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PROBLEM-BASED LEARNING (PBL) IN BASIC EDUCATION: A LITERATURE REVIEW

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ABSTRACT: This article aims to present a systematic review of a survey of scientific productions on “Problem-Based Learning - PBL” and its use for education with a focus on Basic Education. We analyzed studies published from 2010 to 2023, in the thematic area: human sciences and education in English, Portuguese and Spanish, in four databases: Scientific Electronic Library Online - SciELO, Google Scholar, Capes Periodicals and ERIC. The following descriptors were used: “Active Methodology”, “Problem Based Learning”, “Problem Based Learning” AND “Elementary Education”, “Active Methodology AND Problem Based Learning” and “Problem Based Learning” AND “Elementary Education”. The scope of this review included 209 articles from the SciELO database, 55 from Google Scholar, 12 from Capes Periódicos and 45 from ERIC. These numbers of productions show little representativeness after going through the inclusion and exclusion criteria, the latter being research that does not include Basic Education and research published in journals that are not in the field of education. This review shows in numbers the need to have scientific productions in Portuguese and with a focus on Basic Education on this methodology, which has been adhered to by education professionals due to its benefits for an innovative education and fostering skills necessary for the adult life of the student.

Keywords: Problem-based learning; active methodologies; basic education; liberating education; critical-reflective citizen.

INTRODUCTION

At the turn of the century, many things changed, due to the speed with which information spread and the shortening of distances due to technological advances, so that not only did this technological aspect “enter” classrooms, but it also polarized the issue that, while on the one hand we have all this technological advancement, on the other, there is an increasing demand for a humanizing education, making pedagogical and educational practices intend to unite technology and human formation.

In this scenario, in which there is a demand for new ways of dealing with knowledge, making the student the center of the teaching/learning process, the concept of “Problem-Based Learning (PBL)” emerges from the perspective of “Active Methodologies” as an innovative learning method, in contrast to traditional teaching models, in which the teacher is the center of the process of transmitting knowledge to students who only receive and memorize the knowledge transmitted.

With these new forms of educational practice in mind, the concept of Problem-Based Learning coined by Barrows (1986) represents a learning method based on using problems as a starting point for acquiring and integrating new knowledge. In essence, it promotes student-centered learning, with teachers facilitating the process of knowledge production.

That said, it is necessary to discuss how this methodology can actually help students and educators to build knowledge from the problems that surround them and thus be able to transform them into opportunities for solutions, as well as ways of thinking and rethinking the future, as a pedagogical option that really aims to prepare citizens for the 21st century. However, there are not many scientific productions on the use of this methodology in basic education, so the question arises: “Are there not many productions in Portuguese on

the subject in Basic Education because it is an unprecedented method in national territory?”

Therefore, the aim of this data survey is to review previous productions in databases and authors who have studied Problem-Based Learning and how it has been described and used in Basic Education.

METHOD: RESEARCH STRATEGIES

We analyzed studies published from 2010 to 2023, in the thematic area: human sciences and education in English, Portuguese and Spanish, in four databases: Scientific Electronic Library Online - SciELO, Google Scholar, Capes Periodicals and ERIC. The following descriptors were used: “Active Methodology”, “Problem Based Learning”, “Problem Based Learning” AND “Elementary Education”, “Active Methodology AND Problem Based Learning” and “Problem Based Learning” AND “Elementary Education”. All scientific productions containing the descriptors researched were included in this study, following two criteria: inclusion and exclusion.

Inclusion criteria: reading the titles of articles focusing on basic education in primary and secondary schools and the various ways of applying the method in the classroom.

Exclusion criteria: reading the titles of scientific articles that do not focus on the area of Education, Basic Education in Primary and Secondary Schools, or do not apply the method in the classroom. Similarly, articles focusing on medicine, education in the training of doctors and nurses, higher or postgraduate education, engineering or isolated disciplines were excluded.

DATA COLLECTION AND INTEGRATIVE REVIEW

The systematic literature review was carried out in the *Scientific Electronic Library Online* (SciELO) database under the terms “Active Methodology and Problem-Based Learning”. The *Google Scholar* database was searched for the terms “Problem-Based Learning” AND “Basic Education”. The CAPES database was searched for the terms “Active Methodology” AND “Problem-Based Learning”. Meanwhile, the ERIC database was searched for the term “Problem Based Learning” AND “Elementary Education”. The searches made it possible to analyze scientific articles, dissertations and theses in Portuguese, Spanish and English.

According to Barrows (1986), PBL is a learning methodology based on using problems as a starting point for acquiring and integrating new knowledge. In this way, it promotes student-centered learning, with teachers facilitating the process of knowledge production. In this process, problems are a stimulus for learning and the development of problem-solving skills.

The basic premise of PBL is the use of everyday problems to stimulate the development of conceptual, procedural and attitudinal content. Conceptual content is knowledge of a set of concrete facts, events, situations, data and phenomena (ZABALA, 1998). According to the same author, procedural content is a set of actions organized into processes for a specific objective, such as rules, techniques, methods, strategies, procedures and skills. Still for Zabala (1998), attitudinal content refers to values, such as principles or judgments of conduct, attitudes and norms as rules of behavior to be followed within a society, and are made up of cognitive, affective and behavioral components.

This methodology is also in line with the skills that are developed through its use and the general competencies of Basic Education described in the BNCC, especially competencies 2, 7 and 10, as we can see in the excerpt below:

2. Exercise intellectual curiosity and use science approaches, including research, reflection, critical analysis, imagination and creativity, to investigate causes, develop and test hypotheses, formulate and solve problems and create solutions (including technological solutions) based on knowledge of the different areas. (BNCC, 2018, p. 9)

7. Argue on the basis of facts, data and reliable information in order to formulate, negotiate and defend ideas, points of view and common decisions that respect and promote human rights, socio-environmental awareness and responsible consumption at local, regional and global levels, with an ethical stance towards caring for oneself, others and the planet. (BNCC, 2018, p. 9)

10. Act personally and collectively with autonomy, responsibility, flexibility, resilience and determination, making decisions based on ethical, democratic, inclusive, sustainable and solidarity principles. (BNCC, 2018, p. 10)

When relating PBL and the BNCC (2018), it is clear that this methodology fits into pedagogical practice in order to make students reflect on the reality in which they are inserted, giving them the tools to transform it through the exercise of intellectual curiosity through the investigations that the methodology provides, the creation of arguments based on facts and reliable information and dialog between individual and collective actions.

It is important to consider innovative ways of teaching in order to achieve the development of the competences shown above, so that students become critical-reflective thinkers and align the knowledge developed in the school environment with their realities. According to Freire (1987), Dewey (1976), Berbel (1998), Delisle (2000) and Souza and Dourado (2015), the analysis of problem situations has been shown to be very relevant to this formation of a more humanizing education, focused on a critical pedagogy. It is therefore important to deepen studies in this

area in order to have more data from different researchers to make a substantially concrete survey on Problem-Based Learning.

Based on the guiding question: “How many and what scientific productions deal with Problem-Based Learning and Basic Education concomitantly?”, the following descriptor was first used: “active methodology” and 67 articles were found. A second descriptor was used: “Problem-Based Learning”, and 142 scientific articles were found in Portuguese, Spanish and English. The following filters were selected: from 1998 to 2020, subject area: humanities and education.

In addition, scientific articles containing the descriptives researched were included in this study, following two criteria: inclusion and exclusion. Inclusion criteria: scientific articles focusing on the broad line of education, basic education in primary and secondary schools and ways of applying the methodology in the classroom.

The exclusion criteria used include: scientific articles that do not focus on the area of education, basic education in primary and secondary schools, or do not apply PBL in the classroom. Similarly, articles focusing on medicine, education in the training of doctors and nurses, higher or postgraduate education, engineering or isolated disciplines were excluded.

Thus, scientific articles were excluded according to the inclusion and exclusion criteria mentioned above. With the first descriptor (active methodology), 57 articles were excluded, leaving 10. With the second descriptor (ABP), 123 articles were excluded, leaving 19.

A total of 29 articles that met the inclusion criteria and served as the basis for the literature review were archived for consultation and organized in an *excel* table. Table 1, below, shows the productions according to the descriptors, having already passed the criteria for reading the titles of scientific productions.

After an initial analysis by title, authors and place of publication, it was realized that some articles were not published in journals in the field of education, so these studies were excluded because they did not belong to the scope of the research. Therefore, 29 scientific articles were selected, taking into account journals with a focus on education, basic education in primary and secondary schools.

After this analysis, 3 scientific articles were discarded from the “Active Methodology” descriptor, leaving 7. With the descriptor “Problem-Based Learning (PBL)”, 14 scientific articles were discarded and 5 were selected, giving a total of 12 scientific studies, combining the two descriptors.

We then read the abstracts, analyzing the objective of the article, the method used, the results and the conclusions of the work. Following this investigation, 4 articles were left from the “Active Methodology” descriptor and 5 from the “Problem-Based Learning” descriptor, with 4 studies appearing in common in the two descriptors mentioned above. After excluding these 4 common articles, 5 scientific articles remained.

In the Google Scholar database, we searched for “problem-based learning” AND “basic education” in review articles between 2010 and 2021, in Portuguese, English and Spanish. 55 results were found. It also eliminated academic texts according to the inclusion and exclusion criteria mentioned above. With the descriptors “problem-based learning” AND “basic education”, 34 articles were excluded, leaving 21. The 21 articles that met the inclusion criteria and served as the basis for the literature review were archived for consultation and organized in an *excel* table.

Based on an analysis of the titles, authors and places of publication, the journals that published the 21 scientific productions archived were researched, taking into account journals with a focus on education, basic

education in primary and secondary schools. Likewise, journals focusing on medicine, education in the training of doctors and nurses, higher education or postgraduate studies were excluded.

After this analysis, 1 scientific production was discarded, leaving 20. Moving on, the abstracts were read, analyzing the objective of the article, the method used, the results and the conclusions of the work. Following this analysis, 6 studies remained, and only 1 scientific production was selected for the research literature review.

In the Capes Periódicos database, we searched for the descriptor “active methodology AND problem-based learning” in peer-reviewed articles, books and dissertations, in the subjects *studies, education, teaching, analyses, pedagogy, learning, students, teachers, teacher education, education & educational resources, teaching methods*, between the years 2010 and 2021, articles in Portuguese, English and Spanish in the journals *educação temática digital, holos, interface, revista ibero-americana de estudo em educação*. 25 results were found.

Once again, scientific articles were excluded according to the inclusion and exclusion criteria mentioned above. Texts with the descriptors “active methodology” AND “problem-based learning” were eliminated, leaving 13. Twelve scientific productions that met the inclusion criteria and also served as the basis for the literature review were chosen for consultation and organized in a table.

We followed the same methodological sequence used in the databases mentioned above and after this analysis, 6 scientific productions were discarded, leaving 6.

After reading the abstracts, the aim of the article, the method used, the results and conclusions of the work were analyzed. Following this analysis, 2 remained, and 1 of these scientific productions proved to be relevant to the research literature review. In the ERIC data-

base, we searched for the descriptor “Problem based learning” AND “elementary education” in peer-reviewed articles, books and dissertations, in the subjects *studies, education, teaching, analyses, analyses, pedagogy, learning, students, teachers, teacher education, education & educational resources, teaching methods*, between the years 2013 and 2021, English language articles and 51 results were found.

Scientific articles were excluded according to the inclusion and exclusion criteria mentioned above. With the descriptor (“Problem based learning “ AND “elementary education”), 6 productions were excluded, leaving 45. They were archived for consultation and organized in an *excel* table, which presented the inclusion criteria and served as the basis for the analysis of the literature review.

Based on the analysis of the titles of the articles, the focus was on education, basic education in primary and secondary schools and ways of applying PBL in the classroom. Likewise, articles focusing on medicine, education in the training of doctors and nurses, higher or postgraduate education, engineering or isolated disciplines were excluded. This left 11 scientific productions archived for later analysis. After reading the abstracts, the aim of the article, the method used, the results and conclusions of the work were analyzed. Following this analysis, 6 remained, and 2 of these scientific productions proved to be relevant to the research literature review.

As a result, the following results were obtained from the articles and scientific productions in the four databases selected, after going through the inclusion and exclusion criteria, analysis of the reading of titles, analysis of the reading of abstracts and analysis of the reading of the work.

THEORETICAL FOUNDATION: IDENTIFYING THE CONCEPTS OF PBL

The initial literature review was carried out on four databases: SciELO, Google Scholar, Capes Periodicals and ERIC, presented 7 scientific productions selected according to the inclusion criteria and the analyses by title, abstract and reading of the work in full. The research found covers the years 1998 to 2021, involving a set of journals: *Revista Brasileira de Estudos Pedagógicos, Educação e Revista, Ciência e Amp, Da Investigação às práticas, Revista Brasileira de Ensino de Física, Educação e Pesquisa, Revista Iberoamericana de Tecnología en Educación y Educación en Tecnología, Revista electrónica de investigación en educación en ciencias, Análise Psicológica, Psicologia Escolar e Educacional, Psicologia Escolar e Educacional, Revista Lusófona de Educação, Educar em Revista, Revista Portuguesa de Educação, Revista Transinformação* and *Revista Holos (IFRN)* in partnership with the University of Minho in Portugal.

According to Botelho, Cunha and Macedo (2011), the most widely used tool for extracting information from selected scientific productions is the synthesis matrix (KLOPPER; LUBBE; RUGBEER, 2007). It has been widely used as a tool for extracting and organizing literature review data due to its ability to summarize complex aspects of knowledge. The matrix should contain information on aspects of the research and allow the researcher to have an overview of data related to a performance of certain points. The interpretation of the selected data enriches and clarifies this data not only for the scientific community in the field, but also for the entire reading public.

On the Scielo platform, three scientific productions stand out, making it possible to understand the path taken by Problem-Based Learning in Brazil. The first is the article by the author Berbel (1998), who in Brazil propa-

gated terms and concepts in Portuguese that were originally translated from English. Berbel (1998) in her book *A problematização e a Aprendizagem Baseada em Problemas (Problematization and Problem-Based Learning)* reports that nursing schools in Rio de Janeiro, São Paulo and Minas Gerais have used the methodology to enrich practical classes in the health area, as well as in the United States and Canada as described by Barrows and Tamblyn (1980) and Barrows (1986). Berbel also reports that at the State University of Londrina, Paraná, there have been study and research groups on the training of nursing assistants and nurse managers since 1995. The purpose of this study was to provide a description and comparative analysis of the Problematization Methodology and Problem-Based Learning. Both, despite having different origins, have common points. In both proposals, teaching and learning are based on challenges. In the Problematization Methodology, as an alternative teaching methodology, the problems are extracted from reality through observation by the students.

According to Berbel (1998), the first reference that used the Methodology of Problematization is the Arc Method, by Charles Magueres, in which the scheme presented by Bordenave and Pereira is known. In this scheme there are five stages that develop from reality or a cross-section of reality: Observation of Reality; Key Points; Solution Hypotheses and Application to Reality (Berbel, 1998, p. 3 and 4). When comparing the Problematization Methodology with the Problem-Based Learning methodology, there are some similarities, especially in the stages of acquiring knowledge and developing skills to solve the problem, as can be seen below.

The aforementioned author uses the concept of PBL described by Sakai and Lima (1996) in their book *PBL: an overview*, in which they compare PBL with traditional pedagogy:

PBL is the main axis of theoretical learning in the curriculum of some medical schools, whose pedagogical philosophy is student-centered learning. It is based on the study of proposed problems with the aim of getting the student to study certain content. Although it is not the only pedagogical practice, it is predominant for learning cognitive content and integrating subjects. This methodology is formative as it stimulates an active attitude on the part of the student in search of knowledge and not merely informative, as is the case with traditional pedagogical practice (SAKAI and LIMA, 1996, p. 3, apud BERBEL, 1998, p. 7).

In the excerpt quoted above, it can be seen that the GPA aims for a more active role on the part of the students in order to get them to research and study subjects and areas that will help them to solve the problem.

Berbel (1998) concludes with an important finding about PBL: when solving problems, individual investigative study is essential for retaining knowledge and after this stage, the results are discussed in the group and thus evaluated to see if they are appropriate for solving the problem presented (BERBEL, 1998, p. 13).

The author also emphasizes that PBL came from a line of research into pedagogical currents based on problem solving, improving its techniques and contextualizing it with the reality of a given moment, as described by the author herself in the following excerpt:

Problem-Based Learning is inspired by the principles of Active Schooling, the Scientific Method, Integrated Teaching and the integration of content, study cycles and the different areas involved, in which students learn how to learn and are prepared to solve problems relating to their future profession (BERBEL, 1998, p.14).

Another article still in the Scielo database belongs to the authors Borochovicus and Tassoni (2021) under the title "Problem-based learning: An experience in elementary school"

which reports that Problem-Based Learning (PBL) is a teaching and learning methodology that seeks to develop content through collaborative work. The methodology can be applied in different areas of knowledge, but there has been little research into it in primary education and more commonly in higher education.

According to the authors, the role of the teacher is to act as an important mediator in learning, working as a collaborator with the students: “Teacher and student are partners in the construction of knowledge, empathy is fundamental and, through it, dialogue is opened up so that the teacher knows the difficulties, demotivation and lack of interest of the student, assuming an attitude of pedagogical mediation” (BOROCHOVICIUS and TASSONI, 2021, p. 4).

According to the authors, the classroom is an environment of social interaction, a representation of the world for students. In this case study, PBL contributed to the perception of oneself and the other in relation to participation and collaboration, which promoted changes in attitude towards group work, with signs of more individual commitment in favor of the collective (BOROCHOVICIUS and TASSONI, 2021, p. 19). The authors also point out that the methodology is commonly used in interdisciplinary projects and generates a problem situation that makes students develop critical-reflective thinking in the exchange of information between research participants to solve the problem situation.

Although PBL was originally created in an interdisciplinary and self-directed learning structure, it can be used with modifications without losing its essence: activities organized in groups, based on a problem situation that generates the development of reflective thinking, research and the exchange of knowledge and experience between people. (BOROCHOVICIUS and TASSONI, 2021, p. 18 and 19)

A third article in the Scielo database, by Freitas (2012), with the title “Teaching through problems: an approach for student development”, Teaching through problems in Brazil, according to Freitas (2012), has been used as an innovative pedagogical proposal, commonly as two approaches: problem-based learning and problematization methodology. These approaches are presented as methodologies that go beyond traditional teaching, with the clear intention of encouraging active student learning. Both do indeed contribute to making students more active in their learning, but they also have some shortcomings. In this text, these inadequacies are discussed, such as: adapting teachers, schools and students to these innovative methodologies; restructuring the vision of educators’ workloads so that there are more collective moments; and reorganizing the physical layout of classrooms so that there is more interaction between students. In this book, the author presents an approach from the perspective of cultural-historical theory: the theory of developmental teaching.

Still according to Freitas (2012), citing Barrows (1986), the general principles of PBL can be described as: teaching centered on the student and their learning process; student responsibility for their learning; consideration of previous learning; active, interactive and collaborative learning; contextualization of teaching; learning is inductive; the teacher’s role as mediator is to create problem situations and coordinate their resolution; the problem situation must precede the theory (FREITAS, 2012, p. 4).

Freitas (2012) also highlights the importance of a methodology based on the assumptions of PBL being innovative and adapting to the challenges of the current century, placing students at the center of their teaching/learning process, compared to other previous pedagogical currents. As mentioned above and

by the author, this methodology has already been used in university circles, but it has not been widely disseminated in basic education:

PBL represents an advance on the transmissive teaching that predominates in university circles, characterized by the student's receptive attitude. By placing the student at the center of the learning scenario, it contributes to forming habits of autonomous learning, initiative and problem-solving capacity. One of its main merits is to situate the learning content in meaningful contexts of action (or professional practice), motivating the student and making them create a sense of responsibility for solving problems. (FREITAS, 2012, p. 5).

As described by the author above, the student ends up feeling part of the situation presented, takes responsibility for researching a solution, thus bringing the theory studied into practice for the concrete reality, thus creating a sense of personal motivation to deal with the resolution, thus making learning that meets the student's daily life, adding more meaning to the content to be developed at school.

In the Google Scholar database, only one scientific production was selected because it was relevant to the research. This article was written in partnership between the Federal Institute of Education, Science and Technology of Rio Grande de Norte (IFRN) and the University of Minho in Portugal, with the authors Souza and Dourado (2015) and entitled "Problem-Based Learning (PBL): An innovative learning method for educational teaching", in which they explore concepts such as: problem situation, individual and collaborative research, teamwork, problem solving; about PBL and trace a historical line of pedagogical currents and philosophical thoughts that led to how it is known today. In this dissertation there will also be a brief historical outline of the origins of PBL. The article reports that Problem-Based Learning emerged as an in-

novative strategy in which students work with the aim of solving a real or simulated problem from a context. It is therefore a learning methodology centered on the student, who leaves the role of passive recipient of knowledge and takes on the role of protagonist of their own learning through research. This article is a review of the basic literature on the subject. The aim is to present PBL as a more meaningful and effective learning methodology that can be used at different levels of education and in a wide variety of subjects.

The authors try to conceptualize PBL based on other researchers who have also been studied and cited in this research. According to the authors, Barrows (1986) describes PBL as promoting student-centered learning with a problem situation as a starting point. Deslile (2000) shares this conceptualization of Barrows (1986) and adds that it is "a teaching technique that educates by presenting students with a situation that leads to a problem that has to be solved". (DESLILE, 2000, p. 5 apud SOUZA and DOURADO, 2015, p.3).

The authors also cite Barell (2007) when he mentions that what drives the use of the methodology is the interpretation of PBL as a curiosity that leads students to ask questions in the face of doubts and uncertainties about complex phenomena in everyday life. In this way, students feel challenged to search for knowledge in order to solve the problem situations presented to them. (SOUZA and DOURADO, 2015, p. 3).

According to Souza and Dourado (2015), the APB is a strategy for learning that is more geared towards students who are keen on an investigative technique in order to produce individual and collective knowledge, encouraging cooperation and critical-reflective analysis in order to solve the challenge.

In line with these various definitions, we present PBL as a method strategy for learning, centered on the student and through investigation, with a view to producing individual and group knowledge, in a cooperative way, and using critical analysis techniques, to understand and solve problems in a meaningful way and in continuous interaction with the teacher tutor. (SOUZA; DOURADO, 2015, p. 3 and 4).

The authors also mention that interaction and the benefit that PBL brings to this is the key to successful learning, as this interaction between students and teachers is present at various levels of this research process (Souza and Dourado, 2015, p. 4). The authors also comment that motivation and curiosity are fundamental to individual and group learning: “motivation, which is stimulated by curiosity about the themes of each area of study, and individual and group communication skills, which are fundamental to the development of group learning (Souza and Dourado, 2015, p.4).

According to the aforementioned authors, the use of PBL follows some essential processes: “PBL has a basic structure governed by general principles that allow it, according to the school level, the university course and the discipline, to be modeled in order to meet each of the specificities (Barrel, 2007; Lambros, 2004 apud Souza and Dourado, 2015, p. 10). These stages would be: developing the problem scenario or context; creating the problem situations; solving the problems; presenting the results and self-assessing the resolution.

The authors also list the benefits and advantages of using PBL, such as: the motivation of some students due to the dynamism of the classes and content presented; the integration of knowledge that enables greater reflection and internalization of the content covered; the development of critical thinking skills through research and curation of information; the

development of interpersonal skills that are fundamental for group work (Souza and Dourado, 2015).

The authors also highlight some difficulties in using PBL: insecurity about the change in teaching and the view of students compared to a more traditional pedagogical approach; the time and speed that is often required of the school curriculum; the inadequacy of the school curriculum, which in turn limits the use of PBL; the limitation of financial resources and infrastructure in the school environment; the use of instruments to assess the knowledge acquired and the understanding of these instruments by students and teachers, since PBL advocates an assessment related to the entire problem-solving process. And finally, the lack of skills or training of the teacher tutor (Souza and Dourado, 2015).

The authors Souza and Dourado (2015) report that the benefits outweigh the difficulties of using Problem-Based Learning and that, given the right precautions, the gains made by the students are rewarding.

In the Capes Periódicos database, we found a master's thesis from the University of São Paulo (USP), by Gazale (2018), entitled “Problem-based learning: a proposal for the final grades of elementary school”, which describes a methodology based on problem-based learning and the skills it tends to foster in students. This research was applied to elementary school students, seeking to develop the following skills: autonomy, initiative, interaction, communication, argumentation, logical reasoning, participation, reflection and creativity, using the transdisciplinary approach as a resource, relating the mathematical content of the Pythagorean Theorem, “Rectangle Triangle”, to the contents of Art and History.

According to Gazale (2018), PBL is a path to be followed, a process to be carried out until it culminates in the final result, which is the solution to the problem situation.

Systematizing this process, it can be said that “The starting point is always the analysis of the problem, going through self-managed studies by the student, the exchange of ideas between group members until reaching the solution to the problem”. (GAZALE, 2018, p. 18). This whole process makes students reflect on the learning process as it happens, a reflection that takes place individually and collectively through the exchange of ideas with the group.

For the author, PBL presents itself as a teaching methodology that presupposes interpersonal relationships and metacognition, i.e. “thinking about thinking” (GAZALE, 2018, p. 19), thus making learning meaningful for the student, creating knowledge networks based on relationships with what they already know and what they can come to understand cognitively.

For Gazale (2018), one of the benefits of using PBL is the collective and individual skills developed during the problem-solving process:

One of the great advantages of this methodology is the way in which work is carried out in groups and with self-management of studies, which leads students to develop inter- and intrapersonal intelligences, fundamental elements for life in society and for collaborative work. (GAZALE, 2018, p. 19 - 20)

Also according to the author, the ABP methodology contributes to the education of the student as well as the educator, as it involves constant reflection on the progress of the work, so that educator and student learn together (GAZALE, 2018). The author goes on to clarify that the methodology requires self-management of studies on the part of the student, and can achieve a transdisciplinary approach, bringing together the theory learned in the classroom with the concrete reality of the students, developing important skills for living in society.

It is a student-centered proposal, which sees self-management of studies as an opportunity to learn for oneself, based on problem situations and can also contemplate a transdisciplinary approach, facilitating the construction of knowledge by contextualizing various contents from different disciplines. This methodology favours the integration of theory and practice, prioritizing not only the development of cognitive skills, but also communicative and creative skills (GAZALE, 2018, p.20).

In addition, Gazalle (2018) sees active, competency-based and contextualized learning as the main premise of PBL, thus promoting the involvement of all students in the teaching-learning process, helping to develop skills and competencies for problem-solving, going against the traditional pedagogy model that advocates the accumulation of knowledge and information by the student (GAZALLE, 2018).

In addition to the students, Gazale’s (2018) research also included math, art and history teachers, both permanent and substitute, as well as the students’ parents.

Gazale (2018) came to the conclusion that PBL and transdisciplinarity are actions that can be carried out, as they require few human and material resources, and also provoke student interest in the activities, as they are carried out in groups, which allow ideas and experiences to be shared.

In the international Eric database, two scientific productions proved to be relevant to the subject of this study. The first, entitled “The Contribution of Metacognitive Skills and Reasoning Skills on Problem Solving Ability Based on Problem Based Learning (PBL) Model” written by Setiawan and Supiandi (2018) in Indonesia, describes that the study of the correlation between metacognitive skills and reasoning skills in problem solving ability simultaneously in the PBL learning model used in the classroom is still not widespread in the Basic Education environment in that country.

The pattern of learning at various levels of education in Indonesia is still largely oriented towards conceptual mastery and has not pursued the empowerment of thinking skills including students' metacognitive skills". The same thing happened to lectures in the Primary School Teacher Education Department STKIP Persada Khatulistiwa Sintang which showed that lecturers have not fully attempted to empower metacognitive skills in lecturing. (Setiawan; Supiandi, 2018, p. 75).

The authors aim to reveal the relationship between metacognitive skills and reasoning skills in the problem-solving ability of students learning mathematics using the Problem-Based Learning (PBL) model. Setiawan and Supiandi (2018) correlate the development of skills such as planning, monitoring and even reorganizing learning strategies with a metacognitive learning process, thinking about thinking, which PBL can provide to students, making them more critical citizens, decision-makers and problem-solvers in their concrete realities.

The goals of instructions are to deliver knowledge and also develop students' abilities to plan, monitor and even reorganize learning strategies. Students with good metacognitive skills are better critical thinkers, problem-solvers, or decision makers than students who are not. (Dawson, 2008 apud Setiawan; Supiandi, 2018, p.76)

The result of the analysis shows that there is a correlation between metacognitive skills and reasoning skills in the student's problem-solving ability when learning math based on the Problem-Based Learning (PBL) model. For the authors, metacognitive skills are essential for developing problem-solving skills, including self-management and planning. Self-management for problem solving is understood as an individual's ability to directly examine the process of problem solving, including research and investigation. For the authors, problem-solving planning involves

a certain complexity in the problem-solving process, the ability to subdivide goals and strategies to solve stages of the problem and sequentially enrich the final resolution.

The correlation between metacognitive skill and reasoning skill on problem solving ability in this research is because metacognitive skill is an important matter in solving problems which includes self-monitoring and planning. Self-monitoring refers to an individual's ability to perform a direct examination of the problem-solving process. Planning involves certain complexity of problem-solving into sub-goals so they can be solved separately and sequentially to enrich the final completion. (SETIAWAN; SUPIANDI, 2018, p.80)

The authors conclude that one of the pedagogical methodologies that enhances the development of metacognitive and problem-solving skills would be PBL, where the focus is centered on the students' reasoning and learning process.

One of the learning models that potentially empower problem solving abilities is Problem Based Learning (PBL). PBLs focus on challenges to make students think. Learning using the PBL model is similar to teaching metacognitive and critical thinking skills to students so it can indirectly develop students learning with PBL models of metacognitive skills and thinking ability. (SETIAWAN; SUPIANDI, 2018, p.80)

The authors even compare teaching through PBL to teaching metacognitive skills and critical thinking skills, which are essential for the challenges of everyday life in the 21st century.

The second scientific production, still in the Eric international database, by author Janet Waltson (2014), from the United States of America, under the title "Teachers as Expert Learners and Fellow Travelers: A Review of Professional Development Practices for Problem-Based Learning", proposes a new look at the methodology on the part of teachers in

making PBL more a part of their classes, and analyzes how prepared these teachers are to use it by mentioning the teaching role in Problem-Based Learning (PBL), which instead of acting as a source of content knowledge, PBL educators are lead learners who demonstrate learning to students through their own authentic investigation: “The label of “teacher” is, in fact, something of a misnomer for the PBL practitioner. Rather than acting as a source of content knowledge, PBL educators are lead learners, demonstrating learning to students through their own authentic inquiry.” (HMELO-SILVER, 2004, p.1 apud WALTSON, 2014, p.67). PBL educators and students travel together along a path that often takes them into uncharted territory.

Although PBL presents unique pedagogical challenges for K-12 teachers, professional development activities that incorporate recognized elements of effective professional development can increase the likelihood of implementation in the classroom.

According to the author, the US is encouraging the use of active methodologies in which the student is at the center of the teaching-learning process, with PBL being one of the most widely used, and which encourage research, critical thinking, problem-solving and communication in order to better prepare students for the challenges of the 21st century, using skills developed in the classroom in their daily lives:

There is a nationwide call for inquiry-based pedagogies such as PBL within the current context of educational reform. In response to this call, the Partnership for 21st Century Skills (n.d.) offers a framework for K-12 educational policy and instructional design in its statement, “Within the context of core knowledge instruction, students must also learn the essential skills for success in today’s world, such as critical thinking, problem solving, communication.” (WALTSON, 2014, p.67).

Waltson (2014) comments that since the emergence of PBL in the 1970s in American medical universities and more recently in basic education, this methodology has replaced the lecture style, as PBL has a more student-centered pedagogical approach, following a number of stages: a semi-structured problem situation related to real life; students conduct research; students apply the researched theory to try to solve the problem; exchange information collaboratively in small groups; teacher as tutor or facilitator of mediation; students responsible for the learning process.

Since its inception in the 1970s in the field of medical education, PBL has replaced or supplemented lecture-based instruction in nursing education, schools of engineering, and, most recently, in K-12 schools (Hmelo-Silver, 2004). PBL is a learner-centered pedagogical approach that integrates the following features: (a) a semi-structured problem with real-world context; (b) student-conducted research; (c) student application of theory to practice in the process of developing a solution; (d) small-group collaboration; (e) teacher as tutor or facilitator; and (f) student responsibility for learning (Hmelo-Silver, 2004; Savery, 2006 apud Waltson, 2014, p. 68).

The author points out a curiosity that can also be seen in Brazil. Despite a lot of encouragement from American educational institutions to apply PBL in Basic Education in the USA, there is little record of research with this content, so there is no substantial data to evaluate the methodology on American territory: “There is little research, however, on PBL and student outcomes in K-12 settings” (HMELO-SILVER, 2004; NRC, 2012 apud WALTSON, 2014, p. 69).

According to Waltson (2014), PBL practices are a departure from traditional pedagogies. However, the research makes an interesting discovery, stating that one is not better than the other, but that they work for different objectives. For the author, PBL is more advan-

tageous for long-term learning, while traditional pedagogy is more beneficial for tasks that require the use of short-term knowledge. It is important to note that the author recommends further research so that more data can be gathered, especially in basic education, because, as previously mentioned, there is not much research in this area.

These researchers found that PBL strategies were superior to traditional classroom instruction in terms of long-term retention, skill development, and teacher and student satisfaction. Interestingly, traditional classroom practices resulted in better outcomes for tasks that require short-term retention, such as standardized tests (WALTON, 2014, p. 69).

The author correlates the possible lack of research with professional development programs that must meet the specific challenges that primary school structures and policy requirements impose on teachers. To implement PBL effectively, teachers must learn to work as facilitators and to investigate with students. While PBL can be challenging for primary school teachers in terms of the structure in which the school is designed and also in terms of curriculum and public policy, programs for the exchange of experiences and professional growth among teachers should be fostered for the use of this methodology due to its benefits for students.

While PBL poses unique pedagogical challenges to K-12 teachers, professional development activities that incorporate recognized elements of effective professional development can enhance the likelihood of classroom implementation. Because, however, PBL practices are a departure from the traditional pedagogies around which school structure is designed, professional development programs also must attend to the specific challenges that school structures and policy requirements pose for teachers. (WALTON, 2014, p.70)

Walton (2014) concludes that PBL is a powerful pedagogical strategy for developing skills such as critical thinking and problem-solving strategies. "PBL is a powerful tool that schools can use to foster critical thinking and problem-solving skills, yet rigid school schedules and lack of cross-curricular rigor create a less-than-amenable environment for PBL in K-12". (WALTON, 2014, p. 90). However, more rigid schedules and curricula make this work more challenging for teachers in basic education, as described by the author.

By reading the scientific productions in their entirety, including the main references in the area, we were able to find the main authors in the study on the subject. An integrative review of the main authors cited in the papers made reading them a *sine qua non*. Authors and researchers who were forerunners in the field, doing research and collecting data on Problem-Based Learning, academics who coined terms and research methods on the subject.

As proven in this research, the literature review was necessary in order to find authors and works that have been references in the area of study with concepts and terms that were of great value in understanding the object researched. As Botelho (2011) reiterates:

The literature review process requires the preparation of a synthesis based on different topics, capable of creating a broad understanding of knowledge. The literature review is a first step in the construction of scientific knowledge, as it is through this process that new theories emerge, as well as recognizing gaps and opportunities for the emergence of research on a specific subject. (BOTELHO, 2011, p.123)

In this way, the literature review guided this research to build scientific knowledge about the object studied and, as stated by Botelho (2011) above, this review also served to give legitimacy to an opportunity for this work to emerge.

FINAL CONSIDERATIONS

This review confirms the need for research on the subject of Problem-Based Learning in Basic Education, where there is a scarcity of published scientific productions, as observed in this review over the last 10 years.

A total of 3 scientific articles were selected from the SciELO database with the descriptors “ACTIVE METHODOLOGY” and “PROBLEM-BASED LEARNING”. In the Google Scholar database with the descriptors “PROBLEM-BASED LEARNING AND BASIC EDUCATION” 1 scientific production was selected. In the Capes Periódicos database, 2 scientific productions were selected. In the ERIC database, with the descriptors PROBLEM BASED LEARNING AND ELEMENTARY EDUCATION, 2 English-language scientific productions were selected. It is worth noting that the inclusion criteria for the scientific pa-

pers were studies published in an education journal, with a focus on primary education and interdisciplinary projects, as this is one of the principles of Problem-Based Learning.

The largest number of productions and case studies using this methodology is in higher education in the areas of health and engineering. This begs the question: “Are there not many productions in Portuguese on the subject in Basic Education because it is a new method in Portugal?”

The research carried out in this review points out that yes, it is an innovative teaching method, and even though it is new to Basic Education, it requires more in-depth research on Problem-Based Learning (PBL) with a focus on Basic Education and published in journals related to the area of Education with researchers who are educators and live the reality of the classroom in Brazil.

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