

Model of Project-Based Learning Platform

Ava Chikurteva
Institute of Information and Communication Technologies
Bulgarian Academy of Sciences
Sofia, Bulgaria
avapaleva5@gmail.com

Denis Chikurtev
Institute of Information and Communication Technologies
Bulgarian Academy of Sciences
Sofia, Bulgaria
dchikurtev@gmail.com, ORCID: 0000-0003-4903-7544

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Abstract—The implementation of the Project Based Learning (PBL) in education facing a number of problems and difficulties, prompting teachers to avoid its use and rely on traditional methods of training. The article examines the role of ICT in PBL, the benefits of PBL and its main problems in its implementation. A conceptual model of a PBL platform in education is proposed to guide and assist the teacher in planning, implementing and presenting project results. The role of the teacher is leading and involves preparing, presenting a project, motivating students, managing the process through continuous communication and facilitating.

Keywords—project-based learning, education, ICT

I. INTRODUCTION

Project-based learning is defined as “an instructional method that gives students complex tasks based on challenging questions or problems that include problem solving, decision making, research skills. It focuses on issues that make students come up with basic concepts and principles in practical terms. Students do their own research on a leading issue that allows them to develop valuable research skills, as they participate in the design, problem solving, decision making and research activities themselves. Students learn from these experiences, take them into account, and apply them to the world outside their classroom. A different teaching technique that encourages the practice of forming new learning habits, emphasizing creative thinking skills and allowing students to discover that there are many ways to solve the problem” [2, 6].

The current project-based learning model was developed by the Buck Institute for Education in the late 1990s in response to school reform efforts [14]. Unlike ordinary projects, PBL requires critical thinking, problem solving and communication between participants [3]. Students must organize their own work and manage their own path when working on the project.

PBL is the interactive method that can most strongly cause a change in the teaching culture, involving collaboration between both students and between student and the teacher, who often acts as a facilitator [4, 8]. The feedback that the teacher periodically gives is concrete, useful, positive [1].

The advantages the PBL offers over traditional teaching methods are:

- **Students receive adequate preparation for real life.** Project-based learning enables students to relate what they do in school to the big world around them - to ask questions and to find a solution themselves, using their available knowledge and experience. Through project-based learning, they learn and practice skills that

traditional teaching often neglects - group work, decision making, process monitoring, in-depth problem-solving, communication, and feedback. Along with the new knowledge, students acquire all the skills required by the rapidly changing global world [9].

- **Learning material is better absorbed.** Studies show that, compared to the traditional way of teaching, students learn the learning material as well or even better. The advantage of project-based training is that trainees remember the lessons learned longer and are able to use the knowledge they have acquired [11].
- **Improving students' attitude to learning.** According to the results of studies, project-based learning in mathematics reduces students' anxiety and creates a positive attitude towards the subject [10].
- **Positive effect on the relationship between students' achievements and their social background.** In schools that work predominantly on projects, students' success is not directly dependent on their social status, while in traditional schools this relationship is clearly evident.
- **Collaboration between students is developing.** Interpersonal conflicts must be seen as an opportunity for change. Classes with real problems cause students to develop teamwork and teamwork skills, which are a prerequisite for successful professional and personal realization [8]. In addition, during their work, students learn to overcome various difficulties associated with more passive classmates, difficulties in coordinating online projects, meeting deadlines, or using technical means.
- **Increases computer literacy of teachers and students** - ICT is present at every stage of project organization, implementation and presentation [7, 12]. This unlocks the potential of information technology in training and allows PBL to be distance learning.

All these advantages over traditional teaching are only observed when project-based learning is planned and managed properly [5, 13].

In order to structure the study model and to formulate its functions and services, it is necessary to identify and categorize the problems that teachers face when using the PB method.

II. PBL PROBLEMS

In PBL, the teacher becomes the facilitator and the students work under his guidance. This article explores the problems associated with creating and managing teacher's PB lessons.

The problems that teachers encounter when creating a PB lesson are the following [11, 13]:

- to identify important issues;
- to structure meaningful tasks;
- to develop knowledge;
- to develop social skills;
- to evaluate what students have learned from the experience.

The specific challenges faced by teachers at PBL are related to:

- the selection or design of situations that suggest the possibility of good projects;
- structuring problems as learning opportunities;
- working with colleagues to develop interdisciplinary projects;
- dynamic management of the learning and self-learning process;
- technology integration;
- assisting students in authentic assessment.

There is a great deal of research on PBL, proving the benefits and effectiveness of the method, ways of its application, various developments of PB lessons and results of its application, but there is no comprehensive platform to integrate this data and provide it to the user in a convenient and selective form. In order to disseminate and promote the use of PBL as an integral part of the curriculum, supporting materials, guidelines, and appropriate conditions for working with PBL must be created.

III. MODEL OF THE PROJECT-BASED LEARNING PLATFORM

The research model provides an opportunity for the teacher to prepare and deliver a project-based lesson, following a series of steps to create a new project. To create a PB lesson, it is necessary to follow the technological modular model presented in Figure 1. Using a modular model allows consistency in the formation of the individual steps, tasks and objectives of the lesson. On the other hand, modularity allows modifying and editing the different parts of the individual modules for a lesson. This means that the teacher can easily update or modify existing projects. In this way, teachers can share models of successfully completed PB lessons that can be used as a basis for forming good practices for creating improved future lessons in PBL.

The module manager takes care of organizing the participating modules in one lesson. It interconnects modules and provides tools and services for working with modules.

Modules 1 to 5 are the main modules that make up a single PB lesson. Each of these modules can be removed or edited as desired by the teacher.

Module 1 - Determination of Expected Results - Working in a team of teachers to formulate and develop the project idea; Deciding on the scope of the project; Selection of indicators for achievement of the result; Determination of overall results; Working on project design criteria; Creating an optimal learning environment;

Module 2 - Preparation of leading questions - Design of questions; Clarification of questions; Generalization of questions; Development of standard based questions.

Module 3 - Evaluation Planning - Defining the Outcome and Evaluation Criteria; Compare the product with the result; Use of headings;

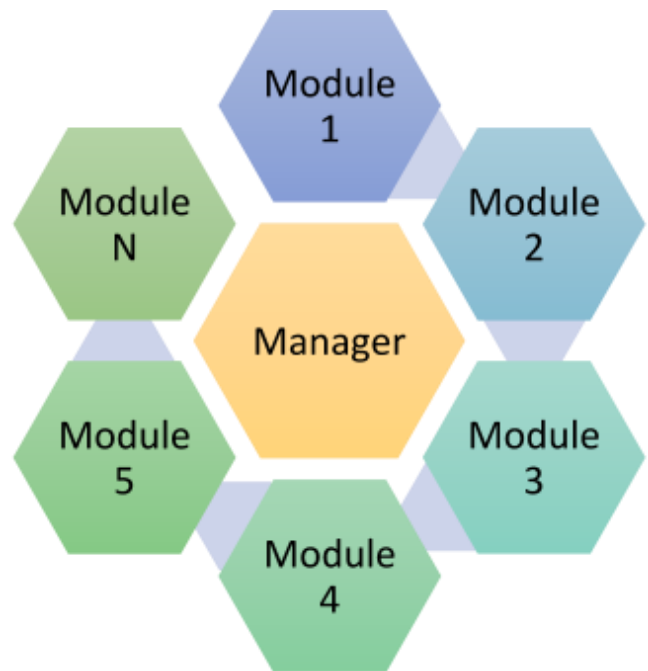


Fig. 1. Modular structure of the PBL system.

Module 4 - Project Map - Organization of activities by the teacher, which creates the environment and provides the preconditions for successful independent research work of the students; Directing students' attention to key issues and focusing on ways to solve the problems as the project progresses; Collecting resources from students; Forming the Performance Matrix i.e. developing a plan for the implementation of the project and its practical implementation;

Module 5 - Project Management - Understanding the role of the teacher as a Manager; Sharing goals with students; Using different methods and tools to solve problems; Use of anchor points and milestones; Assessment and reflection plan.

Module N - represents any additional module added by the teacher. The system provides the opportunity to add new or existing modules both at the end and between already installed modules.

A. Tools, Functions, Services

A key element in the implementation and application of PBL is the use of ICT. Thanks to ICT, we can create, manage and present the content of a project. In order to implement PBL, we need to research and develop an ICT platform that enables the creation and management of PB lessons online. Such a platform should provide a range of tools, functions and

services to facilitate and optimize the work of teachers and students in creating and delivering a lesson.

The PBL platform should contain a large amount of materials and data in different fields, subjects and topics. These materials must be checked for authenticity. Teachers will be able to add new materials and edit current ones. The materials to the platform database are: lessons, articles, lectures, e-books, presentations and videos.

Tools for creating and editing modules have been developed. These tools are part of the module manager. The tools make it easy to edit texts, assignments, tutorials, and multimedia content. Evaluation criteria and automated checks of results can be created and edited.

Functions and services have been developed for the gradual verification of the completion of the tasks, by setting tags and a template for the completion of the stages of a project. Functions have also been developed for connecting different components from one module to another. In this way, evaluation criteria or guidelines for the implementation of a project can be set.

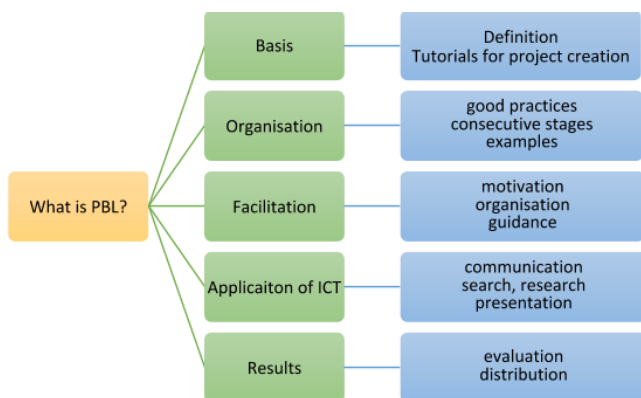


Fig. 2. Structure of information on work with the PBL.

An important step in working with PBL is to become familiar with the nature of this type of training and to learn the basic methods of work. Therefore, specialized information for teacher training is structured. In this way, they will get into the matter and become familiar with the opportunities offered by the developed platform for working with PBL. Figure 2 illustrates developed structure. The main problem in the structure is "What is PBO". To answer this question completely, there are several basic categories: basis, organization, facilitation, application of ICT and result. Each of these categories contains detailed information organized into sub-categories represented in the blue rectangles.

The main service of the platform under study is the Data Selection Service, which is presented in Figure 3. When creating a new lesson according to set criteria: subject, class and / or keyword, automatically output information about already completed projects and study materials according to the assignment of the teacher. This service requires the introduction of at least one of the specified criteria. Increasing the criteria increases the specificity of the information provided by the service. This facilitates the work of the teacher by limiting the amount of information required by entering keywords.

By default, the provided information is sorted by class and subject, where the keywords occur. In addition, the user can

change the ranking criteria according to popularity, rating, class, subject, date and more.

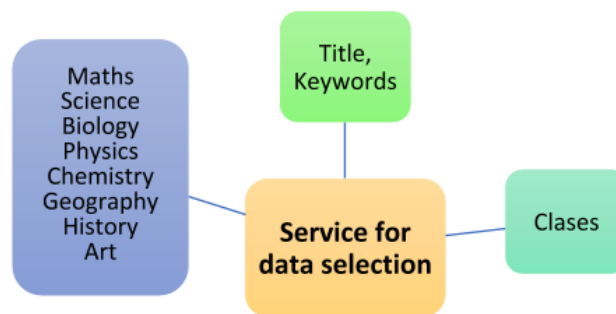


Fig. 3. Organizing information by subject, class, and keyword.

The information in the database is organized by subjects and by class. This makes it possible to distinguish the specifics of the subject, taking into account the age of the students (by class). When we have opened a subject for a class, we will have references to basic documents for the subject of the class - State educational requirements, curricula, references to other sources of information; lesson units; development - plan of a real problem for the category; problem projects that have already been worked on; ideas for new project-based lessons.

IV. TECHNOLOGY DESIGN OF THE PLATFORM

Implementation of a PBL portal can be implemented in the form of a website or web application. For this purpose, the latest ICTs in the field of mobile and web technologies and database technologies are used.

The model consists of three main blocks: databases, management system and user interface. Each of these components plays a key role in the implementation of the above functionalities of the PBL model. The database management unit stores all the information that is needed to create the PB lesson and implementation. It stores the already entered training materials and lesson templates, records the new lessons, as well as the profile data of each registered user. The sorting and searching of data is performed by standard database sorting algorithms.

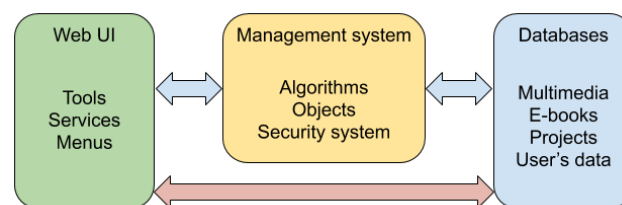


Fig. 4. Architecture of the PBL platform.

The PBL platform management system is made up of multiple features and objects that are designed to connect the user interface to the database. The system includes all the tools and services for creating and working with lesson modules. This block executes requests and commands received from the user interface that are processed according to certain algorithms. This is how complex automated platform management processes are implemented. The management system, on the other hand, sends requests to the database according to requests received from the user interface or according to the necessary data for the proper functioning of the working algorithms or the results of their operation. A

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module for providing cyber security and user authorization is also included in the management system. Depending on whether the user is a teacher or a student, he or she is granted different access rights to projects and databases. If a user is not logged in, then the system only allows access to some information resources such as - what is PBO, some of the projects already completed and others. A guest type user is not allowed to create or edit projects, or to access profile information of other users.

The user interface provides interaction between the user and the platform. It provides the necessary menus and buttons to operate the model. All platform services and tools can be used through the interface. The interface illustrates the necessary information requested by the user. This information can be presented as multimedia or as an electronic textbook.

V. CONCLUSION

Project-based learning has the huge potential of a method that develops key competences and skills of the 21st century. The implementation of the method makes it possible to increase the efficiency of the education system, implying intensive, focused and 'smart' use of ICT. The teacher must have the necessary training to successfully and fully implement the PBL. The model developed allows the teacher to apply the method quickly and easily. The model has the necessary functionality to learn, create and manage project-based lessons. This model will contribute to the development, implementation and dissemination of PBL.

For future work it is envisaged development of graphical web based user interface and communication services: video, chat, forum.

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