

Challenges faced by teachers in implementing PBO and STEAM activities in a multicultural educational environment

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ABSTRACT: Encouraging active participation in the educational process, creating conditions for learning through inquiry, experimentation, integration, and increased student motivation are key elements in the education of today's students. Project-Based Learning (PBL) and STEAM are among the most commonly applied innovative approaches in modern education, as part of the effort to develop key competencies in students. The challenges faced by educators when working in a multicultural environment are specific, while their difficulties, attitudes, and preparation exist within a different context. This study aims to identify the attitudes, level of preparation, and challenges that teachers face when implementing PBL and STEAM activities in a multicultural educational environment. Are these established, effective pedagogical approaches in the multicultural classroom? To what extent do teachers have the confidence and professional experience to implement specific project-based activities? What are the actual difficulties they encounter when implementing PBL and STEAM, and what kind of support do they need? These are the questions we seek to answer.

KEYWORDS: PBO, STEAM, multicultural educational environment, attitudes, challenges

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I. INTRODUCTION

Today's society needs professionals with interdisciplinary skills in a variety of fields. Innovative technologies and approaches in the education system support this preparation. It is no coincidence that the well-established PBO and STEAM are among the most widely applied innovative activities in modern education, as part of the context for developing key competencies in students. The conditions created for active participation and integrative learning through research and increased student motivation are key elements in preparing today's learners. However, educational reforms must take into account the growing multiculturalism in classrooms. Cultural and linguistic diversity requires educators to create an interactive environment in which all students, regardless of their social or cultural background, participate equally in the educational process. Nazer and Day emphasize that "increasing cultural diversity requires teachers to be familiar with and understand the differing values, customs, and traditions of their students and to help create inclusive intercultural experiences for all of them" [5]

According to European Education Area „A strong focus on future-proof skills in strategic sectors is essential to sustain EU competitiveness, preparedness, and technological leadership. Education plays a key role in supporting, developing and attracting the talent that the EU needs.“ <https://education.ec.europa.eu/focus-topics/stem> [2]

Zafirova believes that „...modern educational requirements promote the development of skills that enable students to apply their knowledge in various contexts and solve real-world problems.“ [9]

It is precisely PBO and STEAM that offer an interdisciplinary, holistic approach to education, preparing students for further learning as well as for their future careers.

II. METHODOLOGY

PBO and STEAM approaches are not new to the education system. They are well known and widely implemented around the world and represent one of the ways to integrate science, technology, engineering, and mathematics with creativity and practical skills among students. The connection between PBO and STEAM is particularly significant, as it enables students to integrate knowledge, conduct research and experiments, and create and present their own projects.

Active and dynamic learning, such as PBL, is based on the constructivist theory of Piaget and Dewey.

According to Govers et al., PBL encourages students to complete tasks based on “real-world” experiences. [2] Stanley argues that working on various interdisciplinary projects and activities improves students’ learning skills and academic achievement, as well as their soft skills. [8]

According to researchers Douglas and Jaquith, Patton and MacMath emphasize the importance of training teachers to master the fundamentals of PBL and develop effective teaching strategies when creating multidisciplinary projects in the classroom. [1], [6], [4]

STEAM is an educational approach that integrates science, technology, engineering, the arts, and mathematics. According to Kozuharova and Kozuharov, “STEAM education represents a shift toward a more holistic and integrated approach to learning, in which students are encouraged to explore and innovate across multiple disciplines, preparing them for success in an increasingly complex and interconnected world.” [3]

According to Sanders, the key characteristics of STEM are that learning is a constructive process; motivation is linked to knowledge; and knowledge, strategies, and assessment are linked to the context of the activities, among other things. [7]

Interest in STEM and STEAM education is growing and gaining increasing popularity both worldwide and in Bulgaria. The Ministry of Education and Science (MES) of the Republic of Bulgaria has established a National STEM Center, which “coordinates, supports, and advises on the creation and development of a STEM environment in every Bulgarian school, establishing a model for learning, professional development, and working with scientific research methods and tools.” <https://stem.mon.bg/>. [11] STEM classrooms are constantly being equipped and opened in schools. Educators must be prepared to apply integrative approaches that meet the specific requirements of modern education.

PBL and STEM share a common pedagogical foundation based on learning by doing, active student participation, and the integration of knowledge and skills from various fields. The learning process follows these steps: formulating and posing a topic or problem; generating and discussing ideas; selecting an appropriate solution; developing and creating a final product; testing different options; and presenting and discussing the results achieved.

The theoretical and practical training of educators is crucial for the implementation of PBL and STEAM; at the same time, the challenges they face are specific and diverse. To a large extent, the implementation of PBL and STEAM is directly linked to teachers’ professional skills in integrating the solving of practical and real-world problems into the educational process. The required competencies for teachers include:

- planning interdisciplinary activities;
- managing learning through research and experiments;
- applying a variety of resources and modern technologies;
- tailoring and adapting activities to students’ needs;
- maintaining high motivation for learning through engagement;
- organizing and coordinating teamwork;

A multicultural educational environment requires tolerance, empathy, and mutual respect. Support, collaborative task completion, and preparation for hands-on activities combined with knowledge from various fields is an approach that will strengthen students’ engagement and motivation. Specifically, PBO and STEAM transform learning into an interesting process that is closely tied to real life.

III. DISCUSSION

The purpose of this study is to identify and analyze the main challenges teachers face when implementing PBO and STEAM activities in a multicultural educational environment, as well as to examine their preparation, attitudes, and needs for professional support.

The research objectives set prior to conducting the study are related to:

- examining the frequency of implementing PBO and STEAM activities in a multicultural educational environment;
- determining the level of teachers’ preparation;
- examining attitudes toward PBO and STEAM;
- identifying positive effects on students;
- identifying the main difficulties and challenges;
- determining the need for methodological, resource, and professional development support.

To address the stated goal and objectives, a survey was created using Google Forms and distributed to teachers in small towns in the Sliven region with a predominantly Roma population. The empirical study was conducted through a survey of teachers at various educational levels. The analysis of the results will reveal attitudes toward the implementation of project-based and STEAM approaches, as well as the preparation required and the main challenges teachers face when applying these approaches in a multicultural environment.

Demographic information: Fifty-three teachers participated in the study. The main characteristics by indicators, number, and percentage are presented in Table 1.

Table 1. Characteristics of the study sample

Nº	Indicator	Number (n)	Percentage (%)
	Number of Respondents - Teachers	53	100,0
1.	<i>Gender</i>		
	Women	44	83,0
	Men	9	17,0
2.	<i>Age</i>		
	Up to 35 years	14	26,4
	36–55 years	31	58,5
	Over 56 years	8	15,1
3.	<i>Teaching Experience</i>		
	Up to 5 years	11	20,8
	6–10 years	12	22,6
	11–20 years	19	35,8
	Over 20 years	11	20,8
4.	<i>Level of education</i>		
	Elementary school	27	50,9
	Middle school	24	45,3
	High school	2	3,8
5.	<i>Type of community</i>		
	School in a village	50	94,3
	School in a city	3	5,7
6.	<i>Working in a multicultural environment</i>		
	Yes	52	98,1
	No	1	1,9

The data from the survey indicate the following:

In response to the question, “How often do you use project-based learning?” 49.1% of respondents answered “sometimes,” 32.1% of teachers selected “rarely,” and 18.9% selected “often.” This result shows that teachers have incorporated PBL activities in one form or another into their teaching practice. Not a single respondent selected “never.”

We should also examine the frequency of STEAM activities. The results show “sometimes” – 35.8%, “rarely” – 35.8%, “often” – 9.4%, and “never” – 18.9%. From the last two results, we can conclude that project-based learning is better known and more widely implemented by teachers than STEAM. Nearly 20% of respondents have never used STEAM in the process of teaching students.

In light of this finding, it was interesting to investigate whether teachers had completed a training course or had acquired their knowledge of these innovative approaches independently and in an unorganized manner. Regarding theoretical training, 33 of the teachers (62.3%) had not undergone specialized and organized training in PBO and STEAM, while 20 of them (37.7%) had undergone such training.

Self-assessment is always of interest from a research perspective, which is why the survey included the question: “How would you rate your preparedness to implement PBO and STEAM?” Only 6 of them (11.3%) rated their preparedness as “very good.” Seventeen of the respondents (32.1%) reported an insufficient level of preparedness, 15 (28.3%) rated it as “average,” and 15 (28.3%) rated it as “good.”

A statistically significant and strong correlation was found between participation in training and self-assessment of preparedness. The results show a clear relationship between participation in professional development activities and a higher self-assessment of readiness to implement PBO and STEAM. It is particularly telling that 80.0% of those who completed the training rated their preparedness as “good” or “very good,” while among those who did not complete the training, this proportion was only 15.2%.

To determine whether and how the project activities influenced the students, we examined the responses to the question: “If you have implemented PBO, in which aspects have you observed a change in the students?”, with respondents having the option to select more than one structured response. The data are presented graphically in Figure 1.

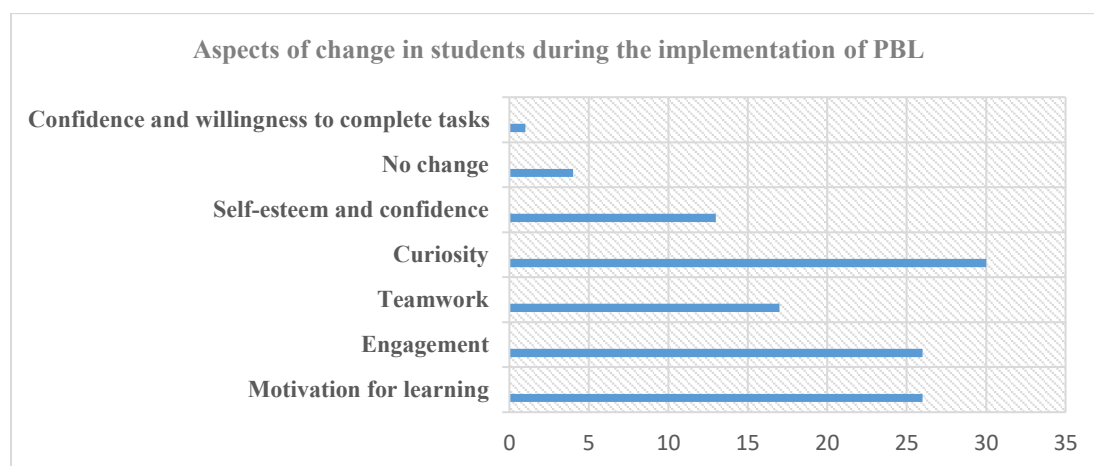


Figure 1. Aspects of change in students during the implementation of PBL

The results show that, according to teachers, project-based tasks have the greatest impact on curiosity (56.6%), motivation to learn (49.1%), and engagement (49.1%), followed by teamwork (32.1%), self-esteem and confidence—24.5%, and 7.54% reporting no change. These data can be interpreted as an indicator of increased interest, desire, and readiness for active participation in the learning process. Project-based learning (PBL) activities provide a variety of forms of participation, while at the same time allowing students to apply their knowledge and prior experience. Setting a common task facilitates interaction and encourages communication. The impact on students' social-emotional development while working on a project is also significant. Success and task completion gradually boost students' self-esteem and confidence in the multicultural classroom.

The results regarding the impact of STEAM activities and the areas in which changes were observed among students are presented in Figure 2.

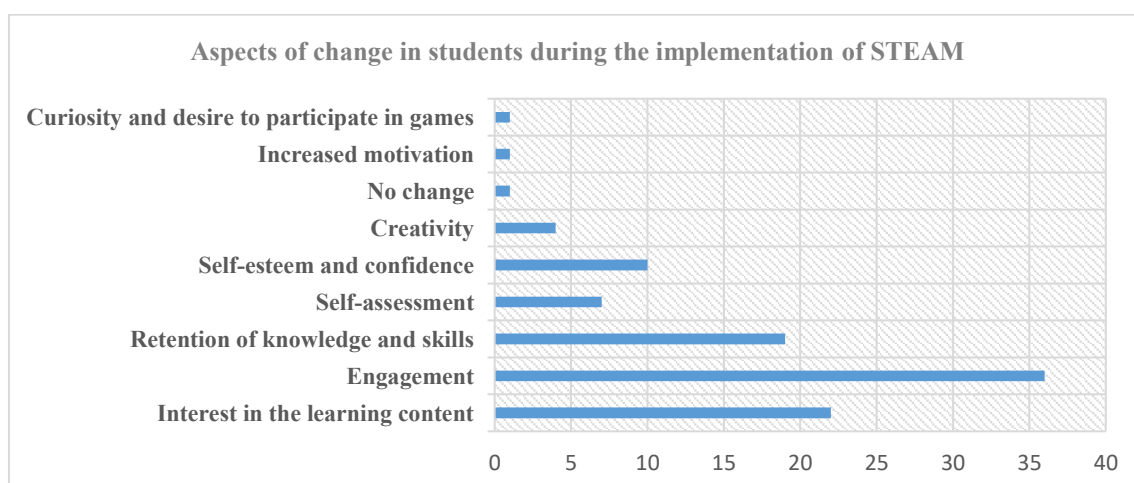


Figure 2. Aspects of change in students during the implementation of STEAM

It should be noted that the responses listed are directly related to the students' cognitive activities. Respondents were allowed to select more than one answer. The strongest impact is on student engagement—72%—followed by interest in the curriculum—44%—and the retention of knowledge and skills—38%. Teachers report a positive impact on creativity and opportunities for creative expression—20%.

Both approaches are reported to have a positive impact on students, with the effects related to their engagement, interest, and involvement in the learning process receiving the highest ratings.

The attitudes of educators toward the innovative PBO and STEAM approaches were examined using the following question, to which respondents could select more than one answer (Figure 3).

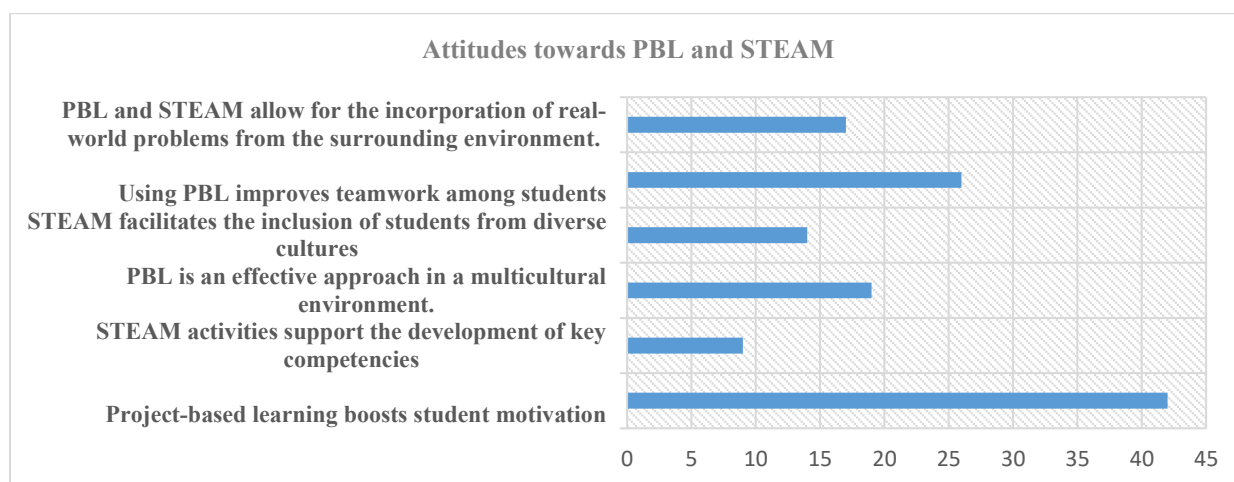


Figure 3. Attitudes towards PBL and STEAM

The results indicate that teachers are supportive of, highly value, and readily implement PBL and STEAM: “Project-based learning increases student motivation”—79.2%, “The use of PBL improves teamwork among students”—49.1%, “PBL is an effective approach in a multicultural environment”—35.8%, “PBL and STEAM allow for the incorporation of real-world problems from the surrounding environment”—32.1%, “STEAM facilitates the inclusion of students from different cultures”—26.4%.

Teachers identify the challenges they face when implementing PBL and STEAM. Low student motivation is the most frequently cited challenge among respondents—66.0%. This can be explained by the fact that the family environment and the lack of education among a large proportion of parents have a significant impact on student motivation. This is followed by lack of time—43.4%; difficulty integrating academic subjects—37.7%; lack of resources and equipment—28.3%; insufficient preparation—28.3%; and large class sizes—5.7%. The percentages exceed 100 because respondents could select more than one answer. We can categorize the difficulties encountered into several groups:

- personal and social;
- organizational and methodological;
- resource-related and professional.

Teachers’ opinions regarding the necessary forms of support for implementing PBL and STEAM activities provide valuable information for research aimed at identifying actual needs. The results are presented graphically in Figure 4; respondents were able to select more than one answer.

Notably, a high proportion of teachers—64.2%—expressed a desire for “access to platforms for sharing best practices and ideas.” The use of up-to-date “digital resources and technologies” can also improve teachers’ work—49.1%. The fact that 47.2% of respondents cited the need for additional professional development indicates that educators require opportunities to build upon their existing competencies, which are necessary for the effective implementation of innovative and integrative approaches. 20.8% selected “support from school administration.”

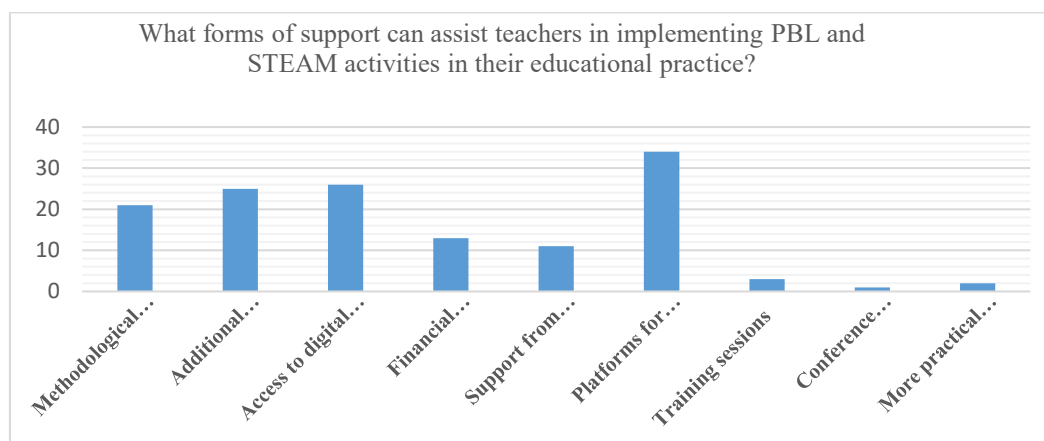


Figure 4. Forms of support can assist teachers in implementing PBL and STEAM activities in their educational practice

Teachers' interest in and voluntary participation in additional training to enhance their competencies related to ESD and STEAM were examined through an additional specific question (Figure 5).

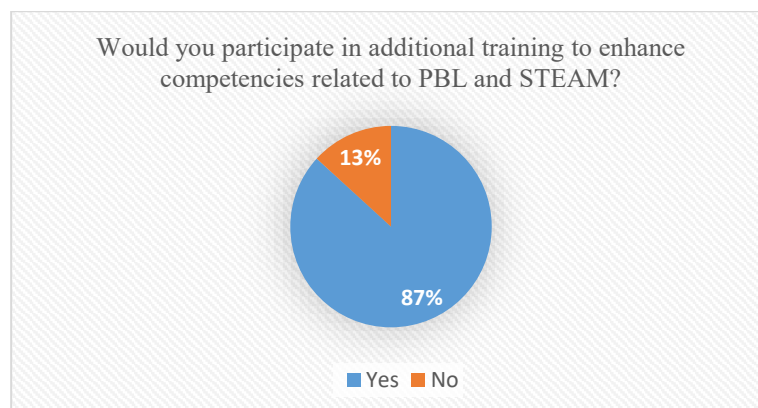


Figure 5. Would you participate in additional training to enhance competencies related to PBL and STEAM?

The data indicate a clear willingness to build on existing competencies and learn about new developments in the field of innovative pedagogical approaches. As many as 86.8% of teachers have recognized the need to incorporate PBO and STEAM when working with students from diverse cultural and ethnic backgrounds..

IV. CONCLUSION

To summarize the results of this study, it can be noted that PBL and STEAM activities are innovative pedagogical approaches well-suited to the multicultural classroom. Teachers recognize their potential, positive effects, and their cognitive and social significance for enriching the educational process.

- Frequent implementation can increase motivation to learn and sustain students' attention and engagement through collaboration and hands-on experimentation;
- Integrated and hands-on learning serves as an incentive to keep students in the classroom and foster their inclusion, regardless of linguistic, cultural, and ethnic differences.

As a recommendation, it is worth noting the need for additional theoretical and practical training for educators; the development and sharing of best practices; and the provision of material and instructional resources, as well as methodological and financial support from the leadership of educational institutions.

Project-based activities are an effective tool for creating an inclusive learning environment in a multicultural classroom. They will enable students to apply the knowledge and skills they have acquired in real-world situations.

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