

Teaching in STEM and Project-Based Learning

Education has long recognised the significance of STEM (Science, Technology, Engineering, and Mathematics) subjects, considering them as fundamental pillars of knowledge. However, recent statistical data, such as the sample mean PISA scores compiled by Bacovic et al. (2022), reveal a concerning trend. Over the past two decades, Europe has witnessed a decline in the proportion of graduates from STEM programs compared to the total number of tertiary graduates. Alarmingly, despite the extensive efforts, the quality of education has remained stagnant, with PISA scores mirroring those from the year 2000.

This disheartening scenario has prompted schools and educational institutions to explore innovative approaches to teaching, seeking to engage students, nurture their interests, and foster growth within the STEM sector.

In this regard, one promising method gaining traction is Project-Based Learning (PBL). By shifting the educational paradigm towards experiential and hands-on approaches, PBL revolutionises STEM education, transforming it into an exciting and meaningful journey for students. PBL is a teaching method in which students learn by actively engaging in real-world and personally meaningful projects (PBLworks, 2023). “The core idea of... [PBL]... is that real-world problems capture students’ interest and provoke serious thinking as the students acquire and apply new knowledge in a problem-solving context” (Jane David, 2008)

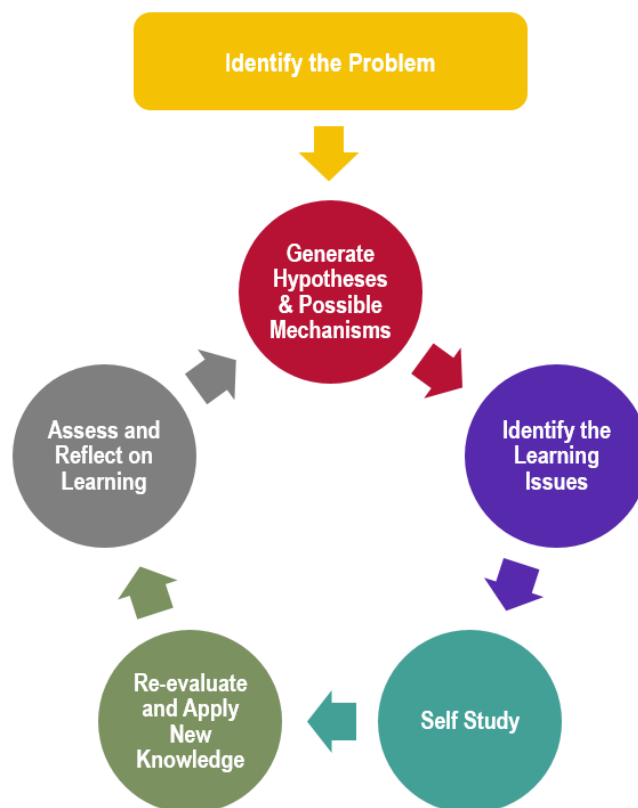


Image 1: Chart explaining the process of PBL (taken from <https://cte-blog.uwaterloo.ca/problem-based-learning-pbl-in-stem-education-mahmoud-a-allam/>)

Looking at the chart above as well as the reasons listed above, teachers can better understand why PBL is an important educational method that they need to follow. When a new problem is introduced in a class setting, the teacher will then instruct the group of students to **Identify the Problem**. Then they allow the students to **Generate Hypotheses and Possible Mechanisms** to solve the problem. Because the students are allowed to **Identify their Learning Issues** and understand where their knowledge is lacking, they will have the opportunity to study on their own (**Self Study**) and fill in those gaps. After **Re-evaluating the problem and applying their New knowledge**, students can now ensure that no other gaps remain and then **Assess and Reflect on their Learning**, allowing for group feedback to generate new hypotheses as the cycle starts again (Mahmud A. Allam, 2017).

When PBL is used in STEM education following the chart above, students can benefit in **five main ways**:

1. Promotion of interdisciplinary thinking:

As PBL focuses on learning around real-world problems, students are invited to consider skills that are used beyond school. Students need to draw on knowledge from various disciplines and expertise in order to deal with the problems they are tasked with solving. (Bednar Kelsey, 2022)

2. Promotion of active engagement:

PBL promotes active engagement and student-centred learning. Instead of having more passive classes where students just receive information through a lecture format, students actively can explore and investigate the subject matter, fostering curiosity, motivation, and a sense of ownership over their learning. This can enhance student engagement and promote a deeper level of understanding.

3. Promotion of deeper connections to the content:

As PBL is an inquiry approach, students are often required to make connections between the problems they are tasked with solving and to develop lines of inquiry to help them identify and avoid misconceptions, while connecting facts and information with their knowledge to solve, evaluate and reflect on specific situations (Melinda Kolk, 2023)

4. Promotion of collaboration and teamwork skills:

PBL allows students to apply their knowledge and skills in a group environment, allowing for students to learn how to work effectively in teams, communicate ideas, delegate tasks and resolve conflicts all of which are vital skills for one to have.

5. Promotion of skills needed for success in the workplace:

PBL in STEM education allows for students to leave schools prepared with the skills they need in the workplace and “compete in the new economy” (Tsupros et al., 2009). Being able to apply this knowledge to solve real-life problems is really important, allowing graduates to flourish in their chosen field of work.

Overall, PBL in STEM classes helps students to develop a deeper understanding of STEM concepts, enhances their problem-solving and critical thinking skills, while promoting collaboration and teamwork, preparing them for their future careers (Smith Kathy et al, 2022). By engaging students in hands-on, authentic projects, teachers can create meaningful learning experiences that inspire and empower students in their STEM education journey.

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