

# ***PBL-Tutor Canvas: a Tool based on Backward Design to Plan PBL in Computing Education***

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**Abstract** — The Problem-Based Learning method has become an alternative to develop problem solving skills and abilities strongly required by the current labor market. However, studies indicate that due to the subjectivity of PBL concepts and the lack effective instruments for its implementation, the PBL teaching planning is compromised and strongly dependent on the teacher's ability. In addition, related studies indicate the existence of guidelines to support high level planning for the courses and disciplines in PBL such as infrastructure. Given that context, this paper proposes a tool for supporting PBL planning in Computing Education based on Backward Design Model that will lead teachers to structure their planning in order to comply with PBL processes and principles, maximizing the adherence of proposed activities to the PBL culture considering usability principles. The validation comprised the usability and acceptance evaluation of the tool proposed as well as its structure for conducting teachers planning their learning activities as much adherent as possible to PBL process and principles. The results analyzed indicate good usability scores and acceptance of the tool proposed through usability questionnaires as well as indicated the approach would assist in PBL educational planning process, supporting to maximize maturity in PBL.

**Keywords** — *Problem-Based Learning; Backward Design; Bloom's Taxonomy; Teaching Plan; Canvas Model; Computer Education.*

## I. INTRODUCTION

As the authors of [1] the growing demand of the labor market by professionals with skills and abilities that go beyond the cognitive, especially in the ability to solve real and complex problems in their areas, requires these same professionals concrete experiences in addressing these problems. However, studies show that often their training is not directed so as to enable them to face such problems, revealing a gap in traditional learning methods.

Thus, one of the major challenges and problems faced by teachers is to attract and keep the attention and interest of their students, as well as face a lack of motivation as a result impacts the performance rates and dropout [2].

Seen above, traditional methods of teaching and learning cannot meet many of the needs of young students, such as: the significant and contextualized learning, skills development and skills for professional and personal life, transdisciplinary view of knowledge, entrepreneurship, among others.

This raises the active learning methodologies as an alternative to meet the demands and challenges mentioned above. Therefore, it is necessary, to know their reasons and their potential to improve the teaching and learning processes [2].

Thus, the choice of the PBL method, Problem-Based Learning, based on constructivist principles [3], is justified by the fact that, in its essence, it fills the gap of providing the student and professional future through problems, and, through actual experience, the dissemination of knowledge, exercise and the development of various skills required by the current labor market [4]. However, the application of this approach is often not effective, since their techniques cannot be understood due to the subjectivity of some of its concepts, which can impact on their application and effectiveness [5].

This work proposes a "Computer education planning tool in the approach PBL based on Backward Design model," with a view to assisting the teacher to develop a structured way of teaching planning, consistent and stick to the process and principles PBL.

The design of PBL-Tutor Canvas was also based on the assumptions and principles listed below. It is necessary to remember that other authors besides those mentioned were considered: Instructional Principles for projection of constructivist teaching [3]; In the PBL method "Problem-Based Learning" [6]; At maturity model PBL-Test [7]; In PBL methodology for management, called xPBL [8]; In the Backward Design Model [9]; In Revised Taxonomy of Bloom [10] and The Model Canvas [11].

## II. METHOD

The method adopted in this study is qualitative and deductive nature. The context of the research and the choice of participants have considered experienced teachers and who teach subjects related to Computer Science, using the PBL method in their teaching practice. The criteria for selection of participants is justified by the fact that they experience in practice the difficulties and challenges inherent in the planning of education and teaching using the PBL method, which enables them to analyze the solution proposed adopting a critical according to their reality.

### A. Research Question

The question of this research refers to the absence of a model for implementation of the PBL method considering the subjectivity of some of his concepts that may involve their application and effectiveness. In addition, the lack of tools, standards, and proper support for adopting PBL in education planning have also contributed for this research question. These facts indicate causes that contribute to the lack of understanding and adherence of the PBL method and its use in teaching. Such difficulties increase the resistance of the adoption of PBL teaching by suggesting stem from their lack of training to do so.

Another point to note is the change of culture that is not easy to do. There are indications that this factor may contribute negatively to adoption, since no shortage of tools to assist teachers in the acculturation process in PBL.

Thus, the hypothesis formulated here, h1: A Computer education planning tool in the PBL approach based on the Backward Design model will support teachers to develop PBL educational planning: a) in a structured and standardized way; b) adhering to PBL principles and c) ensuring usability principles.

### B. Objectives

**General Objective:** Propose a computer education planning tool in the PBL approach that will lead the teacher to structure it, based on the Backward Design model (learning objectives, evidence assessment and activities), in order to include PBL processes and principles, maximizing thus adherence of the proposed activities to PBL culture, ensuring usability principles.

**Specific objectives:** (Obj. 1) To perform mapping between PBL and PBL principles process, analyzing the influence of the principles throughout the stages of the PBL process; (Obj. 2) To define adaptation of the PBL process in order to include the Computer education based on their principles and relevant references in the area; (Obj. 3) To set the standard of teaching itinerary planning framework based on learning objectives, based on technical reference area; (Obj. 4) To define framework for development of learning objectives based on literature; (Obj. 5) To group PBL principles into manageable areas with similar nature in order to delimit the scope for preparation of action plan for learning activities; (Obj. 6) To map features that suggest maturity on PBL principles to serve as requirements for educational planning; (Obj. 7) To develop proposal Computer education planning tool in the PBL approach based on the model and Backward Design (Obj. 8) To validate the acceptance and usability of the proposed approach.

### C. Procedures

This work was divided into three (3) phases, namely: "Research Proposal", "Preparation Proposal" and "Research Consolidation".

The first phase "Research Proposal" began with the ad-hoc review of the literature based on the literature available through books, scientific articles, dissertations and academic theses in order to compose the theoretical basis for this research. Based

on these foundations, the research question, seen from the lack of structured education planning tools, standardized, adhering to the essence of PBL and that are easy to use / assimilation by teachers was established.

With well-defined research question and structured theoretical basis, the second phase was started, "Preparation Proposal". This phase consisted of a few steps that enabled the projection of the PBL-Tutor Canvas tool.

In order to structure the proposal it was initially carried out "Mapping Process PBL x Principles PBLs", since it was observed that there is a clear relationship between process and principles, for example, not all principles are exercised at all stages of the PBL process. Each step of the PBL process exercises a specific set of principles, which act as vectors within each dimension of the process. Such information is very important and should be addressed in education planning for exercising constructivist principles, the basis of the PBL method. After having such mapping completed, it was realized the need to adapt the PBL process, originally presented by [6], making it compliant for educational reality in computing.

Once process vs. principles mapping was completed then it was developed the standard itinerary of educational planning in order to conduct the teacher prepare your structured way of teaching plan, adhering to the process / PBL principles, ensuring usability requirements. The structure of this itinerary was anchored based on learning objectives, once defined, with the objective requirements of PBL principles, increase the chances of experiencing the benefits proposed by the PBL method. Taking as its starting point the goal of well-defined learning, the proposal included a reasoned itinerary in the model Backward Design, which proposes a teaching planning roadmap based on learning objectives.

With the default set educational planning structure, it was observed the need for the process of defining learning objectives and for this, it was used the Taxonomy Revises Bloom, who has been widely mentioned and used as a means of classification and structuring of learning objectives.

After this step, the ground of the literature review by xPBL methodology, ranked the principles in dimensions according to their nature in order to delimit the scope of treatment, benefiting the systemic view of the principles and focus on propositions of learning activities.

In addition to the already stated, it was used the characteristics that indicate maturity in PBL approach as described by PBL-Test maturity assessment model, such additional requirements to be covered by the teacher teaching planning, since their characteristics are directly PBL connected to principles.

Finally, the PBL-Tutor Canvas tool has been designed using the Model Canvas as an instrument in order to consolidate the teaching educational planning.

The last phase of the research, three (3) "Research Consolidation", was designed to validate the proposed tool through questionnaires that analyzed beyond the practice of PBL approach, other aspects of the solution, including the

usability (focusing on acceptance and utility solution) and PBL-Tutor Canvas as a teaching planning tool.

The context of the research considers the consolidation experienced teachers who have on average more than 5.5 (five and a half) years of teaching and teach subjects related to Computer Science, using the PBL method in their teaching practice.

The criteria for selection of participants is justified by the fact that they experience in practice the difficulties and challenges inherent in the planning of education and teaching using the PBL method, which enables them to analyze the solution proposed adopting a critical according to their reality.

Finally, the results were analyzed and described.

#### D. Techniques

This research used the questionnaire technique which for Preece [12, p.20]: "[...] is a well-established technique for collecting demographic data and users reviews. They are similar to interviews and may contain open or closed questions." 4 Questionnaire types were used, namely:

1 - Profile of Participants - the purpose of this questionnaire was to know the profile of respondents related to their training and the PBL method in their teaching practice.

2 - Teaching Practice using PBL - was applied in order to know which knowledge that the teacher has the PBL method, in regard to its principles and constructivist foundations. As well as their difficulties and motivation to use it in their practice. It is noteworthy that the direction of the research was to practice planning PBL teaching.

3 - Usability PBL-Tutor Canvas - the objective of this questionnaire was to evaluate the usability of the proposal presented in this research has said it is "an approach to PBL teaching planning supported by the Backward Design Model in Computing Education". Thus, it is composed of seventeen (17) issues, of which the ten (10) former were adapted from the System Usability Scale and other adapted the Questionnaire for User Interface Satisfaction, Technology Acceptance Model and Measuring Usability with the USE Questionnaire. This questionnaire made use of the Usability Scale scale.

4 - PBL-Tutor Canvas as a planning instrument - your goal is to verify the acceptance of "PBL-Tutor Canvas: an approach to PBL teaching planning supported by the Backward Design Model in Computing Education" as well, the artifacts that comprise it. This questionnaire made use of the Usability Scale.

Whereas this is a technique in which the researcher does not necessarily interact directly with the researched, it was decided to present an overview of the proposal being examined, then he was asked the participant to answer the above questionnaires. The models that supported the preparation of questionnaires that were applied in this research were:

- System Usability Scale, usability measuring tool that consists of ten (10) questionnaire items with five (5) options of answers from "strongly agree" to "strongly disagree". Created by John Brooke in 1986, allows usability evaluations of various

products, services, including hardware, software, mobile devices, websites and applications. According to [13], the benefits highlighted by using SUS as usability evaluation tool for are: a) easy to use scale understanding by its participants; b) can be used in small samples with reliable results and c) can effectively differentiate systems with low / high usability.

- Questionnaire for User Interface Satisfaction, known as WHO and created by a multidisciplinary team of researchers from the Human / Computer Interaction Laboratory at the University of Maryland in College Park. According to [14] enables the 21 usability analysis (twenty-one) aspects, using a scale of 10 (ten) points. The analysis of responses describes the user satisfaction, contemplating evaluating the overall reaction to the system, the evaluation of the presentation screen, the terminology and the system information, the learning system, and system capabilities.

- Technology Acceptance Model [15] by Davis 1989 and known as technology acceptance model (TAM), focuses on why users accept or reject the information technology and how to improve their acceptance, thus offering a support to predict and explain the acceptance. It is based primarily on two aspects: perceived usefulness and perceived ease of use.

- USE Questionnaire created by [16] Arnold M. Lund (2001), the "USE", the Portuguese "USE" means utility, satisfaction, and Ease of Use. These are the three (3) dimensions considered by the "Questionnaire Use". Said author developed a questionnaire to measure the most important dimensions of usability for users considering various fields. Such as software, hardware, services and user support. It allows meaningful comparisons of products in different fields.

#### E. Sampling

In this research, participated in six (6) teachers who had their needs and difficulties related to PBL methodology considered when evaluating the proposed approach. It is noteworthy that the condition for participating in the research was to know and use the PBL method in their teaching practice. All participants are of Computer Science, 1 (one) master, four (4) PhD students and one (1) post-doctoral student.

#### F. Data Analysis

The analysis of the data collected involves the activities defined by [17], namely: a) Initially, the awareness was sought on the types of data that could be examined and how they could be described and explained; b) Then, appropriate analysis practical activities of the types of data collected in order to extract the information required for research were developed.

It is noteworthy that the data analysis considers a deductive approach in which "[...] a situation is explained by deduction from a statement of the circumstances" [17, p.20]. Thus, the hypothesis of this study was derived from a general law, having been tested against the reality in this case - the training of teachers in the use of PBL method supported by the Backward Design Model in computer education - looking for circumstances that confirm or refute.

The implementation of the various above-described Questionnaires aimed triangular data obtained so as to

minimize misinterpretation clear limitations or suggest conflicting views [17].

### III. THE PROPOSAL - PBL-TUTOR CANVAS: AN APPROACH TO EDUCATION PLANNING PBL SUPPORTED BY BACKWARD MODEL DESIGN IN COMPUTING EDUCATION

The PBL-Tutor Canvas tool - a teaching planning approach supported by the Backward Design model is a tool intended to lead the teacher to structure planning in order to include PBL processes and principles, maximizing thus the adherence of the proposed activities to PBL culture suggested in this work. It is the result of non-systematic review of the literature and is based on the assumptions and principles listed below:

**Instructional principles for projection of constructivist teaching** [3]: Since the constructivist principles have instructions and requirements to be treated and these are perfectly suited to the proposal presented here, it is necessary to have them as input for a teaching planning that consider the foundations of legitimate relevance. To ignore them would somehow reduce or even eliminate the benefits and results that these principles preach to those who use them.

**PBL methodology "Problem-Based Learning"** [6]: Having constructivist principles as requirements to be addressed by the educational planning, teachers can perform their planning so as to adhere them through activities and resources, however, it is made necessary to anchor these activities in the teaching process, in this case, the PBL process. Thus, the principles are treated in the implementation of the PBL process activities according to the teaching of planning.

**PBL-Test Maturity Model** [7]: The maturity model PBL-Test offers a maturity assessment using a questionnaire, where each of the 10 principles PBL is evaluated. In turn, each response is associated with three possibilities correspond to the following scale: 0 (not meet the principle), 0.5 (partially fulfills); 1 (fully meets). Considering the above, it is noteworthy that for the proposed design presented here was chosen third scale value of PBL-TEST QUESTIONS Questionnaire, as it indicates the highest level of adherence to the principles.

Thus, the answer "fully meets" indicates a mature environment in PBL. So when the sentences are the objectives have your answers "meet completely," the (s) ingredient (s) connected (s) can be used as objectives to be achieved in a PBL teaching planning, since, if treated well they tend to improve PBL maturity.

**Method for managing PBL and PBL** [8]: PBL year is used in order to assist in grouping of PBL principles of the same nature, thus facilitating the analysis and proposals activity / learning experiments since demand similar needs and treatments. Thus, one of the benefits it brings together the similar nature of principles is to conduct planning to analyze them jointly, enabling more consistent and possibly more effective.

**Backward Design Model** [9]: It provides structure for educational planning focusing on learning objectives, leading to development planning in order to have all the learning

activities and practices related to learning objectives. Its premise eliminate activities and propositions that have no connection and collaboration with such goals. Given the above, the choice of this model fits fully the proposal presented here as it helps the teacher plan focusing structure the objectives and PBL principles and the PBL-Test that must be carefully worked out as objectives and requirements, eliminating any practice that does not compete for both.

**Bloom's Taxonomy Revised** [10]: There was use of the revised taxonomy of Bloom understanding that would be the best approach for structuring the learning objectives required by the Backward Design Model. Standardization and the foundations required for assembly of the sentences are designed to help teachers build better goals and therefore maximize the chances to plan their teaching more consistently and effectively.

**Canvas Model** [18]: The Model Canvas or Business Model Framework is a tool that was created by Alex Osterwalder and Yves Pigneur to plan and visualize the main functions of a business and its relationships. Providing a holistic and flexible view of the business model, assists in the process of creation, differentiation and innovation.

The Canvas is based on four (4) concepts, namely: a) visual thinking; b) Systemic vision; c) Co-creation and d) Simplicity and applicability.

Thus, the choice of the model to be applied to the proposal made here is justified by 4 (four) concepts presented above.

It is worth noting that in addition to eight (8) principles proposed by [3], the proposal considered the two (2) additional principles that according to [7], complement the constructivist principles, here treated as ten (10) principles PBL.

#### A. The Proposal

The proposed solution includes three (3) macro artifacts:

1. **Canvas Planning**: The planning of teaching proposed PBL should be conducted by filling the five (5) Canvas Planning, grouped by key area of knowledge: Problems, Environment, Content, Human Capital and processes. This grouping is proposed by the methodology xPBL [8] that aims to organize the PBL principles into categories that have similarities as to the nature of your requirements, facilitating among other things, its treatment, see Fig. 1.

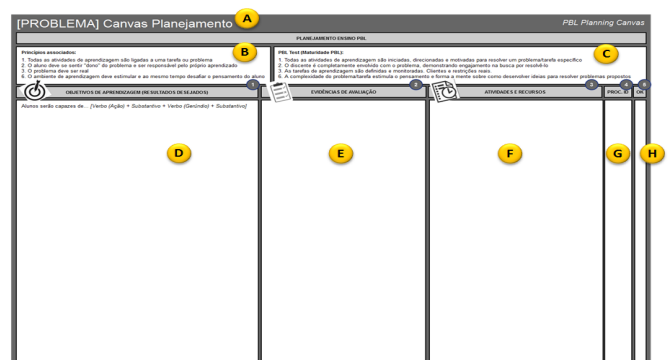


Figure 1 - Canvas Planning

The structure shown in Fig.1 indicates the elements:

**"A" - key area name grouping PBL principles** - Objective: cluster (s) ingredient (s) PBL according to their nature in order to facilitate the teaching reflection and enhance the idealization of actions in its action plan, since the propositions are driven by a set of principles that are matching and complementary requirements.

- Fill: Problems, Environment, Human Capital, Content and Processes.
- Source: xPBL the proposed methodology. [8].
- Relevant Comments: N / A.

**"B" - PBL principles associated with the key area** - Objective: To serve as input, insight and checklist for reflection and proposition of the teaching of the action plan. The principles listed here should be seen essentially as requirements that must be met, contemplated in order to exercise the PBL method in its fullness.

- Fill: according to the grouping performed by the PBL method, there is a subset principles key area for each cluster, which are described in "A" above it. These subsets are extracted from ten (10) PBL principles listed below:
  1. PR1. To base all learning activities to a task or major problem;
  2. PR2. Support students in the development of ownership of the problem or task;
  3. PR3. Design an authentic task;
  4. PR4. Designing the task and the learning environment to reflect the complexity of the environment they should be able to act at the end of learning;
  5. PR5. Give the student the ownership of the process used to develop the solution (ownership of the solution development);
  6. PR6. Design the development environment to support and challenge the thinking of the student;
  7. PR7. Encourage testing ideas against alternative views and alternative contexts;
  8. PR8. Provide opportunity and support for learning contents of reflection and to the learning process;
  9. PR9. collaborative and multi-learning;
  10. PR10. Continuous evaluation.
- Font: 10 Principles PBL
- Relevant Comments: N / A.

**"C" - maturity Assertions listed by maturity model PBL-Test [7]** - Objective: This item serves as input and insights for planning the teaching, acting as requirements to be met. It is also proposed "Principles associated" in "B".

- Fill: Assertions PBL-test of maturity that indicate adherence to PBL methodology.
- Source: PBL test model to assess process maturity PBL [7].
- Relevant Comments: This Canvas aims to collaborate with increasing maturity of the PBL process verified by the model proposed by [7]. Therefore, it proposes to be a tool to assist a possible action plan from a specific evaluation by the PBL-Test. To do so, use the sentences listed in this section "C" as requirements to complement the requirements of PBL principles

**"D" - "Learning Objectives (Expected Results)"** - Objective: based on the requirements of the principles

("associated Principles," A and "PBL Test", C), the teacher should now list the learning objectives it expects its students to achieve. What knowledge, skills, students should be able to achieve such desired result, considering the PBL requirements?

- Fill: as can be seen by next to the title, this is the first field to be completed by the teacher; Anchored by Backward Design and using the Taxonomy revised Bloom, the teacher must complete as many goals you want, in order to meet the most with the requirements associated with each PBL principle, according to the following structure:

1. "My students will be able to"

Verb (action) + Noun + verb (Present participle) + Noun

2. Example: For the PBL principle (P2) which argues that the "Student as a problem owner (To stimulate the student so that he takes responsibility for their learning, taking on the problem as yours)", you can list 2 (two) learning objectives:

• Obj1P2: DESCRIBE the chosen problem and its related tasks BRIEF the main points;

• Obj2P2: IDENTIFY the benefits that the resolution of the problem / task

- Source: Backward Design Model [9] and Taxonomy Revised Bloom [10].

▪ Relevant Comments: a) have well defined goal is critical to stemming the steps, resulting in a more assertive and effective planning; b) List how many goals deems necessary in order to better meet the requirements demanded by the principles; c) to assist the filling of teaching, it is recommended to use the "Guideline Canvas Support 3/3 - Learning Objectives", which is provided a support containing the menu of verbs to be used, arranged according to their dimensions, according to the Taxonomy revised Bloom. It also contains additional information intended to support teachers in better structuring of its objectives; As a suggestion to promote the identification of objectives, it is proposed that teachers make three (3) questions in order to determine the focus on the most relevant content, according to [9]: 1) students must hear, read, see, explore ? What they should be familiar? 2) Knowledge and skills students must master? What is important is "knowing" and "doing"? What facts, concepts they should know? Processes, strategies and methods must learn to use? and 3) What are the "big ideas" and important understandings that they should retain? On this occasion, the choices are the "enduring understandings" that the teaching aims that the student record having forgotten the details of the discipline or course.

It is expected that the above questions posed help teachers to better define the content to discipline or course, and thus create specific learning objectives, specific and consistent for students.

**"E" - Evaluation of Evidence** - Objective: from learning objectives initially listed, it is necessary to establish a way to measure whether students are developing knowledge, skills and competencies expected. It is necessary to plan and list what the evidence certify the achievement of learning objectives concerned by the students. It is necessary to answer the question: "what" and "how" will assess whether students have

achieved the expected and proposed objectives? Such evidence must support the process and teacher evaluation strategy.

- Fill: List what students should produce. For example: articles, texts, videos, verbal presentations, projects, among others. At this stage, the teacher should define what (is) evidence (s), as produced by the students, would be (m) capable (es) to indicate that they have achieved the learning objectives initially proposed. Another important aspect to be considered is how students generate such evidence, ie, the way they proceeded to achieve the proposed objective. The teacher must identify and define evidence that will assess the aspects mentioned above, must be in tune with the learning objectives.

- Source: Backward Design Model [9].

- Relevant Comments: a) for each objective it is necessary to have one or more associated evidence; b) it is important to highlight beyond the "what", must also be generated as evidence, the "how". In some cases the way the student performs such activity is evaluation criteria as well. Thus, the evidence satisfied the Canvas should also be considered, where appropriate, with the "how."

**"F" - Activities and Resources** - Objective: Finally, after deciding which results the teacher hopes to achieve through the "Learning Objectives" and how they will be achieved by the "Evaluation of Evidence", the Canvas Planning leads the teacher to list the "activities and Resources" to be performed in order to achieve the learning objectives.

- Filling: In this stage, the teacher should design their teaching strategy through learning activities. What are the best activities, exercises, practices, experiences, issues to develop the knowledge, skills and competencies of the students? The teacher should fill in "what", "how", identifying which one (s) feature (s), when applicable. Example: Perform lecture specialist in a given area, give seminars, using video lessons, conduct group dynamics, debates, using specific features that need to be provided. In completing this section it is also important to note an early indication of sequencing the activities.

- Font: Backward Design Model [9].

- Relevant Comments: a) should be emphasized that the planned activities should be directly linked to learning objectives, so that there is a strong synergy between them and it all makes sense. This enables the teacher to reflect and can delete or add whatever is necessary to maintain the coherence and focus of what is being planned. The more consistent the design, the more stimulated students will be, to realize the existing consistency between the activities carried out, the evidence and how they will be evaluated and the goals you should achieve.

**"G" - Proc. ID** - Objective: on the premise that the activities devised by teachers should be held sometime in the teaching process, either in preparation or during the execution of activities, this step aims to relate the triad "learning objective", "evidence review" and "activities / resources", to one or more stage of the adapted PBL process [6]. The purpose is to specify which one (s) stages of the PBL process (s) activity (s) concerned shall (m) run (s) in accordance with the teaching of planning.

- Fill: Reports) numbers) identifiers) of (s) activity (s) presented PBL process "Guideline Canvas Support 2/3 - Process and Principles PBL", see Figure 13 in the "Process PBL" section. For example, "1" to "Proposing the problem," "5" to "learning needs survey" and so on.
- Source: PBL process adapted [6].
- Relevant Comments: N / A.

**"H" – OK** - Objective: to finish filling the field "Learning Objectives", "Evaluation of Evidence", "Activities / Resources" and "Proc. ID", the Planning Canvas requires a faculty review, which is invited to review what was completed in the above fields, confronting their proposals with the requirements of the principles PBL and PBL-Test, in order to validate what was proposed by him. Basically, the "OK" section have the motivation to serve as a checklist to review the mentioned triad. If you are aligned with the defendant and there is a momentary need change in the professor's view, it can proceed with the other objectives and all planned sequence. Otherwise, it should carry out the necessary correction in order to update its proposal in accordance with the expected result.

- Fill: In this section, the teacher must meet with some signs indicating that conducted the review, for example, "OK", "x", ".".

- Source: N / A.

- Relevant Comments: N / A.

**2. Canvas Result**: The "Canvas result" is intended to consolidate the planning of activities prepared by the teacher in "Canvas Planning". Basically, the teaching is conducted to transcribe the "Canvas Planning", the activities and resources mapped by the triad (Objectives, Evidence and Activities / Resources) through the "PROC. ID". Thus, using this identifier, the teacher should identify which of the five (5) "Canvas Planning" there are activities associated with a particular stage of the process and transcribe all the activities and resources for "Canvas result", fitting them within each step of the process in question. For example, using the "Canvas Result 1/2 - Planning Macro Vision", based on the "PROC ID" 1 "Proposition trouble," observed within the five (5) "Canvas Planning", the activities and resources previously raised and transcribe them to "Canvas result".

This way, the teacher generates through the "Canvas result", a clear view of the proposals of activities / resources for processes, quickly answering the question: "what the teacher should perform in a given process activity".

**3. Canvas Support**: The "canvas Support" are intended to serve as a quick query to the teacher, gathering relevant information that may help in understanding or completing the "Canvas Planning".

#### IV. RESULTS

The consolidated results show the proposal in this research as a necessary tool for teaching practice PBL in the category planning. Since, it presents coherent and adherent to the PBL methodology, with pleasing and acceptable interface, in order to assist the teacher in preparing the PBL teaching planning.

Thus, this approach was accepted as perceived by the results of the participating teachers, who pointed out that such

planning framework, through the Canvas model, enables a logical sequence, standardized and simplified. In it the teaching is conducted to develop its PBL teaching plan, adhesively to PBL methodology, its process and principles by completing the required fields according to their skills and experience.

From the usability perspective, results presented a SUS score of 77,9 as well as 86% as final evaluation score obtained from a mix of usability analysis through Questionnaire for User Interface Satisfaction, Technology Acceptance Model and USE Questionnaire.

The improvement observed points by participating teachers do not impact the proposal of the heart, it may be considered to improve the proposed structure extensions.

## V. CONCLUSIONS

PBL teaching planning is an essential activity for the effective experience of the PBL method, thus enabling those involved in this process to benefit from that preaches constructivist methodology through its principles. It was observed by research carried out [5], there is a shortage of instruments that allow the teacher to structure their teaching planning consistent and compliant way to PBL methodology, considering its process and the exercise of its principles.

In this context, it characterized the general objective of this research, to propose a Computer education planning tool in the PBL approach based on the model Backward Design, called PBL-Tutor Canvas. Its purpose is to serve as a tool to drive through a structured itinerary, minimally familiar teachers with the PBL method, to develop their PBL teaching plans, consistent, standardized and consistent through a friendly interface, simple and useful. Rearing thus through the proposed structure, adherence to PBL methodology.

Thus, it is believed that this objective was achieved by evaluating the proposal PBL-Tutor Canvas, which brought together teachers with average experience of 5.5 years in office, with teaching practice in the PBL method.

The bid evaluation was performed under three (3) dimensions: "Teaching Practice in PBL", "Usability" and "PBL-Tutor Canvas as a planning tool", aiming to analyze the acceptance and indication of the effectiveness of the proposal, the order to meet the current need for tools as proposed in this paper.

The results obtained by evaluating the dimensions mentioned in the paragraph above converge positively, signaling that the PBL-Tutor Canvas was adequate to meet the current need for tools to assist teachers in their planning of teaching PBL, thus responding positively to hypothesis initially raised.

In order to meet the overall objective, the specific objectives set initially, were also achieved, since the preparation of the proposal PBL-Tutor Canvas (Obj. 7) groups all the other specific objectives. The approach was built on a standardized structure (Obj. 3) and (Obj. 5) which allows the teacher to propose learning activities through learning objectives (Obj. 4) previously defined based on requirements:

PBL principles and assertive maturity PBL (Obj. 1) (Obj. 2) and (Obj. 6).

Finally, the objective (Obj. 8) was achieved through the teaching of the evaluations carried out by questionnaires in three (3) dimensions, as mentioned above, generating the results.

With all the goals achieved, one can relate the main contributions of this research were: a) Proposal for a standardized instrument for PBL teaching planning and adhering to PBL methodology; b) Guidance for educational planning approach considering PBL process PBL versus PBL principles, in order to work out the methodology in its essence; c) Development of research, bringing together various techniques and models such as PBL methodology, Backward Design Model, Bloom's Taxonomy, Model Canvas, xPBL, PBL-Test; d) Creation of a model that can serve as a tool for continuous improvement process, as it enables through its structure, generating new shares to existing teaching plans, to better contemplate the PBL method, whether targeting your process or principles; e) model creation that can be used in conjunction with the PBL-Test Maturity Model with a view to leading the development of an action plan directed to identified items of low maturity, identified by the PBL-Test; f) Serve as a collaborative working tool between teachers, since the structure proposed by the Model Canvas allows teachers groups perform dynamic for proposals for PBL teaching plan in subjects, courses and institutions using brainstorm techniques, work in pairs, etc.; g) prepared Artifacts "PBL-Tutor Canvas" (Support Canvas, Planning and results) that can be used for educational planning PBL h) Improve teacher communication process with respect to the planning of teaching PBL, funded by an instrument standardized planning in their structures, terms, etc.

While all the stated objectives have been achieved, it stands out as the main challenge during the development of this work the teacher's awareness of the importance of structuring the educational planning consistent and standardized manner, respecting important variables to achieve the learning objectives.

Besides the above, there is the difficulty of linking learning activities proposed to the PBL process. Finally, the failure to carry out a complete experiment where teachers would use the proposal and the results would be confronted, revealing several important aspects to consider the proposed approach can be considered a limitation.

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