Relações Internacionais do Mundo Atual – unicuritiba
Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: 2316-2880

INQUIRY-BASED LEARNING MANAGEMENT IN THE INTEGRAL FORMATION OF STUDENTS

GERENCIAMENTO DA APRENDIZAGEM BASEADA EM PESQUISAS NA FORMAÇÃO INTEGRAL DOS ALUNOS

SOLEDAD MENDOZA ESPINOZA
Universidad César Vallejo, Lima, Perú
https://orcid.org/0000-0001-7429-8311
msmendozam@ucvvirtual.edu.pe

DORIS FUSTER- GUILLÉN
Universidad Nacional Mayor de San Marcos, Lima, Perú
https://orcid.org/0000-0002-7889-2243
dfusterg@unmsm.edu.pe

DAVID ELÍ SALAZAR ESPINOZA
Universidad Nacional Daniel Alcides Carrión, Cerro de Pasco, Perú
https://orcid.org/0000-0003-4509-2132
dsalazare@undac.edu.pe

YESSENIA KARINA ROSELL GARAY
Universidad Nacional Daniel Alcides Carrión, Cerro de Pasco, Perú
https://orcid.org/0000-0002-3262-6740
yrosellg@undac.edu.pe

PALPA INGA VILMA ENEIDA
Universidad Nacional Daniel Alcides Carrión, Cerro de Pasco, Perú
https://orcid.org/0000-0003-0608-6012
vpalpa@undac.edu.pe

ABSTRACT:

Purpose: The purpose of this article is to explain how inquiry-based learning management influences the comprehensive education of students based on a systematic review of the literature. Applying inquiry in science education is fundamental nowadays, since it provides students with the scientific capabilities to solve problems in their environment, transforming their reality and thus improving their quality of life.

Methods and materials: The methodology used is the bibliographic review of scientific articles, belonging to databases such as Scopus, Eric, Google Sholar, Dialnet, among others. A total of 69 documents have been reviewed, published from 2014 to 2022, of which 68 are original articles and 1 doctoral thesis, national and international, in Spanish and English language.

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

Results: The literature review shows that inquiry learning is effective because it favors autonomous learning, the development of scientific, mathematical and metacognitive skills. It also allows the comprehension of information, the strengthening of scientific literacy, the development of critical thinking and creativity, thus achieving the integral development of the student. To this end, it is important that teachers and students assume their new role in the science class: where the teacher is a facilitator, a guide for learning, and the student is an active researcher, a builder of his own learning, capable of making his own decisions and solving problems.

Conclusions: However, in the search for information based on the literature review, the effectiveness of inquiry in strengthening cooperative work has not yet been studied, considering that it allows understanding, the development of scientific skills and achieves significant learning in science classes.

Keywords: Inquiry; mathematical; scientific and metacognitive skills; autonomous learning.

RESUMO:

Objetivo: O objetivo deste artigo é explicar como a gestão da aprendizagem baseada em questionamentos influencia a educação integral dos alunos com base em uma revisão sistemática da literatura. A aplicação da investigação no ensino de ciências é fundamental nos dias de hoje, pois fornece aos alunos a capacidade científica para resolver problemas em seu ambiente, transformando sua realidade e, assim, melhorando sua qualidade de vida.

Métodos e materiais: A metodologia utilizada é a revisão bibliográfica de artigos científicos, pertencentes a bancos de dados como Scopus, Eric, Google Sholar, Dialnet, entre outros. Foram revisados 69 documentos, publicados de 2014 a 2022, dos quais 68 são artigos originais e 1 tese de doutorado, nacionais e internacionais, em espanhol e inglês.

Resultados: A revisão da literatura mostra que a aprendizagem por investigação é eficaz porque favorece a aprendizagem autônoma, o desenvolvimento de habilidades científicas, matemáticas e metacognitivas. Também permite a compreensão de informações, o fortalecimento da alfabetização científica, o desenvolvimento do pensamento crítico e da criatividade, alcançando assim o desenvolvimento integral do aluno. Para isso, é importante que professores e alunos assumam seu novo papel na aula de ciências: onde o professor é um facilitador, um guia para a aprendizagem, e o aluno é um pesquisador ativo, um construtor de sua própria aprendizagem, capaz de tomar suas próprias decisões e resolver problemas.

Conclusões: No entanto, na busca de informações com base na revisão da literatura, ainda não foi estudada a eficácia da investigação no fortalecimento do trabalho cooperativo, considerando que ela permite a compreensão, o desenvolvimento de habilidades científicas e alcança uma aprendizagem significativa nas aulas de ciências.

Palavras-chave: Investigação; matemática; habilidades científicas e metacognitivas; aprendizagem autônoma.

1 INTRODUCTION

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

Inquiry learning is a strategy that provides the methodology and a structure that adapts to the way people learn and practice science (Reyes-Cárdenas, 2012); it is based on Piaget's constructivism theory, which assumed that, in learning activities, students construct knowledge in cognitive structures through interactions with their environment (Sutrisno et al., 2020). Inquiry learning starts with questioning, the problem is carried out by asking questions related to the material being studied; then students write hypotheses. The teacher plays the role of facilitator by reviewing the open-ended questions and hypotheses (Ristanto et al., 2017). The effectiveness of this approach has been demonstrated with respect to education, which is why a large majority of countries are interested in improving science sessions in Regular Basic Education (Yzcátegui, 2013), since it favors the strengthening and development of problem-solving skills and the development of critical thinking and decision-making skills (Avsec and Kocijancic, 2014). This learning includes the stages of independent exploration and construction of concepts, which are important keys to train students' processing skills; it increases motivation and curiosity, understanding, skills and attitudes of learners (Sutrisno et al., 2020). Also, it should be oriented to promote research skills with a correct perspective of science, promote argumentation based on demonstrations, compare and evaluate alternative ideas, build theories and explanatory scientific models (Romero-Ariza, 2017); it allows students to participate in the generation of knowledge instead of being passive recipients of knowledge (Mansour, 2015 cited by Fan and Ye 2022), students learn science by doing science, which is the basis of research (Mariños and Apolaya, 2021): therefore, it is important that science lessons are enjoyable, useful for their daily lives (Rubio and García Conesa 2022), learning activities should occur in a close context, using real contexts, generating alternatives to solve problems in teams, communicating what they have learned and favoring the transmission of knowledge to other usual scenarios (Aramendi Jauregui et al., 2018).

Students lack interest in science, which is due to the lack of value in science education (Sosa and Dávila, 2018). One of the reasons is the way science is taught, which prevents learners from establishing connections between concepts, representations and contexts of reality; analysis and critical thinking are not promoted (Martínez and Riveros, 2019, cited by Mariños and Apolaya, 2021). The research conducted shows that teachers do not use didactic methods that help learners to

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: 2316-2880

acquire knowledge in a meaningful way, which leads to the loss of interest in learning (Peña et al, 2019); consequently, learners do not know the meaning and importance of research, which evidences a weak mastery of scientific skills (Flóres and Gonzáles, 2021); Likewise, they show other problems such as information storage, information search and lack of investigative initiative, they merely follow the teacher's indications and expect to be directed in the teaching process, i.e., the constructivist approach is not fully adopted as proposed by the Ministry of Education (Mandujano et al 2021). Inquiry-based science learning is effective and essential in quality teaching for the development of critical thinking skills. But teaching practices show gaps in research training and, as a consequence, a poor repetition of these processes in teaching, since a methodology that allows active participation is not applied so that students can inquire as a team (Oquendo, 2019). For this, teachers need to change the concept of science education, applying an inquiry methodology, in which the student is the protagonist, thus assuming that he/she has a great responsibility in the process (Martínez and Riveros, 2019, cited by Mariños and Apolaya, 2021).

In this article we will address the contributions of different authors with respect to the following aspects: inquiry in the strengthening of critical thinking, in the comprehension of information, in the development of scientific and metacognitive skills, in the development of creativity, in the strengthening of literacy, autonomous learning and mathematical skills. Research on the effectiveness of inquiry in enhancing critical thinking affirms that the inquiry learning model is effective in improving the quality of critical thinking in students' scientific (Pujani, 2022) and cognitive learning (Zain, 2018; Sutiani et al., 2021; Adnan, et al., 2021). Regarding the effectiveness of inquiry in skill development, they mention that teachers using inquiry models improve learners' cognitive skills and critical thinking (Adnan, et al., 2021; Wale, & Bishaw, 2020). So also that inquiry-based learning strategies significantly improve students' knowledge on topics developed in science; it allows greater acquisition (Nybo & Mayo, 2015), promotes meaningful learning, construction and management of scientific knowledge and turns the teacher into a learner together with his or her learners (Gómez, et al 2017; Castillo, 2019). On the other hand, it is also mentioned that inquiry is effective in the development of scientific skills (Sosa and Dávila, 2019), since this approach effectively trains learners' metacognitive capacity at an even higher level, makes learners reflect, investigate, solve problems and make decisions (Nunaki et al., 2019). Also, articles on inquiry in autonomous learning, mentions that inquiry learning

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

gives learners the opportunity for independent learning (Arantika et al., 2019); it encourages learners to think and work autonomously, stimulates learners to think scientifically and solve problems on their own (Husni, 2020; Utaminingsih, 2022). Also, research on inquiry in strengthening scientific literacy argues that inquiry effectively and efficiently promotes students' scientific literacy, thinking skills, and scientific attitude (Pratiwi et al., 2021; Vergara and Tovar 2017). Moreover, articles on inquiry in the development of creative thinking, claim that the inquiry learning model is more effective than in traditional learning in developing students' creative thinking skills (Suardana et al., 2019; Asy'ari, et al., 2021; Nurhadi et al., 2016) since in inquiry skills are practiced in terms of completeness and originality (Suardana et al., 2019). Finally, research on inquiry in the development of mathematical skills tells us that inquiry learning in mathematics effectively promotes the development of learners' reasoning skills (Sen et al., 2021), is effective in optimizing the quality of problem-solving skills (Pujani, 2022; Divrik et al., 2020).

The objective of this research article is to explain how inquiry learning influences the integral formation of students. Also, to make known the effectiveness of this strategy in learning since it favors the development of scientific skills, the construction of scientific knowledge, motivates the active participation of the student, allowing them to use the skills that scientists use when conducting research (Mariños and Apolaya 2021), to achieve the objectives established in a culture of science and to develop critical thinking (Gallejo and Márquez 2018), thus achieving the integral development of the student. In this process of inquiry learning, it is important to highlight the role of the teacher, who must be reflective in his pedagogical activities, knowing that he not only directs the student to make decisions as a scientifically literate citizen, but also constantly reconstructs his professional knowledge (Vergara and Tovar 2017). Regarding the research on the effectiveness of inquiry learning, this was conducted from the systematic review of 48 scientific articles from reliable sources of Scopus, Eric, Google Sholar databases, among others. On the other hand, one of the problems that arose was that most of the original articles in English were found in platforms without access to download and visualization. In addition, the results of the study with their respective conclusions and the bibliography used will be presented.

2 METHODS

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

The research article aims to explain the effectiveness of inquiry-based learning in the comprehensive training of students based on the systematic review, which consists of a study that examines quantitative and qualitative aspects of primary sources with the purpose of summarizing knowledge in order to provide clear information on a specific topic (Manterola et al., 2013; Pardal-Refoyo & Pardal-Peláez, 2020); the systematic review is based on the scientific method, which follows a predefined protocol with strict inclusion and exclusion criteria for the synthesis of the results, allows improving the transparency and reliability of the conclusions obtained (Linares-Espinós E, et al., 2018). The research has a qualitative approach, which is oriented to the study of the meanings of human action and social life, it uses an interpretive methodology, its purpose is to find a theory with which the effectiveness of the data can be verified, the hypotheses are not verified for compelling reasons, they arise during the process and are debugged when more data are collected or are research results (Polanía et al., 2020), The bibliographic search was carried out in primary sources: 68 original articles; and secondary sources: 1 doctoral thesis, making a total of 69 documents explored; in relation to language, articles in Spanish and English were analyzed; as well as from different countries besides Peru, such as Colombia, Indonesia, Turkey, among others. A variety of databases were considered: Scopus, Eric, Google Sholar, Dialnet, Redalyc and Latindex. The review was carried out through search tricks, subject, key words and by bibliography. The validity of the information was given according to the use and contribution to the research problem, therefore only 48 articles were accepted that were published from 2014 to 2022 and those that contained information related to the topic and easy access to all the information of the scientific article in order to analyze the effectiveness of inquiry learning in the development of critical thinking, understanding of information, creativity, scientific and mathematical skills, in addition, inquiry in strengthening autonomous learning and scientific literacy.

3 RESULTS AND DISCUSSIONS

The literature review to perform the analysis on Effectiveness of inquiry learning in the integral formation of students was carried out in 48 documents, including 47

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

original articles and 1 doctoral thesis, which were published from 2014 to 2022, from different databases, languages and nationalities.

After debugging different original and review articles, we have organized the information on the chosen topic. To this end, we will address the contributions of different authors with respect to the following aspects: inquiry and the development of critical thinking, understanding of information, development of scientific and metacognitive skills, development of creativity, strengthening of literacy, strengthening of autonomous learning and strengthening of mathematical skills.

Critical thinking is the ability to explain with an open mind the evidence supporting reasons for solving problems; this ability to interpret and explain empirical data from different perspectives, as well as discussion during lectures, increases self-confidence and activates the learning process (Adnan, et al., 2021). Critical thinking helps students in their professional life because it involves interpretation, analysis, reasoning, evaluation, explanation, and self-regulation (Wale, & Bishaw, 2020). Aspects of critical thinking are: analysis, reasoning, evaluation, and decision making (Verawati et. al 2020). Inquiry learning model is effective in improving the quality of critical thinking in scientific (Pujani, 2022) and cognitive learning of students (Zain, 2018; Sutiani et al., 2021) and university level (Adnan, et al., 2021). Scientific literacy inquiry developed in teaching and learning enhances students' critical thinking (Sutiani et al., 2021). On the other hand, the inquiry model involved in the process of reflection (Verawati et al., 2020) and the inquiry creative processes (ICP) learning model foster critical thinking skills of future science teachers (Wahyudi, 2019; Verawati et al., 2020). This ICP model uses well-constituted and systematic learning through a series of experiential activities that include scientific creativity and scientific process skills Scientific process skills have a great impact on learning because it helps the student to improve higher mental skills such as critical thinking, decision making, and problem solving skills (Wahyudi, 2019). Teachers using guided inquiry models improve learners' cognitive skills and critical thinking (Adnan, et al., 2021). So also, inquiry-based learning in argumentative writing classes strengthens students' critical thinking (Wale, & Bishaw, 2020), being more effective than the traditional learning method considering students' higher level of knowledge and skills, the level is understood as an increase of knowledge and skills in the cognitive domain at the following levels: remembering, understanding, applying, and analyzing (Sotáková et al., 2019). Likewise, process-oriented guided inquiry learning (POGIL) is a model related to constructivism theory

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: 2316-2880

that is learner-centered, making them more active with thinking skills and apt to solve problems through group work (Aiman et al., 2020). Learning science through guided inquiry based blended learning more effectively enhances students' critical thinking (Zain, 2018). For all of the above, it is important and necessary that teachers of regular basic education apply in their classes, inquiry-based learning strategies to promote the development of critical thinking in students as this will allow them to understand, reason, analyze, interpret, and solve problems that are presented to them and they can also apply it to their daily lives and make important decisions for their professional life.

Inquiry learning strategies significantly improve students' knowledge of developed topics in science; allows for greater acquisition (Nybo and Mayo, 2015), development (Letina, 2016) and improvement of scientific knowledge and does not distort the learning of initially underachieving students (Gomez, et al 2017) even for more experienced students, while a step-by-step instructional course limits the development of experiential skills and conceptual knowledge (Wing-Mui et al., 2016); improves understanding of scientific concepts (Koksal and Berberoglu, 2014); achieving better academic results in the field of natural sciences (Abdi, 2014; Gomez et al., 2017; Jiun et al.,2018); students engage in many activities and thought processes that scientists use to produce new knowledge, design and conduct experiments to gather information about questions, formulate explanations from evidence, communicate and justify explanations (Arantika et al., 2019); help to use memory in learning and move to new situations; encourages students to think scientifically and solve emergent problems (Husni, 2020; Utaminingsih, 2022); stimulates higher thinking; makes students significantly more active, receptive and enthusiastic, more questioning and happier to discover new information in the learning process; emphasizes the balanced development of cognitive, affective and psychomotor aspects (Arantika et al., 2019; Husni, 2020). Designing and implementing this approach, requires taking into account the characteristics and previous experiences of the participants; in experimental lessons, it is important that students are actively involved in learning activities before the experimental phase (Sosa and Davila, 2019; Nybo and Mayo, 2015). It is important to be consistent with students in the classroom about what you want to achieve, which means making decisions about what will be learned, what it will be done for and what is the best way to achieve it before practice (Sosa and Dávila, 2019).The inquiry methodology as a didactic strategy

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

is more effective than the traditional teaching methodology, since it significantly favors science learning, privileges experience and prior knowledge, promotes meaningful learning, the construction and management of knowledge and transforms the teacher into a learner together with his students(Castillo, 2019). In this way, valuable and continuous learning is achieved in science teaching, thus favoring scientific and humanistic learning (Tekin. and Mustu (2021). This form of education is more fun and meaningful as it enables and directs the learner to find answer/solution to the question/problem, this leads to a higher level of understanding (Suduc et al., 2015). In science classes, teachers combine in their tasks valuable concepts that are related to scientific competencies and in turn enable the improvement of certain skills: experimentation, exploration of answers in different contexts (Salcedo and Nisperuza, 2022), it is important that these classes help them to understand the subject and are useful in everyday life (Suduc et al., 2015). We can conclude that inquiry-based learning favors the acquisition of scientific knowledge, thus raising the learning level of students, strengthens memory, the ability to solve problems, allows students to actively participate in class, easily receive new information and question what they learn.

Inquiry-based teaching is an approach that develops scientific skills, such as formulating research questions, hypotheses, reasoning and predictions, and helps develop positive and constructive attitudes towards science and science learning. Reasoning is a skill that allows them to correctly analyze what they have observed, learners develop it very well through inquiry (Sosa and Davila, 2019). This approach effectively trains learners' metacognitive ability to an even higher level, it engages learners in various learning activities: reflection, investigation, hypothesizing, information selection, problem solving, decision making, evaluating research findings, and drawing conclusions about possible hypotheses to answer (Nunaki et al., 2019). Metacognitive activities occur when students learn to question and evaluate the opinions of their peers in groups (Hastuti et al., 2020). On the other hand, inquiry-based learning strategy refines metacognitive reading skills; scholars define guessing, analyzing, describing, and identifying the main idea as metacognitive reading skills that can be developed through this strategy (Alshammari, 2022). The use of inquiry methods in science classes has positive effects on students' academic performance, attitudes, and scientific skills (Tekin and Mustu, 2021). Therefore, directing the teacher to inquiry-based activities effectively improves students' performance, inquiry skills and positive attitudes (Koksal and Berberoglu, 2014); since under the teacher's guidance,

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: 2316-2880

the learner has the opportunity to formulate inquiry questions, questions that can be answered through experiments, measurements or observations, which are basic learning in science classes (Sosa and Davila, 2019). Thus, it also allows developing students' reading comprehension and creating a communicative and interactive environment in the classroom (Alshammari, 2022). On the other hand, the Orient-Explore-Explain-Explain-Reflect (OE3 R) strategy, together with inquiry, significantly affects scientific reasoning skills and can be applied to science education at all educational levels as they stimulate the student to better understand the research process that researchers go through (Septyastuti et al., 2021); effectively improves computational thinking (Sulistiyo et al., 2020); as well as, scientific process skills (Utaminingsih, 2022). Guided inquiry has a positive effect on students' cognitive and affective characteristics, as it improves understanding of scientific concepts, as well as inquiry skills and attitudes towards science (Koksal and Berberoglu, 2014). The scientific process skills taught through this approach are superior to those in traditional classrooms; it optimally engages all students' abilities to search and investigate systematically, critically, logically, and analytically so that students can articulate their observations with confidence. It also develops intellectual, emotional, and scientific process skills (Juniar et al., 2021). Incorporating these methodologies in the science classroom is important for them to continue the acquisition of new skills and cognitive processes (Arantika et al., 2019). Indeed, inquiry is able to develop higher order thinking skills (Qamariyah et al., 2021); moreover, they can observe the activity, ask questions, correct, and share their knowledge with their classmates (Jiun et al., 2018); the teacher plays an important role as a motivator, guide, facilitator, and leader of learning (Qamariyah et al., 2021). Then, the importance of effective use of these methods in science education programs and courses is clear (Tekin and Mustu, 2021). Therefore, inquiry learning allows the development of scientific, metacognitive and intellectual skills, since through inquiry the student reflects on his own learning, explores, investigates, selects scientific information, formulates hypotheses, solves problems and makes decisions.

Autonomous learning is a set of learning strategies that allow learners to plan creatively to acquire skills and engage in independent learning (Venegas, 2021). Science-based learning succeeds in providing students with the opportunity for independent learning (Arantika et al., 2019); encourages students to think and work independently; avoid traditional learning; encourages students to think scientifically

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: 2316-2880

and solve emergent problems (Husni, 2020; Utaminingsih, 2022);this allows the learner to be the sole artificer of his own growth and develop his decisions, methods, ideas, tools, techniques, methods, thus using his ability to learn voluntarily, to take on the challenges that he faces (Venegas, 2021); during the science sessions, learners, successfully acquire at least some of the skills, seek and find help from teachers as facilitators, which effectively affects the development of the students' scientific process skills (Arantika et al., 2019). Autonomous learning and inquiry-based learning (ABI) are related because both require changes in curriculum design, ease of access to scientific sources and information technologies, efforts that ensure deep learning. The implementation of ABI in higher education allows the development of new and interdisciplinary work that develops students' research skills by introducing them to the scientific research process. In addition, it allows a natural connection between man and his socio-natural world (Espinel-Guadalupe et al., 2016). Inquiry learning is effective in improving self-efficacy because it offers more diverse sources of self-efficacy, such as mastery experience and cognitive rehearsal (Sulistiyo, 2020); it also moves learners from participation to constructive action. It also allows learners' creative ideas to develop more constructively. Learners choose to work with teachers, but as they make decisions and speak for themselves, it becomes clear to learners that their participation roles have changed (Yıldız-Feyzioğlu and Demirci, 2021). Then, we can say that inquiry-based learning enables students to learn, to think and work independently, to be the one responsible for their own learning, the constructor of their own knowledge that will enable them to make decisions in an assertive way.

The term scientific literacy described in PISA 2015 answers the question of what today's young people should know, value and be able to do in situations related to science and technology (Romero-Ariza 2017). Scientific literacy has the following characteristics: orientation and explanation of content, conceptualization is planned through questioning and hypothesis phases, hypotheses are tested in a process of inquiry that includes stages of research, experimentation and interpretation of data to obtain new information, the conclusion stage are decision-making processes to form explanations, finally contextualization and recontextualization are steps in the analysis of research processes through communication and reflection.The attitude and the level of engagement of students in learning depends largely on the control of scientific literacy (Sutiani et al., 2021). It is significant to learn with inquiry to develop scientific literacy (Widowati et al., 2017; Ristanto et al., 2017). The execution of inquiry education

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

turns the learner into a scientist who wants to understand nature as a scientific application and give an explanation about what he/she has learned (Rakhmawan et al, 2015). Ristanto et al., 2017) Mastering scientific literacy, enables students to plan and design experiments for scientific inquiry, ask questions, formulate hypotheses, design experiments to test hypotheses, gather information, draw conclusions. This skill provides students with a systematic scientific way of thinking about learning and work tasks (Sutiani et al., 2021; Pratiwi et al., 2021). POGIL, a process-oriented guided inquiry learning model that uses real-world tools to help students use expository learning, influences students' scientific literacy and critical thinking (Aiman et al 2020). Research effectively and efficiently promotes students' scientific literacy, thinking skills, and scientific attitude (Pratiwi et al., 2021; Vergara and Tovar 2017). In this sense, it is important to start from the integration of the professional knowledge of the science teacher to increase cognitive and attitudinal research skills and thus develop the scientific thinking of learners who, as citizens of the future, make responsible decisions about the advances, limitations and risks of science and technology in society from the point of view of scientific literacy (Pratiwi et al., 2021), as well as providing tools for teachers to improve their pedagogical practices. In this sense, a reflective teacher in his pedagogical activities not only directs the student to make decisions as a scientifically literate citizen, he also constantly reconstructs his professional knowledge and projects himself as a teacher at the social level through the skills offered by scientific literacy (Vergara and Tovar 2017). Therefore, inquiry-based learning is effective in strengthening scientific literacy because thanks to inquiry the student is able to plan, design experiments to test hypotheses, collect data, and draw conclusions, thus achieving an attitude and commitment of the student towards learning science.

Scientific creativity is the ability to discover, solve new problems, and formulate hypotheses (Panjaitan & Siagian, 2020). The components of creative thinking are fluency, flexibility, and refinement. Creative thinking influences students' scientific processes (Juniar et al., 2021). The development of scientific process skills and scientific creativity is promoted by scientific learning (Panjaitan & Siagian, 2020). Directed inquiry learning with creative thinking skills enhances students' scientific process skills, especially in science courses when they actively participate in learning they succeed in making their own discoveries. Learning that includes creative thinking skills is necessary for formulating problems, forming hypotheses, making decisions,

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: 2316-2880

and drawing conclusions (Juniar et al., 2021). An inquiry learning model is more effective than in traditional learning in developing students' creative thinking skills (Suardana et al., 2019; Asy'ari, et al., 2021; Nurhadi et al., 2016) as in inquiry skills are practiced in terms of completeness and originality (Suardana et al., 2019). For this, it is important to allow greater contextualization of the learning material to everyday life, so that it is easier for them to relate their initial knowledge to the new knowledge being taught (Asy'ari, et al., 2021). Definitely, inquiry effectively favors the development of creativity since students actively participate in science classes, putting into practice all their creativity, originality and scientific skills that inquiry allows.

Problem solving is one of the higher order thinking skills that requires the ability to understand, apply, analyze and evaluate (Gunawan et al., 2020). Prediction, explanation, generalization, and reasoning ability, are one of the indicators of reasoning ability. Inquiry-based learning in mathematics (IBL-M) positively promotes the development of students' reasoning skills (Sen et al., 2021), is effective in improving the quality of problem-solving skills (Pujani, 2022; Divrik et al., 2020); it offers the opportunity to identify, discover, and develop students' reasoning skills (Sen et al., 2021); in addition, it provides problem-based learning that allows students to learn through problem solving (Pujani, 2022); this approach requires students to logically explain their solutions or justify their answers with a "why." The National Council of Teachers of Mathematics (NCTM, 2000) emphasizes the importance of mathematical problem solving in the IBL-M process, where learners engage in mathematical reasoning, speculation, questioning, and problem solving (Sen et al., 2021). On the other hand, the inquiry model combined with an advanced applied organizer enhances students' problem-solving skills. Each step of the problem-solving process can be effectively enhanced by inquiry activities combined with an experienced organizer (Gunawan et al., 2020). We also have, the process-oriented inquiry-guided learning (POGIL) model an innovative learning method to enhance students' logical thinking in mathematics. POGIL classrooms are characterized by high levels of activity, student discussion of content, student connections, and immediate feedback on what students know and think. Inquiry activity ensures students' physical and mental engagement in the learning process (Andriani et al., 2019). Likewise, process-based guided inquiry learning with feedback is effective in developing students' mathematical thinking skills because they meet the criteria of: learning mathematics with enthusiasm and without pressure; the teacher provides a learning experience, the purpose of which is to

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

understand the material and construct one's own knowledge with the help of discussion and guidance. Peer feedback helps to improve cooperation in learning mathematics, helping each other in learning activities to better understand the topic they have not mastered (Shora, 2020). An inquiry-based learning method supported by metacognitive strategies effectively develops students' problem-solving and problem-solving skills. In addition, the application of the inquiry processes offered in the curriculum enables students to structure their knowledge by developing independent questions. Students with greater metacognition are better problem solvers (Divrik et al. 2020). To further improve students' mathematics achievement and learning skills, teachers must design effective lesson plans that implement inquiry-based learning (Santos and Boyon 2020); in this process, the role of the teacher as a facilitator and guide of the learning process is important(Gunawan et al., 2020), in addition, he/she should be creative in selecting and implementing innovative teaching as POGIL(Andriani et al., 2019); therefore, teachers should organize lessons effectively by knowing and understanding the nature of students and improving their content management (Gunawan et al., 2020;). Then, inquiry-based science lessons play a very important role because through them, learners can learn about the environment around them and everything in it (Pujani, 2022) have a positive impact on the mastery of basic numeracy study skills (Santos and Boyon 2020). Inquiry learning encourages students to engage in active mathematical activities (Hastuti et al., 2020). Thanks to this approach, students strengthen the development of their mathematical skills because it allows them to understand, inquire, analyze, interpret, predict, draw conclusions, and communicate what they have learned, important skills for solving mathematical problems that they can apply in their daily lives.

4 CONCLUSION

First: It is important that regular basic education teachers apply in their classes, inquiry-based learning strategies to promote the development of critical thinking in students as this will allow them to understand, reason, analyze, interpret, and solve problems that are presented and can also apply it to their daily life and make important decisions for their professional life.

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

Second: Inquiry-based learning favors the acquisition of scientific knowledge, thus raising the students' learning level, strengthening their memory, their ability to solve problems, allowing students to actively participate in class, to easily receive new information and to question what they learn.

Third: Inquiry allows the development of scientific, metacognitive and intellectual skills, since thanks to inquiry the student reflects on his own learning, explores, investigates, selects scientific information, formulates hypotheses, solves problems and makes decisions.

Fourth: Inquiry learning allows students to learn, to think and work independently, to be responsible for their own learning, to build their own knowledge that will allow them to make assertive decisions; students choose to work with teachers, but as they make decisions and speak for themselves they assume new roles.

Fifth: Inquiry effectively favors the development of creativity since students actively participate in science classes, when they actively participate in learning they manage to make their own discoveries putting into practice all their creativity, originality and scientific skills that inquiry allows,

Sixth: Thanks to inquiry the student is able to plan, design experiments to test hypotheses, collect data, and draw conclusions, thus achieving an attitude and commitment of the student towards learning science, effectively strengthening scientific literacy and critical thinking of students.

Seventh: Thanks to this approach, students strengthen the development of their mathematical skills because it allows them to understand, inquire, analyze, interpret, predict, draw conclusions and communicate what they have learned, thus strengthening their skills necessary for solving mathematical problems, important for them to apply in their daily lives.

Eighth: In the search for information based on the literature review, the effectiveness of inquiry in strengthening cooperative work has not yet been studied, considering that it allows understanding, development of scientific skills and meaningful learning in science classes.

REFERENCES

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

Abdi, A. (2014). The effect of inquiry-based learning method on students' academic performance in science course. Universal journal of educational research, 2 (1), 37-41.

Adnan, G., Zulfikar, T., Armia, MS, Gade, S., & Walidin, W. (2021). Impacts of inquiry learning model on students' cognitive and critical thinking skills. Cypriot journal of educational sciences, 16 (3), 1290-1299.

Aiman, A., Hasyda, S., & Uslan (2020). The influence of Process Oriented Guided Inquiry Learning (POGIL) realia media assisted model in improving scientific literacy and critical thinking skill of elementary school students. European Journal of Educational Research, 9(4), 1635-1647. https://doi.org/10.12973/eu-jer.9.4.1635.

Andriani et al., 2019:The effects of process-oriented guided inquiry learning environment on students' self-regulated learning skills.

Aramendi Jauregui, P.; Arburua Goinetxe, R.M. and Buján Vidales, K. (2018). Inquiry-based learning in secondary education. Revista de Investigación Educativa, 36(1), 109-124.DOI: http://dx.doi.org/10.6018/rie.36.1.278991

Arantika, J., Saputro, S., & Mulyani, S. (2019, February). Effectiveness of guided inquiry based module in enhancing scientific process skills. In Journal of physics: conference series (Vol. 1157, No. 4, p. 042019). IOP Publication.

Asy'ari, M., Ikhsan, M., & Muhali.(2019). The Effectiveness of Inquiry Learning Model in Improving Prospective Teachers' Metacognition Knowledge and Metacognition Awareness. International Journal of Instruction, 12(2), 455-470. https://doi.org/10.29333/iji.2019.12229a.

Castillo, A. J. (2019). The inquiry methodology as a didactic strategy oriented to favor the learning of physics in 11th grade students. Retrieved from: http://hdl.handle.net/20.500.12749/6963

Codina, Lluís (2020). How to do traditional or systematic literature reviews using academic databases ear canaloma: a case series study. ENT Journal, 11(2), 139-153. Epub Oct 13, 2020.https://dx.doi.org/10.14201/orl.22977.

Divrik, R., Pilten, P., & Tas, AM (2020). Effect of inquiry-based learning method supported by metacognitive strategies on problem solving and problem posing skills of fourth grade students: a mixed methods investigation. International Electronic Journal of Primary Education, 13 (2), 287-308.

Espinel-Guadalupe, J., Robles, A. J., Ramírez-Calixto, C., & Ramírez-Anormaliza, R. (2016). Inquiry-based learning: UNEMII case. Revista Ciencia UNEMI, 9(21), 49-57.

Gómez, M. C. S., Maldonado, K., Acevedo, E., & Said, A. (2017). A didactic proposal based on scientific inquiry for teaching ecological sciences. Diálogos educativos, (33), 20-34.

Gunawan, G., Harjono, A., Nisyah, MA, Kusdiastuti, M. and Herayanti, L. (2020). Enhancement of students' problem solving skills using inquiry learning model

combined with advanced organizer. International Journal of Instruction, 13 (4), 427-442.

Hastuti, I. D., Surahmat, Sutarto, & Dafik (2020). The Effect of Guided Inquiry Learning in Improving Metacognitive Skill of Elementary School Students. International Journal of Instruction, 13(4), 315-330. https://doi.org/10.29333/iji.2020.13420a

Husni, H. (2020). The Effect of Inquiry-based Learning on Religious Subjects Learning Activities: An Experimental Study in High Schools. Jurnal Penelitian Pendidikan Islam, 8(1), 43-54.

Jiun, L. T., Kamarudin, N., Talib, O., & Hassan, A. (2018). The Effect of Structured Inquiry-Based Teaching on Biology Students' Achievement Test. International Journal of Education, Psychology and Counseling, 3(12), 81-89.

Juniar, A., Far dilah, R., & Tambunan, P. (2020). The Distinction of Students' Science Process Skill and Learning Activities between.

Koksal, EA and Berberoglu, G. (2014). The effect of guided inquiry instruction on Turkish sixth grade students' achievement, science process skills and attitudes towards science. International Journal of Science Education, 36 (1), 66-78.

Letina, A. (2016). Effectiveness of Inquiry-Based Science and Social Studies Teaching in the Development of Students' Scientific Competence. Croatian Journal of Education: Hrvatski časopis za odgoj i obrazovanje, 18(3), 665-696.

Linares-Espinós E, et al. Methodology of a systematic review. Actas Urol Esp. 2018. https://doi.org/10.1016/j.acuro.2018.01.010.

Manterola, C., Astudillo, P., Arias, E., Claros, N., & MINCIR, G. (2013). Systematic literature reviews. What to know about them. Cirugía española, 91(3), 149-155.

Nunaki, J. H., Damopolii, I., Kandowangko, N. Y., & Nusantari, E. (2019). The Effectiveness of Inquiry-based Learning to Train the Students' Metacognitive Skills Based on Gender Differences. International Journal of Instruction, 12(2), 505-516. https://doi.org/10.29333/iji.2019.12232a

Nurhadi, Lukman, Abas, R., Erni, Yuliana and Hamrina (2016). Implementation of inquiry-based learning to enhance the understanding of the concept of creative and dynamic thinking skills electric (an empirical study in high school students of class IX State 4 Kendari).

Nybo, L., & May, M. (2015). Effectiveness of inquiry-based learning in an undergraduate exercise physiology course. Advances in Physiology Education, 39(2), 76-80. doi:10.1152/advan.00161.2014.

Pardal-Refoyo, José Luis, & Pardal-Peláez, Beatriz (2020). Annotations for structuring a systematic review. ENT Journal, 11(2), 155-160. Epub Oct 13, 2020.https://dx.doi.org/10.14201/orl.22882.

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

Panjaitan, M. B., & Siagian, A. (2020). The Effectiveness of Inquiry Based Learning Model to Improve Science Process Skills and Scientific Creativity of Junior High School Students. Journal of Education and e-Learning Research, 7(4), 380-386.

Polanía Reyes, C, Cardona Olaya, F, Castañeda Gamboa, G, Vargas, I, Calvache Salazar, O and Abanto Vélez, W. (2020). Quantitative & Qualitative research methodology. Institución Universitaria Antonio José Camacho.

Pratiwi, AK, Makhrus, M. and Zuhdi, M. (2021). The effectiveness of learning media based on guided inquiry model in improving students' scientific literature skills and scientific attitudes. Jurnal Pijar Mipa , 16 (5), 636-639. https://doi.org/10.29303/jpm.v16i5.3041

Pujani, New Mexico (2022). The effectiveness of inquiry learning model on basic science learning materials on problem solving and critical thinking skills. Jurnal Pendidikan Dan Pengajaran, 55 (1), 173-181. https://doi.org/10.23887/jpp.v55i1.44722

Qamariyah, SN, Rahayu, S., Fajaroh, F. and Alsulami, NM (2021). The effect of implementing inquiry-based learning with socioscientific problems on students' higher order thinking skills. Journal of Science Learning, 4 (3), 210-218.

Ristanto, RH, Zubaidah, S., Amin, M., & Rohman, F. (2017). Students' scientific literacy learned through guided inquiry. International journal of research and review, 4 (5), 23-30.

Romero-Ariza, M. (2017). Inquiry learning: is there sufficient evidence of its benefits in science education? Eureka journal on science education and outreach, 14(2), 286-299.

Salcedo, D. P. C., & Nisperuza, E. P. F. (2022). Inquiry competence in learning the physical environment in e-learning environments in 5th grade students. Revista Boletín Redipe, 11(2), 302-317.

Santos, JC and Boyon, M. (2020). Effect of inquiry-based lessons on STEM students' learning competencies on limits and continuity. PUEBLO: International Journal of the Social Sciences.

Sen, C., Ay, Z. S., & Güler, G. (2021). The Effectiveness of Inquiry-Based Learning on Middle School Students' Mathematics Reasoning Skill. Athens Journal of Education, 8(4), 417-440.

Septyastuti, HL, Sutrisno and Widarti, HR (March 2021). The effectiveness of inquiry-based learning with OE3R strategy for scientific argumentation skill. In AIP Conference Proceedings (Vol. 2330, No. 1, p. 020004). AIP Publishing LLC.

Shora, Ry (2020). Effectiveness of process-oriented guided inquiry learning with peer feedback on students' achievement of mathematical reasoning skills. International Journal of Instruction, 13 (3), 555-570.

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

Sosa, J. A., & Dávila, D. T. (2019). Inquiry-based teaching in the development of scientific skills. Educación y Ciencia, (23), 605-624. https://doi.org/10.19053/0120-7105.eyc.2019.23.e10275

Sotáková, I., Ganajová, M. and Babincáková, M. (2019). The effectiveness of implementing inquiry activities in the teaching process at the stage of reviewing and deepening the learning content. In Baltic International Symposium on Science and Technology Education. Scientia Socialis Ltd. 29 K. Donelaicio Street, LT-78115 Siauliai, Republic of Lithuania.

Suardana, IN, Selamet, K., Sudiatmika, AAIAR, Sarini, P. and Devi, NLPL (October 2019). Effectiveness of guided inquiry learning model for enhancing students' creative thinking skills in science learning. In Journal of Physics: Conference Series (Vol. 1317, No. 1, p. 012215). IOP Publication

Suduc, A. M., Bizoi, M., & Gorghiu, G. (2015). Inquiry based science learning in primary education. Procedia-Social and Behavioral Sciences, 205, 474-479.

Sulistiyo, MAS and Wijaya, A. (July 2020). The effectiveness of inquiry-based learning on computational thinking skills and self-efficacy of high school students. In Journal of Physics: Conference.

Sutiani, A., Situmorang, M. and Silalahi, A. (2021). Implementation of an Inquiry Learning Model with Scientific Literacy to Enhance Students' Critical Thinking Skills. International Journal of Instruction, 14(2), 117-138.

Tekin, G., & Mustu, Ö. E. (2021). The Effect of Research-Inquiry Based Activities on the Academic Achievement, Attitudes, and Scientific Process Skills of Students in the Seventh Year Science Course. European Educational Researcher, 4(1), 109-131.

Utaminingsih, S. (2022). The Effectiveness of Guided Inquiry on Understanding Mathematical Concepts. ANP Journal of Social Science and Humanities, 3, 70-76.

Venegas Claros, J. M. L. (2021). Scientific inquiry, formative feedback in autonomous learning in science and technology at IE Celso Lino Ricaldi, Ugel 04, 2020.

Verawati, N. N. N. S. P., Hikmawati, H., & Prayogi, S. (2020). The Effectiveness of Inquiry Learning Models Intervened by Reflective Processes to Promote Critical Thinking Ability in Terms of Cognitive Style. International Journal of Emerging Technologies in Learning (iJET), 15(16), pp. 212-220. https://doi.org/10.3991/ijet.v15i16.14687

Vergara, C. M. M., & Tovar, C. H. B. (2017). Inquiry-based learning towards scientific literacy of students at EI no. 3 Santa Catalina de Siena de Maicao-La Guajira. Biography, 1238-1246.

Wahyudi, NNSP, Ayub, S. and Prayogi, S. (2019). Effectiveness of creative inquiry-process learning model in promoting critical thinking skills of prospective physics teachers. In Journal of Physics: Conference Series (Vol. 1417, p. 012071).

Submetido em: 13/03/2024
Aprovado em: 30/03/2024
Avaliação: Double Blind Reviewe
ISSN: **2316-2880**

Wale, BD and Bishaw, Kansas (2020). Effects of using inquiry-based learning on critical thinking skills of English as a foreign language learners. Asian-Pacific Journal of Second and Foreign Language Education , 5 (1), 1-14.

Widowati, A., Widodo, E., & Anjarsari, P. (2017, November). Developing scientific literacy through nature of science (NoS) within an inquiry-based learning approach. In Journal of Physics: Conference Series (Vol. 909, No. 1, p. 012067). IOP Publication.

Wing-Mui Winnie So, Nga-Yee Irene Cheng, Cheuk-Fai Chow & Ying Zhan (2016) Learning about types of plastic waste: effectiveness of inquiry learning strategies, Education 3-13, 44:3, 311-324, DOI: 10.1080/03004279.2014.976239.

Yıldız-Feyzioğlu, E., & Demirci, N. (2021). The Effects of Inquiry-Based Learning on Students' Learner Autonomy and Conceptions of Learning. Journal of Turkish Science Education, 18(3), 401-420.

Zain, AR (2018, September). Effectiveness of guided inquiry based blended learning in physics education for improving high school student's critical thinking skills. In Journal of Physics: Conference Series (Vol. 1097, No. 1). IOP Publication.