o problema a partir de reuniões colegiadas virtuais. O resultado do primeiro grupo indica 7538 habitantes com base no número de Qolcas e na função do campo de trabalho. O segundo referente à função militar menciona 5.308 habitantes e o terceiro na hipótese de um templo inca indica 291 habitantes. Concluindo que as referidas competências foram alcançadas de acordo com o Currículo Nacional do Peru, autonomia, trabalho colegiado virtual que promoveu a formação continuada de professores.

1. INTRODUCTION

The Inca citadel of Raqchi is a complex of ruins of the Inca empire. It is located in the department of Cusco at 3460 meters above sea level in Peru; it has an approximate area of 1000 hectares. The architecture of the excellent protection wall, aqueducts, underground tombs, Qolcas, and pre-Inca culture precincts (Wari) stands out in its construction. The archaeological center of Raqchi has located on the Ruta del sol between Cusco (Machupicchu) and Puno (Lake Titicaca).

She was also known as the temple of God Viracocha or Weracocha, the largest Inca temple, warehouses, circular structures, enclosures, and water sources for human consumption. A massive rectangular-shaped design, possibly with two floors, stands out, measuring 92 meters long by 25.5 meters wide. Towards the east of the temple of Viracocha, there are 156 Qolcas. These Qolcas are circular enclosures 8m in diameter and 4m high, located in parallel lines. They had the function of storing food products (corn, quinoa, potato, chuño, moray



dried fish brought from the coast, dried alpaca meat obtained from the Collao plateau), which could be used for ceremonial and military purposes and distributed in the different yours (Quispe, 2021; W. Sillar et al., 2019). The central structure consists of a main adobe wall between 18 and 20 meters high, with an andesite stone base with windows and doors. It is flanked on both sides by 11 circular columns, with the lower part in stone and the upper one in clay. In the opinion of Soto (2019) and Sillar et al. (2019) before its destruction by the Spanish conquerors, the temple had what is believed to be the most extensive roof in the Inca Empire, as seen in Figures 1, 2, 3 and 4.

Figure 1

Citadel of Raqchi or temple of God Wiracocha



Note: taken from (16) Facebook

Figure 2

Entrance to the water sources, central wall of the temple.



Note: taken from Raqchi Archaeological Park - Wiracocha Temple :: Inka Express

Figurr 3

Central street with rooms of the acllas, nobility and priests.



Note: taken from, Raqchi Archaeological Park - Wiracocha Inka Express Temple

Figure 4

Qolcas or food deposits.



Note: taken from, Raqchi Archaeological Park - Wiracocha Temple :: Inka Express

The National Curriculum of Basic Education of Peru (CNEB) highlights the intercultural approach in regular primary education due to the socio-cultural and linguistic diversity of the country. According to the CNEB (2017) interculturality aims to build a dialogue for its complementarity and responsible coexistence with values of respect and tolerance to promote an equitable interaction between cultures by promoting the use of their elements in accordance. That allows us to achieve responses to common challenges.

The complexity of intercultural features and the openness to approach learning experiences enrich innovative production by integrating curricular areas. As is the case of science and mathematics in intercultural education, that should be taken as Bilingual Intercultural Education, having language as the central axis. But instead, in a generic way to the use of knowledge and knowledge of other cultures for the construction and empowerment of new knowledge. The concrete experiences derived from teacher training require intercultural mathematics and science that take students' cultural, social, and linguistic diversity for the construction of learning (Schroeder, 2005).

Involving resources, materials, technology, customs, cultural traits and then using them in activities enhance learning in an intercultural context. This use enhances the development of competencies and capacities necessary for cultural groups. It must be achieved that the potentialities and deficiencies are perceived to build their sense of conscious and effective belonging. In the Framework of Good Teaching Performance of the Ministry of Education of Peru (MBDD, 2012) the teacher must get involved with the community where the school is located to interact with its elements and capture the intercultural approach of the CNEB.

The use of elements of ethnomathematics for teacher training generates reflection regarding mathematical knowledge. The influence of cultural aspects on meaningful contextualization for the design of activities. It also promotes the teacher's creativity to develop a mathematics and science curriculum, generating a connection with the socio-cultural environment (Gavirrete & Albanese, 2015). Also, an experience in Argentina shows the findings obtained with the teaching participants in the analysis of the choreographies of the Chacarera dance, which with its choreographic elements of figures and representations favor that some intercultural features can be used in a sociocultural context (Albanese & Perales, 2014; Sardella, 2004).

There is also the report by Salcedo (2017) that in his study from the use of the "Sikuani" language and ancestral knowledge, constructs mathematical and scientific concepts to learn mathematics from the use of the mother tongue and scaffolding that builds learning. Bishop (1999) highlights that both the material and non-material resources of culture in activities and learning experiences acquire a great sense of correspondence or belonging

that motivates participation and identification with learning challenges. Learning, from a sociocultural point of view, is related to the appropriation of tools to think and act in a community of practice (Llinares, 2008).

For students to develop math or science skills, teachers themselves must develop them as part of their daily actions and ongoing training (Chamoso & Cáceres, 2019). In this perspective, conscious reflection to achieve competencies in different curricular areas such as mathematics or science with their abilities has to be initially in teachers from the design of tasks and learning environments that aim to build knowledge by solving authentic tasks or quasi-authentic understand (Llinares, 2008).

Research tasks to develop mathematical and science competencies from reflection are necessary for real situations. For example, the use of an aqueduct managed to promote critical citizenship. In the learning environment, these experiences are valuable in exercising skills in students Alvis et al. (2019) reported that teachers in initial training and in-service training should also be replicated in teachers.

Teachers' achievement of mathematical competencies is reported by Juárez and Arredondo (2017) in their comparative study. They indicate that teachers know didactic theories in Mexico, but there are deficiencies in the disciplinary domain. In France, seminars for learning theories are considered in their training, where penal and didactic knowledge are associated, which is very beneficial. This shows that continuous training is necessary to empower teachers with specialized curricular competencies and pedagogy.

Taípe et al. (2021) report that the achievement of competencies in the area of science and technology with competence investigates through scientific methods in groups of teachers who study the meaning of the symbols in the petroglyph of the Waka de Suyu from the analysis of content motivated by the authentic task and archaeological context.

The use of context situations favors the achievement of competencies in various areas of knowledge (Velásquez et al., 2017). Therefore, a significant training process is necessary as a strategy to improve teaching performance.

The continuous training of teachers in training and in-service in education for all levels is an institutional responsibility of the Ministry of Education, but poor public management and scarce resources do not reach mass education, being notorious only the establishment of focused programs (Rodríguez, 2010). It is necessary that initial training be constantly carried out to achieve continuous training so that the competencies in teachers are constantly developed (Hernández et al., 2017). It is essential for teachers at all levels to build their skills and much more now in this context of virtual work due to isolation due to COVID-19 (Granados et al., 2017; Suárez, 2020).



Due to the health crisis, continuous training tasks cannot be relegated; those that occur are especially in information technology management, having neglected the disciplinary aspect in the areas of science and mathematics, for example. The use of Information and Communication Technologies (ICT) has generated many continuous training programs within the framework of professional training (Gárate & Cordero, 2019). Along the same lines of virtuality, ongoing training programs were generated for the curriculum, competencies, and formative evaluation on the Perueduca platform of the Ministry of Education of Peru. To empower teachers in developing competencies and capacities from continuous training (Bustamante, 2020).

Continuous teacher training is necessary to achieve student learning; it can be gained from teaching practice. One strategy is to work in virtual learning communities voluntarily from the college, school, network, or some type of educational organization, oriented by common interests (Calvo et al., 2019; CNEB, 2017). Significantly, this work results from voluntary participation for continuous training based on the learning needs at school.

When investigating the resource of Ethnomathematics as a tool for teacher training. It is reported that this resource encourages investigation, inquiry, generates assumptions, conjectures, a theoretical framework until a possible response to problematic situations can be concluded with arguments. Gavirrete and Albanese (2015) concluded that using ethnomathematical resources produced excellent participation by teachers in training and contributed to their meta-training in service.

The present study is focused on proposing to know how many inhabitants the Inca citadel of Raqchi could have housed. This situation aims to address three problems: the first of an intercultural aspect to associate western elements of calculation and estimation and the knowledge of the Andean worldview of the Inca culture according to the ideas of B. Sillar (2002) and Morong (2021). The second aspect referred to the development of competencies solves quantity problems and investigates with scientific methods from teachers' performance to put them into practice with students (Martínez et al., 2018). Finally, it is expected to show the use of capacities, abilities, skills in the curricular area of mathematics and science and technology since it is not the direct application of an algorithm that solves the situation (CNEB, 2017; Flores & Juárez, 2017; Pacheco & Pacheco, 2021). As well as confronting teachers with a continuous training activity from the service with virtual collegiate work, so that collegially they can investigate to respond to the problematic situation (J. Escudero et al., 2017; Gárate & Cordero, 2019; Kleinert & Pineda, 2018).

The study's objective is formulated with the problem of How many inhabitants housed the Inca citadel of Raqchi. This knowledge acquires importance in clarifying the uncertainty from the inquiry and mathematics because arguments are intended to defend the solutions and build new hypotheses for future research. Furthermore, this



problem is crucial because it will allow teachers to practice their abilities, skills, and competencies to propose logical scientific arguments.

2. METHOD AND MATERIALS

The investigative inquiry activity was developed in isolation due to COVID-19. Therefore, teachers carried them out virtually, taking advantage of their advantages (A. Hernández, 2020). The role of teachers will be to emulate anthropological scientists from their knowledge and inquiry with the use of available resources such as bibliographic scientific inquiry to be understood (CNEB, 2017; García & Ladino, 2008; Gómez et al., 2014).

A qualitative approach was applied in the study because information, speeches, images, and other data were used in the methodological process (Guerrero, 2016).

The methodology used was that of inquiry learning, with which it is intended to achieve mathematics and science competencies (Canayo, 2019; García & Ladino, 2008; Torres et al., 2003). This method has three concatenated stages. In its first stage, the information of the Inca citadel of Raqchi was presented for motivation. In a second, the bibliographic inquiry and the solution to the problem formulation (Rojas et al., 2017). In the last stage, possible solutions are socialized and presented with arguments as conclusions and that at the same time again pose problematic situations for new research sources (Rivadeneira & Silva, 2017).

It corresponds to a primary type because it generates new theoretical knowledge without contrast with the experimental from a theoretical framework (Muntané, 2010). This aspect is crucial since the arguments of the results could not be verified experimentally by not manipulating variables (Yaranga, 2015).

The technique was the documentary and content analysis with its file instruments, registration tables, information classifiers to be understood (C. Escudero & Cortez, 2017; A. Hernández, 2020). The procedure for developing competence solves quantity problems and investigates through scientific methods to build their knowledge. The work teams were three groups of four teachers, two of mathematics and two of science and technology, belonging to Ugel Canas and Canis. Who developed the three stages of the study in a planned way in an autonomous work system in a virtual collegiate?

The unit of study is the archaeological complex called the Inca citadel of Raqchi, made up of the stone remains still present, such as the foundations of the temple, rooms, Qolcas, enclosures, wall, water sources, channels, and others that can provide information.



The selection of the twelve teachers was voluntary to a public invitation with the criterion of "typical subjects" (A. Hernández, 2020). Since the typology was to be a professor of mathematics or science and technology and belonging to the Ugel Canas or Canchis, they are close to the archaeological site of Raqchi.

The instruments used are the file, the registration tables, and information classifiers to be understood by A. Hernández (2020). First, the data collection process was initiated by presenting the problematic case and some antecedents. Then it was the strategy of each working group that conducted its procedure to collect the information and solve the problem, strictly following the documentary and bibliographic review.

3. RESULTS AND DISCUSSIONS

The first group took into account the ideas of W. Sillar et al. (2019) according to their studies, based on the remains found, the Temple of Weracocha or Raqchi has characteristics of the Wari culture. Therefore, Raqchi was a complex enclosure for temporary workgroups similar to the archaeological sites of Pikillacta and Azángaro. The Incas are considered to have reused the Tiahuanaco and Wari state sites in the late horizon.

In Inca times, work was a highly organized activity, hard work, and disciplined (Alvis et al., 2019). That is why all the Qolcas were considered, which were places of food storage for the sustenance of the workers, due to the requirement that construction should be of quality and quick execution. The 152 Qolcas at 100% of their capacity were taken into account. 70 Qolcas were considered to store potatoes, 60 for corn, and 22 Qolcas for other products (sestina, cañihua, quinoa, and other grains). A first visit to the archaeological center was made for some measurements, the average result of which is that each Qolca has a conical trunk shape with a diameter at the base of 3,501m and 3,172m at the upper floor, an average height of 5,930m and a volume of 57.01. m³. Men were considered for strenuous physical work. Many calories were required, estimating a daily consumption of 0.875kg of potato and chuño (chuño is the dried potato by freezing dehydration), while 0.475kg of corn (consumed dry generally). By experimentation, the density of potatoes was estimated at 695 kg / m³ and corn 755kg / m³, which is analogous to the report by Velásquez et al. (2017).

To calculate the capacity of the Qolca by-product, potato and corn are considered as daily consumption and the consumption of other products for non-daily situations in common, as shown in Table 1.



Table 1

Dear men who housed Raqchi as a temporary work complex.

Product	Qolcas	Density /m ³	kg	Daily consumption kg	Capacity Tn	Men per month	Men per day*
papa and chuño	85	695.0		0.875	3373.1	113003	18833
Dry and fresh corn	45	755.0		0.475	1939.9	119749	19958
Total							18833

Note: own elaboration based on analysis (* 06-month workday)

Potato and chuño food was considered the one with the highest production and consumption in the área (Quispe, 2021). The water supply and the number of rooms available in the archaeological site could not accommodate this amount. Therefore, it is assumed that the maximum amount that could have been sustained was 40% of the use of the Qolcas for their consumption and that 60% was destined for other points of attention. It should be considered that the logistics of the empire did not allow any food need among the peoples of the realm (B. Sillar, 2002). That is why it would have as full-time workers 7,538 adults who also considered the logistics of care, shelter, kitchen, and others.

The second group considered the conjecture that the archaeological site of Raqchi, due to its structures and arrangement, lent itself more to a barracks-type military center (Albanese & Perales, 2014). This is also stated by other historians explicitly based on the walled structure of the site.

The origin of the water source that so far is not known must also be considered (Quispe, 2021; Soto, 2019). The temple of the god Weracocha was a safe house against possible attacks from the south with the Qollas and protection for the Qosqo, which was the sacred city of the empire (Zuidema, 1968; Ellefsen, 1973). For these reasons, this army must have had a unique alert character and, therefore, preparedness and good food care. An exact number of Qolcas cannot be assured; in some cases, they refer to 152 as restored and in others 130 (Quispe, 2021). But their function as reserve sites is proper according to the excavations finding dry seeds. The calculation of food as a daily ration is assumed to be 2.0 kilograms per soldier, considering that half of them were for potatoes, a quarter of corn, and another quarter between Andean grains and meat. With the initial measurements, 135 useful Qolcas are considered at 75% of their capacity, considering approximately 42m³; through a home experiment, it was established that the variety of products would have a density of 700kg / m³, having the information in table 2.



Table 2

Dear men who host Raqchi as a military barracks.

Product	Qolcas	Density /m ³	kg	Daily consumption kg	Capacity Tn	Men*
Papa, maíz y otros	130	700.0		2.0	3822	10616
Total						10616

Note: own elaboration based on analysis (* quartered 06 months)

Regarding the total number of soldiers, it could host, it could not be said that all the Qolcas were for military personnel. Since it was the empire's organizational policy to provide food to all the places in need, there would always be a continuous reserve (Zanabria, 2018). The group assumed that 50% of the capacity of the Qolcas was used for military purposes, which could have been in a time of peace since the empire was constantly in conflict, especially with the Qollasuyo (the southern region of the kingdom). As Gamarra (2020) indicates, the rest of Qolcas was for a persistent storage and care system. Therefore, under normal conditions and as a barracks, I house 5308 people.

The third group of teachers maintains that the determining factor in estimating the number of people who inhabited Raqchi is not a function of the number of Qolcas. The review and content analysis indicates that Raqchi is the only Inca temple of worship to the God Weracocha and that its structure could have been the only one with two floors. According to Calvo et al. (2019) the temple had majesty in its past time. The religiosity of the empire was very notorious not only in its clergy and religious order but also in its popular collective meaning, the Inca was the son of the Sun with a direct relationship with the divinities, Pedro Cieza de León noted the following observation: "... I have said my sins to the Sun my father, your river, with your currents, take them swiftly to the sea, where they never seem again ..." (citado por García & Ladino, 2008, p. 126).

As the temple of the God Weracocha, it was a sacred and private place. Therefore, there were women in charge of taking care of the Sun, and their son, the Inca, chosen in the Tukuricu; this acllas service included the care of the star and those who were dedicated adequately of the Inca. All of them were forbidden to have relationships with other men, under pain of death, "... In the main temples they had a large number of lovely virgins, according to those that were in Rome in the temple of Vesta, and they almost kept the same statutes as those ..." (García & Ladino, 2008, p. 176).



There are 21 large rooms in which it could house virgin and service acllas, in addition to a service of the team of priests for the four of their own and a minimal administration system. In addition, the protection system of the temple that could not enter it is considered; this number is estimated at two guards every hundred meters, having a wall section of five kilometers; the information is presented in table 3.

Table 3

Dear men who host Raqchi as a temple of the God Wiracocha.

Activity	Security	Virgin acllas	Acllas service	of Priests	Ephebos service	and Nobility
Cantidad	120	42	63	20	41	14
Total						291

Note: own elaboration based on analysis (06-month service)

There were also young people in the religious precincts, according to chronicles, these ephebos were used, as sexual employees, the caciques used young boys dressed as women for the "nefarious sin" (Faúndez, 2011, p. 119).

When considering a population of no more than 300 people, the considerations of availability of the water source, logistics of rooms on the site, and the nature of the construction are met.

In the final stage, the groups shared and discussed their approaches in a virtual plenary session; the overall result shows that the bibliographic research was the primary source for assembling, conjecturing, and putting into practice the abilities of the competence to solve quantity problems. Another aspect is the willingness to face the cognitive challenge with motivation because it is considered a significant cultural aspect, as required by the situations presented to students (Canayo, 2019; CNEB, 2017; García & Ladino, 2008). Interestingly, the same groups wish to continue with the investigation and have more arguments. This shows that continuous training with common interests can be viable even without official intervention from the agencies in charge of doing it (Chrobak, 2017; García & Ladino, 2008; Travé et al., 2003).

4. CONCLUSIONS

It was satisfactory to include the Inca citadel of Raqchi as a resource for achieving skills since this intercultural symbol contributed elements that led to its investigation. Knowledge of the gender experience in teachers,



feelings of cultural belonging, and admiration for the information obtained. Intercultural work from the temple of God Weracocha encouraged intercultural dialogue and, therefore, the achievement of competition.

The three different results and conjectures show that the teachers could translate quantities into numerical expressions argued from decision-making, from the bibliographic scientific inquiry. The result reveals their understanding of the numbers and their operations; it is clear that differentiated strategies and different estimation procedures were used supported in their initial conjectures, highlighting the argumentation about their statements based on the study references to justify them. All these capacities correspond to the competence solves problems of quantity and investigates through scientific methods to build their knowledge according to the National Curriculum of Basic Education.

The work developed by the teachers is a clear report of the continuous training of mathematics teachers and science and technology. It is established that ongoing training does not come from the governmental institutionality; it is feasible from the organization itself in the school, in the network in the educational community and free association, the teachers. The competencies were achieved from their voluntary, collaborative work by practicing continuous in-service training.

One limitation for the working groups was the isolation due to the health crisis of COVID-19, which did not allow more visits and interviews to empower their arguments further, having essentially done them with the literature review. However, the most notable point was to verify that they can develop mathematical and science competencies with historical, cultural resources; this practice has strengthened attitudes and skills in teachers that will transfer them to their students in the classroom.

The teachers were able to add to their professionalism the investigation of historical documents, standardized signing, interest in databases, virtual cooperative work. At the end of the study, they promised to continue with the research to develop other mathematical and non-mathematical competencies.

The historical inquiry complemented with a study of mathematical and scientific rigor must continue to clarify many points of the ancient Inca empire. It is suggested to undertake studies on the functionality of the archaeological site based on the water sources and the Inca baths. In addition to anthropological studies associated with science, such as man's relationships in the Inca period with nature and ways of life to evaluate birth and mortality rates, the use of resources, among others.



Agradecimientos / Acknowledgments:

Expresamos el agradecimiento a los docentes la Facultad de Educación de la Universidad Nacional de San Antonio Abad del Cusco, Perú.

Conflicto de intereses / Competing interests:

Los autores declaran que no incurrir en conflictos de intereses.

Rol de los autores / Authors Roles:

Franklin Taípe: conceptualización, curación de datos, análisis formal, adquisición de fondos, investigación, metodología, administración del proyecto, recursos, software, supervisión, validación, visualización, escritura - preparación del borrador original, escritura - revisar & edición.

Nohemy Mamani: conceptualización, análisis formal, investigación, metodología, administración del proyecto, recursos, software, supervisión, validación, visualización, escritura - preparación del borrador original, escritura - revisar & edición.

Mónica Huamani: conceptualización, investigación, metodología, administración del proyecto, recursos, software, supervisión, validación, visualización, escritura - preparación del borrador original, escritura - revisar & edición.

Delio Merma: conceptualización, investigación, metodología, administración del proyecto, recursos, software, supervisión, validación, visualización, escritura - preparación del borrador original, escritura - revisar & edición.

Prudencio Quispe: conceptualización, investigación, metodología, administración del proyecto, recursos, software, supervisión, validación, visualización, escritura - preparación del borrador original, escritura - revisar & edición.

Fuentes de financiamiento / Funding:

Los autores declaran que no recibieron un fondo específico para esta investigación.

Aspectos éticos / legales; Ethics / legals:

Los autores declaran no haber incurrido en aspectos antiéticos, ni haber omitido aspectos legales en la realización de la investigación.

REFERENCES

- Albanese, V., & Perales, F. (2014). Microproyectos etnomatemáticos sobre danzas folclóricas: Aprender matemática desde el contexto con maestros en formación. *Profesorado. Revista de Currículum y Formación del Profesorado*, 18(3). <https://revistaseug.ugr.es/index.php/profesorado/article/view/19356>
- Alvis, J., Aldana, E., & Caicedo, S. (2019). Los ambientes de aprendizaje reales como estrategia pedagógica para el desarrollo de competencias matemáticas en estudiantes de básica secundaria. *Revista de Investigación, Desarrollo e Innovación*, 10(1), 135-147. <https://doi.org/10.19053/20278306.v10.n1.2019.10018>
- Bishop, A. (1999). *Enculturación matemática, La educación Matemática desde una perspectiva cultural*. Ediciones Paidós Iberica S.A.
- Bustamante, R. (2020). *Educación en cuarentena: cuando la emergencia se vuelve permanente Aportes para el Diálogo y la Acción*. Universidad Nacional José Faustino Sánchez Carrión.



- Calvo, F., Tamayo, R., Araujo, Á., Henríquez, L., & Morales, Y. (2019). Creacion de una comunidad virtual de aprendizaje para la maestria pedagogica profesional de la universidad de Holguin. *Didasc@lia: Didáctica Y educación*, 10(2), 203–214. <http://revistas.ult.edu.cu/index.php/didascalia/article/view/884>
- Canayo, E. (2019). *Indagación Científica*. Universidad Científica del Peru.
- Chamoso, J., & Cáceres, M. (2019). Creacion de tareas por futuros docentes de matematica a partir de contextos reales. *Portal de revistas académicas*, 14(18), 59-69. <https://revistas.ucr.ac.cr/index.php/cifem/article/view/39897>
- Chrobak, R. (2017). El aprendizaje significativo para fomentar el pensamiento crítico. *Archivos de Ciencias de la Educación*, 11(12), 031. <https://doi.org/10.24215/23468866e031>
- CNEB. (2017). *Curriculo Nacional de Educacion Basica: Ministerio de educacion del Peru*. <http://www.minedu.gob.pe/curriculo/>
- Escudero, C., & Cortez, L. (2017). *Tecnicas y metodos cualitativos para la investigacion cientifica*. <http://repositorio.utmachala.edu.ec/handle/48000/12501>
- Escudero, J., González, M., & Rodríguez, M. (2017). Los contenidos de la formacion continuada del profesorado: Que docentes se estan formando. *Educación XX1*, 21(1). <https://doi.org/10.5944/educxx1.20183>
- Faúndez, R. (2011). Sumario de la natural historia de las Indias. Estudio, edición y notas de Álvaro Baraibar. *Atenea (Concepción)*, 504, 221-223. <https://doi.org/10.4067/S0718-04622011000200013>
- Flores, G., & Juárez, E. (2017). Aprendizaje basado en proyectos para el desarrollo de competencias matemáticas en Bachillerato. *Revista Electrónica de Investigación Educativa*, 19(3), 71. <https://doi.org/10.24320/redie.2017.19.3.721>
- Gamarra, J. (2020). *Expansión y militarismo Inca* [Universidad de Valladolid]. <https://uvadoc.uva.es/handle/10324/45581>
- Gárate, M., & Cordero, G. (2019). Apuntes para caracterizar la formación continua en línea de docentes. *Revista de Estudios y Experiencias en Educación*, 18(36), 209-221. <https://doi.org/10.21703/rexe.20191836garate10>
- García, G., & Ladino, Y. (2008). Desarrollo de competencias científicas a través de una estrategia de enseñanza y aprendizaje por investigación. *Studiositas*, 3(3), 7-16.

<https://dialnet.unirioja.es/servlet/articulo?codigo=3717381>

- Gavirrete, M., & Albanese, V. (2015). Etnomatemáticas de signos culturales y su incidencia en la formación de maestros. *Revista Latinoamericana de Etnomatemática*, 8(2), 299-315. <https://biblat.unam.mx/es/revista/rle-revista-latinoamericana-de-etnomatematica/articulo/etnomatematicas-de-signos-culturales-y-su-incidencia-en-la-formacion-de-maestros>
- Gómez, E., Navas, D., Aponte, G., & Betancourt, L. (2014). Literature review methodology for scientific and information management, through its structuring and systematization. *DYNA*, 81(184), 158. <https://doi.org/10.15446/dyna.v81n184.37066>
- Granados, J., Vargas, C., & López, R. (2017). Estrategia de formación continua del docente universitario en la didáctica de los entornos virtuales de aprendizaje (EVA). *Revista Conrado*, 13(1 SE-Artículos). <https://conrado.ucf.edu.cu/index.php/conrado/article/view/651>
- Guerrero, M. (2016). La Investigación Cualitativa. *INNOVA Research Journal*, 1(2), 1-9. <https://doi.org/10.33890/innova.v1.n2.2016.7>
- Hernández, A. (2020). Acceso, usos y problemas en la educación virtual: una aproximación a las experiencias de estudiantes y docentes durante la cuarentena obligatoria en Argentina. *PACHA Revista de estudios contemporáneos del sur global*, 1(1). <https://doi.org/10.46652/pacha.v1i1.5>
- Hernández, C., Prada, R., & Gamboa, A. (2017). Conocimiento y uso del lenguaje matemático en la formación inicial de docentes en matemáticas. *Revista de Investigación, Desarrollo e Innovación*, 7(2), 287-299. <https://doi.org/10.19053/20278306.v7.n2.2017.6071>
- Juárez, M., & Arredondo, M. (2017). Las competencias matemáticas de los docentes de Francia y de México. *Voces de la educación*, 2(3 SE-Artículos). <https://www.revista.vocesdelaeducacion.com.mx/index.php/voces/article/view/36>
- Kleinert, E., & Pineda, P. (2018). La formación continua de docentes en educación infantil: El rol del directivo en la transferencia de aprendizajes. *Actas del II Congreso Internacional de Liderazgo y Mejora de la Educación*. <https://repositorio.uam.es/handle/10486/682938>
- Llinares, S. (2008). *Construir el conocimiento necesario para enseñar matemática: Prácticas sociales y tecnológicas*. <http://rua.ua.es/dspace/handle/10045/10435>



- Martínez, O., Combita, H., & De la Hoz, E. (2018). Mediación de los objetos virtuales de aprendizaje en el desarrollo de competencias matemáticas en estudiantes de Ingeniería. *Formación universitaria*, 11(6), 63-74. <https://doi.org/10.4067/S0718-50062018000600063>
- MBDD. (2012). *Marco del buen desempeño docente*. http://www.minedu.gob.pe/n/xtras/marco_buen_desempeno_docente.pdf
- Morong, G. (2021). Haciendo relacion de las cosas tocantes a su gobierno. El orden del Inca en la documentacion colonial temprana. *Diálogo andino*, 65, 133-149. <https://doi.org/10.4067/S0719-26812021000200133>
- Muntané, J. (2010). Introducción a la investigación basica. *RAPD Online*, 33:3, 221-227. https://www.researchgate.net/publication/341343398_Introduccion_a_la_Investigacion_basica
- Pacheco, S., & Pacheco, W. (2021). *Resolución de problemas y su relación con el desarrollo de competencias matemáticas en estudiantes de secundaria* [Universidad de la Costa]. <https://repositorio.cuc.edu.co/handle/11323/7988>
- Quispe, M. (2021). Investigación arqueológica, sector Qolqas del parque arqueológico de Raqchi, Canchis-Cusco. *Arqueología y Sociedad*, 33, 219-242. <https://doi.org/10.15381/arqueolsoc.2021n33.e20274>
- Rivadeneira, E., & Silva, R. (2017). Aprendizaje basado en la investigación en el trabajo autónomo y en equipo. *Negotium: revista de ciencias gerenciales*, 38, 5-16. <https://dialnet.unirioja.es/servlet/articulo?codigo=7169265>
- Rodríguez, C. (2010). El Programa Nacional de Formación y Capacitación Permanente (Pronafcap). *Educación*, 19(37), 87-103. <https://revistas.pucp.edu.pe/index.php/educacion/article/view/2553>
- Rojas, L., Rosas, J., & Sanabria, Y. (2017). *Desarrollo de la competencia de indagacion en la enseñanza de las ciencias naturales en basica primaria del instituto tecnico ambiental San Mateo de Yopal-Arequipa* [Universidad de La Salle (Colombia)]. <https://repositorioslatinoamericanos.uchile.cl/handle/2250/1142233>
- Salcedo, P. (2017). *Saberes ancestrales y uso de la lengua Sikuani en la construcción de conceptos matemáticos* [Universidad Pontificia Bolivariana]. <https://repository.upb.edu.co/handle/20.500.11912/3337>
- Sardella, O. (2004). *La geometria en las danzas folkloricas argentinas*. *Acta Latinoamericana de matematica educativa*. L.Diaz Editores Comite. <http://funes.uniandes.edu.co/6423/>

- Schroeder, J. (2005). Mas alla de los platos tipicos: El proyecto matematica intercultural en el Peru. *Cuadernos Interculturales*, 3(4), 51-64. <https://dialnet.unirioja.es/servlet/articulo?codigo=2370536>
- Sillar, B. (2002). Caminando a traves del tiempo: geografia sagrada en Cacha/Raqchi, departamento de Cuzco (Peru). *Revista Andina*, 35, 221-245. <http://revista.cbc.org.pe/index.php/revista-andina/article/view/246>
- Sillar, W., Dean, E., & Pérez, A. (2019). La ocupacion Wari y el culto Inca a Viracocha en Raqchi, Cuzco. *Revista Haucaypata. Investigaciones arqueológicas del Tahuantinsuyo*, 14, 55-89. <https://discovery.ucl.ac.uk/id/eprint/10113296/>
- Soto, L. (2019). *Análisis del turismo rural comunitario en la comunidad campesina de Raqchi 2018: caso Asociación Turismo Vivencial Raíces Inca* [Universidad Nacional de San Antonio Abad del Cusco]. <https://renati.sunedu.gob.pe/handle/sunedu/2690770>
- Suárez, N. (2020). Formación docente universitaria y crisis sanitaria COVID-19. *CienciAmérica*, 9(2), 109. <https://doi.org/10.33210/ca.v9i2.299>
- Taipe, F., Serna, J., Quispe, C., Quispe, W., & Condori, I. (2021). Desarrollo de la indagación científica, desde una tarea auténtica con el petroglifo de la Wak'a de Suyu. *Revista Innova Educación*, 3(3), 165-186. <https://doi.org/10.35622/j.rie.2021.03.011>
- Torres, L., Ladino, O., & Zapata, P. (2003). *Modelo de enseñanza y aprendizaje por investigacion*. Universidad Pedagogica Nacional de Colombia.
- Travé, G., Cañal, P., & Pozuelos, F. (2003). *Aportaciones del proyecto curricular investigando nuestro mundo al cambio en la educación primaria*. <http://rabida.uhu.es/dspace/handle/10272/10649>
- Velásquez, S., Celis, J., & Hernandez, C. (2017). Evaluación contextualizada como estrategia docente para potenciar el desarrollo de competencias matemáticas en Pruebas Saber. *Eco Matemático*, 33-37. <https://doi.org/10.22463/17948231.1377>
- Yaranga, R. (2015). *Procesos de indagación científica que generan los docentes en la enseñanza del área de Ciencia, Tecnología y Ambiente. I.E. 7059. UGEL 01. Lima. 2015* [Universidad Peruana Cayetano Heredia]. <https://hdl.handle.net/20.500.12866/95>
- Zanabria, L. (2018). La conquista de los incas Hemming, John (2000). *Revista Puquina*, 1(1). revistas.unsa.edu.pe/index.php/puquina/article/download/22/18