Artigo Original

Problem Based Learning With Digital Information And Communication Technologies In Learning In Computer Teaching

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Abstract

Digital information and communication technologies play an important role as teaching resources for curricular content. The teacher is motivated to make use of various technologies inside and outside the classroom, such as software and internet interfaces, among others to make the class more interesting to the student, in addition to the teachers' desire to change the dynamics. Teachers have resorted to the use of active methodologies such as case studies, laboratory classes, group work, simulations, Problem Based Learning or Problem Based Learning (PBL), in which the student actively participates in the learning process and the teacher conducts a survey previous student knowledge, problematization, contextualization and practical application of knowledge. The intention is to make the classes closer to the student's reality, making him be active in his learning. In this article we explore

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the importance of using digital information and communication technologies with PBL in higher education, through two didactic sequences applied in the classroom in the Information Systems course at the Federal University of Alagoas and Systems Analysis and Development at the Federal Institute of Santa Catarina. The first using Unity 3D software; the second made use of the Socrative application and used the PBL methodology. In order to verify the satisfaction of the students involved, a questionnaire was applied about the efficiency of the PBL methodology. The results in different courses from different institutions proved the efficiency of using PBL. They showed that the use of the methodology provided better communication between students. Although it requires better preparation by teachers and tutors, it appears that PBL is an interesting methodology to be applied in higher education, both in person and at a distance.

Keywords: Active Methodologies: Digital Information and Communication Technologies; Problem Based Learning.

1. Introduction

The Digital Technologies of Information and Communication (TDIC) assume an important role in the composition of teaching tools of diverse disciplinary contents. The teacher is motivated to make use of various technologies inside and outside the classroom, such as software, electronic equipment, internet interfaces, among others. The attempt to make the class closer and more pleasant to the students of a new generation provokes in teachers the desire to change the dynamics.

The current technological evolution allows us to live with TDIC through mobile phones and digital televisions. In addition, the popularization and evolution of the internet facilitates access to information and communication between people, regardless of geographic location, through so-called social networks. In this sense, such resources can and should be used in different areas of human knowledge, including education.

It is up to the teacher to use TDIC resources to facilitate and improve

the learning process. Therefore, according to Mercado (2014), some skills of teachers are necessary for the use of TDIC, such as: authorship with media; knowledge and use of interaction tools; pedagogical mediation; production of collaborative knowledge; experiences as a source of learning and methodologies centered on activities that require participation, initiative and cooperation in solving problems. Competences that are often not learned or experienced in their academic backgrounds.

The difficulty and challenges experienced in Brazilian higher education are notorious. According to Amaral (2016), such difficulty may be related to the high dropout rate of students, mainly in undergraduate courses, and the needy student / teacher relationship. Dropout sometimes occurs due to students' demotivation, which can be caused, among other factors, by the quality of the classes.

As a way out of demotivation, Higher Education Institutions (HEIs) and teachers have resorted to the use of active methodologies, that is, they encourage students to actively participate in the learning process, becoming the main responsible for learning. In active methodologies such as case studies, laboratory classes, group work, simulations, Problem-Based Learning (PBL) (SILVA, 2013), the teacher probes the student's previous knowledge, problematization, contextualization and practical application of the contents . The intention is to make the classes closer to the student's reality, making him an active being in his learning.

2. PBL as a didactic strategy

The PBL has its roots in the theory of knowledge of the American philosopher John Dewey (1859-1952), through the Escola Nova movement, inserted in a progressive liberal pedagogical trend in Brazil. American-inspired, the Escolovanist conception has a psychological basis centered on the foundation of evolutionary psychology and learning psychology. The movement advocates the solution of educational problems (VEIGA, 2015).

The learning objectives with the use of APB / PBL in higher education

are: to integrate and structure the development of autonomous skills and teamwork around real problems; motivate students to seek solutions; make it possible to raise hypotheses; reframe learning; build knowledge with autonomy.

In this model of teaching and learning, the role of the teacher becomes that of a facilitator, advisor, co-learner, mentor and professional consultant. The performance, in this context, consists of: focusing on student-centered learning; delegate responsibility to students with responsibility; prepare students to be lifelong learners.

According to Ribeiro (2008), the main characteristics of PBL are: meaningful learning; inseparability between theory and practice; respect for student autonomy; small group work; Permanent Education; formative assessment; targeted study; motivation; focus on learning; activities focused on practice or based on teaching cases. The author emphasizes five elements that he considers essential in PBL: presenting problems; ability to integrate concepts from various disciplines; group work; existence of a formal problem-solving process and independent study.

As for the role of students, at PBL they must define, even partially, their objectives and fulfill the following tasks: explore the problems; raise hypotheses; identify learning issues and elaborate them; solve problems with what they know; identify what they don't know, in addition to sharing, applying and evaluating new knowledge.

The focus on the PBL curriculum structure is in the organization of curriculum content by problem scenarios, rather than subjects or disciplines. Students work in groups to resolve or manage these situations, but they are not expected to acquire a predetermined series of "correct answers". In turn, they are expected to engage in the complex situation presented and decide what information they need to learn and what skills they need to gain in order to manage the situation effectively.

The purpose of PBL is to make students learn certain content. It is, therefore, a formative methodology that stimulates the student to an active attitude and that presents a logic similar to scientific research, since starting from the problem they build hypotheses and search for

data, which are analyzed and discussed until reaching a conclusion (GIL, 2012).

In the context of the PBL, the use of TDIC facilitates access and exchange of information, expanding the possibilities of choosing students and teachers and constituting a facilitator in the educational process. He is, in turn, one of the cultural mediators created by man that makes his relationship with the material world possible. These technologies create challenges for HEIs, as they enable new forms of communication between students and teachers, in addition to collaborative learning, in which the mediating role of the teacher is fundamental, as he acts in the teaching-learning process, presenting, problematizing, demonstrating , guiding and provoking critical reflections with a view to transforming reality (RUIZ-MORENO; LEITE; AJZEN, 2013).

PBL is characterized by advocating that students be active learners, confronting them with situations based on real-world problems and making them responsible for their own learning (COLL et al., 2010). TDIC has impacted the design and development of learning processes based on PBL models, favoring both student access to direct, diverse and complex information sources and the communicational and social aspect, mediated by the construction of knowledge.

The advantages of PBL are: it generates intrinsic motivation, as the student feels satisfaction when he discovers knowledge and solves a problem; develops a planning attitude, as he needs to think and plan how to solve the issue, that is, the way to reach the solution; the student works based on hypotheses, so he is encouraged to make decisions, appreciate values and make value judgments, since the activity requires him to exercise reflection (NÉRICI, 1989).

Ribeiro (2008) reports some disadvantages of PBL: students' difficulty in participating and interacting in groups, for being individualistic, competitive and introverted and, for this reason, not adapting to the participatory and collaborative nature of the methodology; exposure to extensive content, which demands an enormous amount of time; the need for a much greater time of dedication, especially at the beginning, both for students and teachers, due to the need to elaborate

the process and execute the dynamics of the method; difficulty in elaborating the problems of some areas of knowledge for the PBL methodology, among others.

Given the scenario of advantages and disadvantages, for the teacher to be able to apply the methodology, he must observe four basic components in PBL: (1) student: main actor of the learning process; (2) teacher or tutor: conductor of the learning process; (3) problem: stimulating the learning process; (4) learning: student-centered.

The use of active methodologies such as PBL, together with educational software that use the internet on smartphones, has favored the development of classes at all levels. Several courses in person or that use Distance Education (DE) have been using the PBL methodology.

In the case of the use of PBL, the proposals must follow the tutorial dynamics described by Delisle (1997): having a starting point that can be realized by interpreting and reading the problem; promote brainstorm (storm of ideas) on the topic to be studied with students; carry out systematization of ideas; formulate questions with the objective of solving them; have learning goals that will be achieved and defined by students; evaluate the process, in order to analyze the behavior towards the group, with an evaluation carried out by the tutor and / or by the students; resume follow-up. With each new tutorial session, the previous one is repeated in order to review whether the learning goals have been achieved, through the questions now formulated by the tutors.

3. Troubleshooting: the focus of the PBL

The active methodologies are focused on students, their previous knowledge of the reality of the social environment in which they are inserted and the technical knowledge acquired in their respective training. In addition, the role of teachers is to act as assistants in the search for the knowledge proposed to these students, as it is up to them to conduct research, interactions and discussions about their professional training. According to Gorbaneff (2010, p. 26, author's translation), the PBL

takes different forms. What unites them is the teachers' conviction that learning begins when students feel the need to solve a problem. According to this method, the teacher, unlike a traditional class, does not explain the concepts or theories, he only starts the discussion by presenting the problem to the students. Students get together in groups and try to solve the problem. In the course of the discussion, they identify the gaps in their previous knowledge that prevent them from understanding and solving the problem. Once these gaps are identified, students start looking for the missing theory. The teacher participates in the discussions as an advisor in the search for information sources.

For Borochovicius and Tortella (2014), PBL aims to make the student capable of building conceptual, procedural and attitudinal learning, through proposed problems that expose him to motivating situations and prepare him for the world of work. For Ribeiro (2008, p. 106), "PBL is a collaborative, constructivist and contextualized teaching and learning methodology that uses real-life problems to initiate, motivate and focus on building knowledge". Problems must mirror real professional situations, have insufficient information and unanswered questions. They can be problems that demand real solutions by real people or organizations and directly involve students in the exploration of an area of study, whose solutions are potentially applicable in their contexts of origin.

Problems can be presented in the form of text, video, dramatization, interviews with people in the community affected or interested in solving it. When introduced in the form of texts, the problem situations are narratives (written) about challenges or dilemmas faced by the characters, which demand the use of knowledge, the search for information and decision-making, to identify the main issues and arrive at solutions plausible. These problem situations can be original, adapted from textbooks, magazine articles, scientific journals and newspapers. They can be made available as students get deeper into the solution process, helping them to discard some hypotheses initially raised and to add others closer to the heart of the problem at hand.

In this methodology, the student develops the ability to discover and use information, build his own problem solving skills and learn the necessary content. For that, students need a set of essential knowledge to use effectively in solving problems inside and outside the university, expanding or improving their knowledge and developing strategies to deal with future problems (BOROCHOVICIUS; TORTELLA, 2014).

At PBL, teachers assume different roles: mediating discussions; act to keep groups of students focused on a specific problem or issue; motivate students to get involved with the tasks required in the process of finding a solution; encourage the use of the function of thinking, observing, reasoning and understanding. They are guiding investigative processes, in the sense of opening space for the appearance of new strategies and creative and original solutions alternatives, in addition to being mediators between students and the resources of TDIC to enhance the possibilities of cooperation between groups.

4. Didactic Sequences with PBL

PBL is an active teaching methodology used in both face-to-face and distance education, in which learning is carried out through problems solved by students. The problem is the tool to motivate learning, leading the student to retrieve knowledge stored in memory, in addition to instigating scientific doubts, interacting with colleagues, integrating knowledge and directing the study (MEZZARI, 2011).

At PBL the student is active in the search and learning of new knowledge. Generally, students are grouped together forming collaborative learning teams, being able to use various tools for research and search for knowledge in order to solve problems. In this way, PBL develops skills (ALLEN; DONHAM; BERNHARDT, 2011) such as research, teamwork / group, communication, writing and cognitive growth in students. They learn to learn and teaching is viewed in an integrated manner and integrating content (BERBEL, 1998). It is up to the teacher and tutor to elaborate the problems and lead the groups in their problem solving work, in addition to evaluating the moment of application of the methodology. They will be guides in the learning process and no

longer the only holders of knowledge.

The teacher / tutor is responsible for establishing which cognitive objectives are expected to solve each problem. These objectives, previously outlined, may involve more than one subject in more than one subject, hence the importance of advance planning and the participation and collaboration between teachers and tutors.

Students can be divided into groups, in which they have predefined roles taking on roles, such as coordinator, rapporteur, etc. It is important that students change roles so that each one takes on everyone, a dynamic that may occur for each new problem presented.

In this context, when the problem was launched, the group of students defined the roles and some dimensions, such as: provisional certainties, provisional doubts, objectives, development and systematization. The organization of these dimensions depends on the group (BACKES; SCHLEMMER, 2013).

The importance of using TDIC in the classroom is notorious, thus, two didactic sequences will be presented involving the use of TDIC and PBL in the classroom in higher education.

The first didactic sequence deals with the use of PBL via a study group that uses the WhatsApp communication tool, created in the first period of the Information System course at the Federal University of Alagoas (UFAL) Campus Penedo, in which the teacher and six students participate. In this didactic sequence, the Unity 3D software was used, which presents itself as an application that is easy to install and use, despite needing knowledge in programming, to help in the construction of games in two or three dimensions, in which audios, images can be inserted etc. It has windows and areas in which the game scene is developed, a hierarchy area in which the objects of the game are listed, a project area formed by the folders and files of the game and a local inspector area, where the characteristics of the objects are created (CARVALHO, 2015).

The sequence presented reports a problem and the construction of a didactic game to help in the assimilation of certain knowledge

contemplated in a given discipline, indicating Unity 3D as a tool to facilitate the resolution of this problem.

The motivation for the creation of the study group was due to the fact that some students are interested in learning to program and learn other topics related to the course. In order not to demotivate them, the teacher decided to create a study group, which held a weekly face-to-face meeting on Thursdays, and the other activities were carried out online via the WhatsApp application. The algorithms were suggested in the WhatsApp group and students solved them through interactions within the group between themselves. When necessary, the teacher contributed tips for solving the algorithms and / or informed if the path followed by the students was correct or not. In face-to-face meetings, solutions were socialized, and topics related to the course were proposed for students to study and socialize, via seminar, at the next meeting.

The second didactic sequence was applied to a group made up of students from the 1st and 3rd periods of the Federal Institute of Santa Catarina (IFSC), totaling 41 students and the professor of the discipline. This sequence made use of the Socrative application and used the PBL methodology applied to it, as well as the use of the e-mail tool for communication between the groups created during the realization of the active methodology, which allowed its evaluation through the use of Socrative, once that the application gave the teacher the task of creating / elaborating tests that simulate knowledge race situations and / or quizzes, being able to evaluate whether the objectives proposed in the methodology were achieved.

E-mail, in turn, enabled communication between those involved and the participation of students in non-face-to-face moments, which helped in the resolution of questionnaires and in solving doubts. It also proved to be an excellent tool for evaluating the methodology, as well as the participation of tutors.

The PBL methodology, via study groups, made communication via the social interaction tool e-mail viable. Students, when carrying out PBL activities in the classroom, could at any time get in touch with the discipline's teacher to clear up any doubts regarding the content. For

each group, the leader created an email account. All components had access to the user and password. The students accessed the e-mail and referred the doubts related to the content to the teacher. The teacher answered questions and gave feedback related to possible solutions. To avoid discouraging students, the teacher had a return time that could not exceed 24 hours.

Close to the final phase of the process, at the end of the semester, the teacher used the Socrative application to assess student learning. Through the software it was possible to see which points related to the study of the content deserved attention.

With the objective of verifying the satisfaction of the students of the higher course in Information Systems at UFAL / Penedo who used WhatsApp and of the students of the higher course of Analysis and Development of Systems at the IFSC / Campus Canoinhas who used e-mail and Socrative, a questionnaire was applied with six questions about the efficiency of the PBL methodology, being: do you find the PBL methodology satisfactory?; Did PBL contribute to your learning?; was the time of one week for research and resolution of the presented themes sufficient?; Does the study methodology help you to improve your research and learning capacity?; would you change the methodology adopted?; do you intend to remain in the group?

For the UFAL students' study group, the questionnaire was applied to the six students after six months of using the PBL methodology and the result was quite satisfactory. For the first five questions, all students answered "yes", and made a point of writing comments, such as: "the methodology is very satisfactory, as it deepens my knowledge and I learn to work as a team"; "Contributes to learning and will contribute even more", "yes, because I acquired more knowledge"; "A week's time is over-sufficient"; "The proposed exercises were solved in a timely manner, one week is sufficient"; "My research capacity has increased, since it enables a huge range of ideas and content, research sources, etc."; "I would change the location of the face-to-face meetings, placing them in a computer lab".

For the sixth and final question, only one student replied that he does not intend to remain in the group for having transferred the course, not for the activity itself. Two other students, although they intend to remain in the group, cited their difficulty for not having a computer. In other words, everyone approves the PBL and the way it was used.

For the study group formed by 41 IFSC students, the same questionnaire was applied, being answered by 28 students from the 1st period and 13 from the 3rd period. The 1st period students who are using the PBL methodology for learning were taking the Computer Architecture discipline, with 80 hours and two weekly meetings. The students of the 3rd period attended the Computer Networks discipline with 80 hours and two face-to-face meetings. The methodology started in February and ended in June 2017.

To evaluate the students' learning process, at the end of the process, the use of the Socrative application was implemented, which allows the creation of a knowledge base to be applied to groups. This base aims to evaluate the learning of the aforementioned classes (FERREIRA; OGLIARI, 2015).

The analysis started from the verification of the responses of each student. For example, in question 1, two students from the 1st period and two from the 2nd period did not consider the methodology to be useful. The students justified that they prefer to work individually, as they are unable to develop the activity following the PBL methodology in a systematic way, which can be an important point of analysis for the teacher regarding the methodology, as it turns out that these students need attention in the communication item . In question number 2, many were very stimulated, because before the methodology they were doing something new. The problems listed in the PBL methodology also allowed them to opt for other forms of research than those traditionally used only in the classroom.

Regarding the socialization time, three students, two from the 1st period and one from the 3rd period, reported that they did not have enough time to analyze. Among the justifications were: tiredness, as it was the last night class on a Friday; more time of interaction in the face

of a problem and some students said that they did not study the content, impairing the brainstorm requested by the methodology.

From the analysis of the questionnaire, in general, of the 41 responses, only two students answered, in question number 4, that the group did not contribute to improve their research and learning capacity. In the analysis of the profile of these students it was verified that they already have graduation and knowledge in the area. The justifications given by them condition to suggest that, because they have knowledge above the level of the group, they always wanted to be ahead, assuming the position of leaders, however, in the PBL methodology, students must experience different contexts during the activity. Still on question 4, the two students who answered in the negative are from the 3rd period, leading to the definition that in the 1st period class the majority approves the PBL and would continue.

In question 5, about what would change in the methodology, 25% of the students would like the groups to be smaller, around four students, instead of 6, because the intention was to make the roles represented by them feasible. Faced with the methodology, they craved more roles, in addition to the ones presented.

Regarding the formation of groups, only two students informed that they would not remain in the team because they felt they had more capacity and knowledge than the others. The vast majority informed that they would remain in the group, indicating, still, positive points, such as: the group was dedicated and the teamwork was profitable; the teams had responsibility for their roles and content; the group debated the contents well and the accompaniment of the teacher was very stimulating.

In general, the groups played a satisfactory role. By using the active methodology and applying it to a group of students, who until then had not tried other forms of teaching / learning, better communication between them was provided, as well as the knowledge of interaction tools during classes.

5. Final considerations

The need to adapt the classes to the technological reality experienced by students is notorious. Likewise, the search for knowledge and autonomy in the learning process is essential, characteristics acquired with the use of PBL.

It can be proved that PBL is a stimulating teaching methodology to be applied in higher education, both in person and at a distance, despite the need for more preparation by teachers and tutors.

Difficulties were observed in the implementation of the methodology by teachers and, in order to help them, in this article, two didactic sequences were presented using TDIC and PBL, aimed at students of courses related to the area of Computing, in addition to examples of two possibilities of use of PBL both in person and at a distance.

The first didactic sequence dealt with the use of PBL, via study group, for the teaching of programming logic and algorithm, using the WhatsApp communication tool. The teacher taught the theoretical content in the classroom and launched the problems, mostly algorithms, through this communication tool, in which students debated possible solutions, cleared doubts and presented proposals for solutions to the problems. There was better motivation, interest and active participation by the students, which also contributed to the improvement of each student's grades.

The second didactic sequence, using the PBL methodology, made use of the Socrative application, and the communication tool for the non-face-to-face moments was the e-mail, in which the students took their doubts with the teacher during the process of solving the launched problems in face-to-face meetings.

In general, the groups propagate a satisfactory role. By using the active methodology and applying it to a group of students who had not experienced other forms of teaching / learning, better communication between them was provided, as well as the knowledge of interaction tools during classes.

The results of the questionnaires given to students in the two sequences and in different courses from different institutions proved the efficiency of the use of PBL, regardless of the area of knowledge addressed.

References

ALLEN, D. E.; DONHAM, R. S; BERNHARDT, S. A. Problem-based learning. **New Directions for Teaching and Learning**, [S. l.], v. 2011, n. 128, p. 21-29, win. 2011. Disponível em: https://doi.org/10.1002/tl.465. Acesso em: 21 jan. 2021.

AMARAL, N. C. A educação superior brasileira: dilemas, desafios e comparações. **Revista Brasileira de Educação**, Rio de Janeiro, v. 21, n. 66, p. 717-736, jul./set. 2016. Disponível em: https://doi.org/10.1590/S1413-24782016216637. Acesso em: 21 jan. 2021.

BACKES, L.; SCHLEMMER, E. Práticas pedagógicas na perspectiva do hibridismo tecnológica digital. **Revista Diálogo Educ.**, Curitiba, v. 13, n. 38, p. 243-266, 2013. Disponível em: http://dx.doi.org/10.7213/dialogo.educ.7644. Acesso em: 21 jan. 2021.

BERBEL, N. A. A Problematização e a aprendizagem baseada em problemas: diferentes termos ou diferentes caminhos? **Interface** – Comunicação, Saúde, Educação, Botucatu, v. 2, n. 2, p. 139-154, fev. 1998. Disponível em: https://doi.org/10.1590/S1414-32831998000100008. Acesso em: 21 jan. 2021.

BOROCHOVICIUS, E.; TORTELLA, J. C. Aprendizagem Baseada em Problemas: um método de ensino-aprendizagem e suas práticas educativas. **Ensaio:** Avaliação e Políticas Públicas em Educação, Rio de Janeiro, v. 22, n. 83, p. 263-294, abr./jun. 2014. Disponível em: https://doi.org/10.1590/S0104-40362014000200002. Acesso em: 21 jan. 2021.

CARVALHO, A. A. (org.). **Apps para dispositivos móveis:** manual para professores, formadores e bibliotecários. Lisboa: Ministério da Educação, 2015. p. 346-359.

COLL, C. *et al*. Os ambientes virtuais de aprendizagem baseados na análise de casos e na resolução de problemas. In: COLL, C.; MORENO,

C. **Psicologia da educação virtual:** aprender e ensinar com as tecnologias da informação e comunicação. Porto Alegre: Artmed, 2010. p. 188-205.

DELISLE, R. **How to use problem-based learning in the classroom**. Alexandria: ASCD, 1997.

FERREIRA, L. R.; OGLIARI, C. R. A contribuição do software Socrative como suporte pedagógico ao ensino médio. Ensaio com professores de geografia. *In:* CONGRESSO NACIONAL DE EDUCAÇÃO, 12., 2015, Curitiba. **Anais eletrônicos** [...]. Curitiba: PUCPR, 2015. Disponível em: http://educere.bruc.com.br/arquivo/pdf2015/18176_7822.pdf. Acesso em: 2 abr. 2017.

GIL. A. C. **Didática do ensino superior**. São Paulo: Atlas, 2012.

GORBANEFF, Y. Qué se puede aprender de la literatura sobre el aprendizaje basado en problemas. **Revista de la Facultad de Ciencias Económicas de la Universidad Militar Nueva Granada**, Bogotá, v. 18, n. 1, p. 61-74, jun. 2010. Disponível em: https://www.redalyc.org/pdf/909/90920479003.pdf. Acesso em: 12 mar. 2021.

MERCADO, L. P. Tecnologias digitais e educação a distância: letramento digital e formação de professores. *In*: CAVALCANTE, M. M. *et al* (org.). **Didática e prática de ensino: diálogos sobre a escola, a formação de professores e a sociedade**. livro 4. Fortaleza: EdUECE, 2014. p. 333-334. Disponível em: http://www.uece.br/endipe2014/ebooks/livro4/21.%20TECNOLOGIAS%20DIGITAIS%20E%20EDUCA%C3%87%C3%83O%20A%20DIST%C3%82NCIA_%20LETRAMENTO.pdf. Acesso em: 12 mar. 2021.

MEZZARI, A. O Uso da Aprendizagem Baseada em Problemas (ABP) como reforço ao ensino presencial utilizando o ambiente de aprendizagem Moodle. **Revista Brasileira de Educação Médica**, Porto Alegre, v. 35, n. 1, p. 114-121, 2011. Disponível em: https://www.scielo.br/pdf/rbem/v35n1/a16v35n1.pdf. Acesso em: 21 de jan. 2021.

NÉRICI, I. G. **Metodologia do ensino:** uma introdução. 3. ed. São Paulo: Altas, 1989.

RIBEIRO, L. R. **Aprendizagem baseada em problema (PBL):** uma experiência no ensino superior. São Carlos: EduFSCar, 2008.

RUIZ-MORENO, L.; LEITE, M. T. M.; AJZEN, C. Formação didático-pedagógica em saúde: habilidades cognitivas desenvolvidas pelos pós-graduandos no ambiente virtual de aprendizagem. **Ciênc. educ. (Bauru)**, Bauru , v. 19, n. 1, p. 217-229, 2013 . Available from http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1516-73132013000100015&lng=en&nrm=iso. Acesso: 12 mar. 2021.

SILVA, S. Aprendizagem ativa. **Revista Educação**, [S. l.], 2013. Disponível em: http://www.revistaeducacao.com.br/aprendizagem-ativa/. Acesso em: 21 de jan. 2021.

VEIGA, I. (org.). **Formação médica e aprendizagem baseada em problemas**. Campinas: Papirus, 2015.

VYGOTSKY, L. S. **Pensamento e linguagem**. São Paulo: Martins Fontes, 1995.