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TECNOLOGIA E APRENDIZAGEM: NOVOS TEMPOS, NOVOS PROFESSORES: O ENSINO DE MATEMÁTICA MEDIADO POR PROJETOS, POR MEIO DE LEVANTAMENTO DE INTERESSES DOS ESTUDANTES

TECHNOLOGY AND LEARNING: NEW TIMES, NEW TEACHERS: MATHEMATICS TEACHING MEDIATED BY PROJECTS, THROUGH SURVEYING STUDENTS' INTERESTS

TECNOLOGÍA Y APRENDIZAJE: NUEVOS TIEMPOS, NUEVOS PROFESORES: ENSEÑANZA DE MATEMÁTICAS MEDIADA POR PROYECTOS, A TRAVÉS DE LA ENCUESTA DE INTERESES DE LOS ESTUDIANTES

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ABSTRACT

This book chapter addresses the revitalization of mathematics education in the face of contemporary demands, exploring Technology-Mediated Project-Based Learning (PBL) guided by student interests as a transformative pedagogical approach. It analyzes the importance of active methodologies that engage students in the learning process, connecting mathematics to real and meaningful contexts. The chapter discusses how surveying student interests can serve as a starting point for the development of authentic and motivating projects, in which technology acts as an essential tool for research, collaboration, data analysis, and communication of results. It examines the theoretical foundations of PBL and its relevance to mathematics education, presents practical strategies for the implementation of this approach, addresses the challenges, and offers final considerations on the potential of technology-mediated PBL to develop critical, creative, and proficient students in mathematics.

Keywords: Project-Based Learning. Mathematics Education. Educational Technology. Student Interests. Active Methodologies.

RESUMO

O presente artigo aborda a revitalização do ensino de matemática em face das demandas contemporâneas, explorando a Aprendizagem Baseada em Projetos (ABP) mediada pela tecnologia e orientada pelos interesses dos estudantes como uma abordagem pedagógica transformadora. Analisa-se a importância de metodologias ativas que engajem os alunos no processo de aprendizagem, conectando a matemática a contextos reais e significativos. Discute-se como o levantamento dos interesses dos estudantes pode servir como ponto de partida para o desenvolvimento de projetos autênticos e motivadores, nos quais a

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tecnologia atua como ferramenta essencial para a pesquisa, a colaboração, a análise de dados e a comunicação dos resultados. O capítulo examina os fundamentos teóricos da ABP e sua relevância para o ensino de matemática, apresenta estratégias práticas para a implementação dessa abordagem, aborda os desafios e oferece considerações finais sobre o potencial da ABP mediada por tecnologia para formar estudantes críticos, criativos e proficientes em matemática.

Palavras-chave: Aprendizagem Baseada em Projetos. Ensino de Matemática. Tecnologia Educacional. Interesses dos Estudantes. Metodologias Ativas.

RESUMEN

Este artículo aborda la revitalización de la enseñanza de las matemáticas ante las demandas contemporáneas, explorando el Aprendizaje Basado en Proyectos (ABP) mediado por tecnología y guiado por los intereses del alumnado como un enfoque pedagógico transformador. Analiza la importancia de las metodologías activas que involucran al alumnado en el proceso de aprendizaje, conectando las matemáticas con contextos reales y significativos. Analiza cómo la identificación de los intereses del alumnado puede servir como punto de partida para el desarrollo de proyectos auténticos y motivadores, en los que la tecnología actúa como una herramienta esencial para la investigación, la colaboración, el análisis de datos y la comunicación de resultados. El capítulo examina los fundamentos teóricos del ABP y su relevancia para la enseñanza de las matemáticas, presenta estrategias prácticas para su implementación, aborda los desafíos y ofrece consideraciones finales sobre el potencial del ABP mediado por tecnología para desarrollar un alumnado crítico, creativo y competente en matemáticas.

Palabras clave: Aprendizaje Basado en Proyectos. Enseñanza de las Matemáticas. Tecnología Educativa. Intereses del alumnado. Metodologías Activas

INTRODUCTION

The new times demand a reconfiguration of pedagogical practice, especially in the teaching of mathematics, a fundamental discipline for the development of logical reasoning, problem-solving capacity and critical thinking – crucial skills for the performance of individuals in contemporary society (NCTM, 2000). Traditional teaching methodologies, centered on teacher exposition and memorization of formulas, often fail to engage students in a meaningful way, resulting in disinterest and learning difficulties (Boaler, 2016). In this context, the search for innovative pedagogical approaches that are more aligned with the needs and interests of students becomes imperative.

Project-Based Learning (PBL) emerges as a promising active methodology, which shifts the focus from teaching to learning, placing the student at the center of the educational process. In PBL, students are challenged to investigate and respond to a complex question, problem, or authentic challenge, working collaboratively over an extended period of time to create a product or presentation (Buck Institute for Education, 2015). The integration of digital technology in this process further enhances PBL, offering access to a wide range of resources, collaboration tools and possibilities for communication and dissemination of project results (Hmelo-Silver, 2004).

A crucial element for the success of PBL is student engagement, and an effective strategy to promote this engagement is to survey and consider their interests in the design of projects. By connecting mathematics to themes and issues that are relevant and meaningful to students, the teacher creates a more motivating and stimulating learning environment, in which mathematics is no longer perceived as a set of abstract rules and is seen as a powerful tool for understanding and intervening in reality (Wiggins & McTighe, 2005).

This chapter aims to explore the transformative potential of project-mediated mathematics teaching, guided by students' interests and enhanced by digital technology. We will analyze the theoretical foundations of PBL, the importance of identifying and incorporating students' interests in project planning, the role of technology as a facilitating and amplifying tool for learning, and we will present practical strategies and considerations for the successful implementation of this approach in the classroom, aiming at the formation of more engaged, critical, and proficient students in mathematics.

DEVELOPMENT

THEORETICAL FOUNDATIONS OF PROJECT-BASED LEARNING (PLL)

Project-Based Learning (PBL) has solid roots in several pedagogical theories that emphasize the active role of the learner in the construction of knowledge.

Constructivism, as already mentioned, is one of the pillars of PBL. John Dewey, one of the pioneers of constructivist thinking in education, advocated learning through practical experience and real problem-solving (Dewey, 1938). At PBL, students learn by doing, investigating and building solutions to the challenges proposed by the projects.

Kolb's (1984) theory of experiential learning also aligns with PBL, highlighting the learning cycle that involves concrete experience, reflective observation, abstract conceptualization, and active experimentation. The projects provide opportunities for students to experience this cycle, applying their knowledge in practical contexts and reflecting on the learning process.

Vygotsky's (1978) sociocultural perspective emphasizes the importance of social interaction and collaboration in learning. In PBL, group work and the exchange of ideas among students are central elements, allowing the joint construction of knowledge and the development of important social skills.

In addition, PBL connects with the **theory of self-determination** (Deci & Ryan, 2000), which posits that the intrinsic motivation of individuals is fueled by autonomy, competence, and relationship. Projects that are relevant to students' interests and that offer them opportunities to choose and demonstrate their competence tend to increase their motivation and engagement.

THE IMPORTANCE OF SURVEYING STUDENTS' INTERESTS IN PROJECT-BASED MATHEMATICS TEACHING

Incorporating students' interests into the planning of math projects is key to increasing their engagement, motivation, and consequently the quality of their learning. When students have the opportunity to work on projects that connect with their hobbies, passions, and concerns, mathematics ceases to be abstract and isolated content and is seen as a relevant tool for exploring and understanding the world around them (Piaget, 1969).

There are several strategies to raise students' interests in the context of mathematics teaching:

Quizzes and Polls: Applying quizzes or polls, both in print and digital formats, can provide valuable insights into the topics, activities, and areas of knowledge that pique students' interest.

Group Discussions and Brainstorming: Conducting group discussions and brainstorming sessions can encourage students to share their interests and generate ideas for projects that are relevant to them.

Active Observation and Listening: The teacher can carefully observe the conversations, comments and preferences shown by students in the classroom and in other contexts, using this information to guide the choice of project themes.

Connection with the Curriculum and Current Themes: The teacher can introduce students to curricular themes or current issues and invite them to explore connections with their own interests, seeking ways to address these themes through math projects.

Use of Digital Tools: Online platforms and cloud tools can facilitate the collection and analysis of students' interests, allowing the identification of patterns and the formation of working groups with common interests.

By considering the interests of students in the planning of projects, the teacher does not need to abandon the mathematics curriculum. On the contrary, it can use the students' interests as a starting point to explore the curricular contents in a more meaningful and contextualized way. For example, if a group of students shows an interest in sports, a project might involve statistical analysis of game data, the calculation of probabilities in competitions, or the mathematical modeling of athletes' performance. If another group is interested in video games, a project can explore the geometry and algebra present in game design or the analysis of artificial intelligence algorithms.

THE ROLE OF DIGITAL TECHNOLOGY IN THE MEDIATION OF MATHEMATICS TEACHING BY PROJECTS

Digital technology plays a crucial role in mediating project-based mathematics teaching, offering a wide range of tools and resources that can enrich and enhance students' learning experience (Zhao, 2003).

Research and Access to Information: The internet and search engines offer students access to an unlimited amount of information, data, and resources relevant to their projects. Digital libraries, scientific articles, explanatory videos and virtual simulations can enrich research and understanding of the topics covered.

Collaboration and Communication: Online collaboration tools, such as shared documents, discussion forums, and video conferencing platforms, facilitate teamwork, idea

exchange, and communication among group members, even outside of the physical classroom environment.

Data Analysis and Mathematical Modeling: Spreadsheet software, data visualization tools, and mathematical modeling platforms allow students to collect, organize, analyze, and interpret data more efficiently and visually, making it easier to explore patterns, identify relationships, and build mathematical models to represent real-world phenomena.

Creation and Presentation of Results: Multimedia presentation creation tools, video editors, and online publishing platforms allow students to craft creative and effective final products to communicate the results of their projects to the school community and beyond.

Exploration of Mathematical Concepts: Dynamic geometry software, online graphing calculators, and interactive educational applications offer students the opportunity to explore mathematical concepts in a visual and manipulative way, making it easier to understand abstract ideas and experiment with different mathematical representations.

The integration of technology in PBL should not be seen as an end in itself, but rather as a means to enhance learning and the development of students' skills. The teacher should act as a guide, guiding students in the selection and appropriate use of digital tools, in order to ensure that technology is used effectively to support research, collaboration, analysis and communication of project results.

PRACTICAL STRATEGIES FOR THE IMPLEMENTATION OF PROJECT-MEDIATED MATHEMATICS TEACHING

The successful implementation of project-mediated mathematics teaching requires careful planning and the adoption of effective pedagogical strategies:

Definition of Clear Learning Objectives: Before starting a project, the teacher should clearly define the learning objectives that students are expected to achieve, aligning them with the mathematics curriculum and the skills that are intended to be developed.

Selection of Topics That Are Relevant and Connected to Students' Interests: Choosing topics that are meaningful and motivating to students is crucial to the success of the project. The previous survey of the students' interests can guide this choice.

Elaboration of Challenging Driving Questions: The project should be centered on an open, complex, and challenging driving question, which stimulates inquiry, critical thinking, and problem-solving.

Activity Planning and Schedule: The teacher must plan the different stages of the project, defining the activities that students will perform, the resources they will use and the execution schedule, with realistic and flexible deadlines.

Formation of Collaborative Working Groups: Group work is a fundamental element of PBL. The teacher can organize students into heterogeneous groups, taking into account their interests and abilities, and encouraging collaboration and the division of tasks.

Offering Ongoing Support and Guidance: The teacher acts as a facilitator of the learning process, offering support and guidance to students throughout the project, answering questions, providing feedback, and helping them overcome challenges.

Use of Clear Evaluation Rubrics: From the beginning of the project, students should be clear about the criteria that will be used to evaluate their performance, both in the project development process and in the final product. Assessment rubrics can be a useful tool for communicating these criteria in a transparent way.

Promotion of Reflection and Metacognition: At the end of the project, it is important that students have the opportunity to reflect on what they have learned, on the group work process and on the challenges they faced, developing metacognition and the ability to learn from experience.

Celebration and Sharing of Results: The conclusion of the project should be a moment of celebration of learning and sharing of results with the school community, using different presentation formats, such as exhibitions, seminars, websites or videos.

CHALLENGES AND CONSIDERATIONS FOR IMPLEMENTING TECHNOLOGY-MEDIATED ABP

Despite the numerous benefits, the implementation of technology-mediated PBL in mathematics teaching also presents challenges that need to be considered:

Planning and Execution Time: PBL generally requires more planning time on the part of the teacher and more execution time on the part of the students compared to traditional methodologies.

Classroom and Workgroup Management: Managing multiple workgroups engaged in different projects can be challenging for the teacher, requiring organizational, communication, and mediation skills.

Assessment of Individual Learning in Collaborative Projects: Assessing the individual contribution of each student in group projects can be complex and requires the use of diversified assessment strategies, such as self-assessment, peer review, and observation of the work process.

Technological Infrastructure and Technical Support: The effectiveness of technology-mediated PBL depends on the availability of adequate technological infrastructure and technical support to ensure the functioning of the tools and solve problems.

Resistance to Change: On the part of both teachers and students, there may be resistance to the adoption of new teaching and learning methodologies, especially those that require a more active and autonomous role on the part of students.

Overcoming these challenges requires a commitment on the part of the educational institution to offer adequate training and support to teachers, to invest in technological infrastructure, and to promote a culture of innovation and collaboration in the school community.

FINAL CONSIDERATIONS

Project-mediated mathematics teaching, guided by the interests of students and enhanced by digital technology, represents a promising pedagogical approach for the revitalization of the discipline and for the formation of more engaged, critical and proficient students. By connecting mathematics to real, meaningful contexts, stimulating authentic inquiry and problem-solving, and offering students the opportunity to work collaboratively on projects that are relevant to them, this pedagogical approach contributes to deeper and more lasting learning.

The quotations from Dewey (1938) and Kolb (1984) remind us of the importance of experience and reflection in learning. Vygotsky (1978) highlights the role of social interaction, and Deci and Ryan (2000) emphasize intrinsic motivation. Current research on PBL and technology in mathematics teaching (Buck Institute for Education, 2015; Hmelo-Silver, 2004; Zhao, 2003) corroborate the transformative potential of this approach.

We believe that the incorporation of technology-mediated PBL, with a focus on surveying and valuing students' interests, can contribute significantly to overcoming the lack of interest and difficulties often associated with learning mathematics. By creating a more relevant, challenging, and engaging learning environment, we can graduate students who not only master mathematical concepts, but who are also able to apply this knowledge creatively and critically to solve problems and transform reality. We believe that this is the path to new times and to the training of new mathematics teachers, capable of inspiring and empowering their students.

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