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Empowering Teachers with Robotics Video Tools for Reducing Math Anxiety

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Abstract: Reducing mathematics anxiety in primary education requires empowering teachers with effective, practical strategies. This study explores a blended professional development approach that combines educational robotics and scenario-based video resources to help teachers create engaging and emotionally supportive math classrooms. The training model integrates modular theoretical content, real-life teaching videos, and interactive digital tools to enhance instructional confidence and promote student-centered learning. By addressing both emotional and pedagogical aspects of teaching, the approach supports reduced anxiety, improved student motivation, and stronger engagement with STEM subjects.

Keywords: Mathematics anxiety; teacher professional development; educational robotics; blended learning; scenario-based videos; STEM education; digital teaching tools; student engagement.

I. INTRODUCTION

Mathematics anxiety is a well-recognized emotional condition marked by stress, fear, and nervousness that negatively impacts mathematical performance [1]. In primary school students, elevated anxiety levels are linked to lower academic outcomes and unfavorable attitudes toward STEM subjects, often leading to long-term effects on confidence and future opportunities in STEM [2]. While teachers play a central role in shaping students' perceptions of math, many feel underprepared to address its emotional challenges. Despite growing awareness of the impact of emotions on learning, structured strategies to reduce anxiety remain limited in teacher training programs.

To address this gap, the Erasmus+ project RbtcsInEdu established blended professional development resources combining theoretical knowledge with applied tools. Educational robotics and scenario-based video resources were integrated to support teachers in creating engaging, low-pressure learning environments. Robotics activities promote problem-solving and collaboration, while videos model practical methods for integrating these tools into math instruction. This article presents the design and pedagogical rationale of the RbtcsInEdu training model, highlighting how these resources can empower teachers to foster more inclusive and emotionally supportive mathematics classrooms.

II. MATH ANXIETY AND THE ROLE OF TEACHERS

Mathematics anxiety in students is profoundly influenced by teachers' attitudes, instructional practices, and emotional support. Teachers act as both academic guides and emotional regulators, shaping classroom environments that either exacerbate or alleviate math-related stress. Research demonstrates that educators' own anxieties about mathematics can unconsciously permeate their teaching methods, leading to rigid, formulaic instruction that prioritizes rote memorization over conceptual understanding [3][4]. This transmission of anxiety is particularly impactful in early education, where

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students' foundational attitudes toward math are formed. This cycle of influence is illustrated in Figure 1, showing how teacher attitudes and instructional methods can unintentionally reinforce math anxiety.

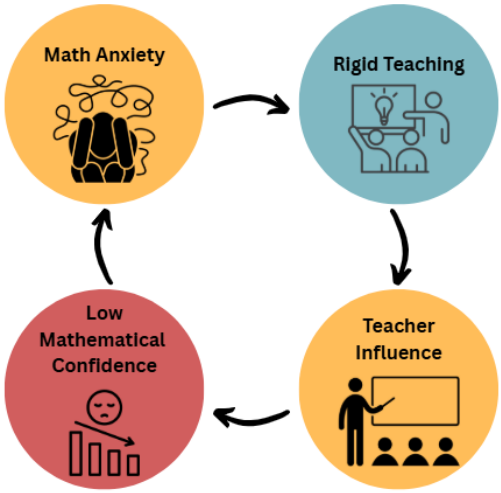

Fig. 1. Cycle of math anxiety and teacher influence

Teachers who lack confidence often avoid student-centered activities, inadvertently reinforcing the perception of mathematics as a high-stakes, right-or-wrong discipline [5][6]. Conversely, educators who model enthusiasm and resilience foster classrooms where mistakes are reframed as learning opportunities, directly countering anxiety triggers [7].

Key studies highlight the mechanisms through which teacher behaviors affect student outcomes. For instance, math-anxious teachers are less likely to employ process-oriented teaching practices, which are critical for reducing fear of failure. Student-centered approaches—such as collaborative problem-solving and hands-on robotics activities—democratize learning by emphasizing exploration over perfection, thereby lowering anxiety levels [8]. Gender differences further complicate this dynamic: male students often benefit more from emotional teacher support in reducing math anxiety, suggesting the need for gender-responsive strategies [7]. Professional development programs that address both pedagogical skills and educators' own emotional barriers show promise, as training in growth mindset principles and mindfulness techniques helps break the cycle of anxiety transmission [5].

Ultimately, empowering teachers to mitigate math anxiety requires systemic support. Blended training models that combine theoretical frameworks with practical tools—such as scenario-based videos demonstrating anxiety-sensitive instruction—enable educators to visualize and implement effective strategies. By fostering emotional intelligence alongside content mastery, such initiatives help teachers create inclusive classrooms where students develop not only mathematical competence but also resilience and self-efficacy [9].

III. DESIGN OF THE PROFESSIONAL DEVELOPMENT APPROACH

The increasing complexity of mathematics teaching, combined with the emotional challenges such as math anxiety, calls for innovative and flexible professional development (PD) models that effectively support teachers. Traditional one-off workshops or purely face-to-face training often fall short in providing sustained, practical, and context-sensitive learning experiences. Blended professional development, which integrates online digital resources with in-person interactions, has emerged as a promising approach to address these limitations. It offers teachers flexibility in time and pace, access to diverse instructional materials, and opportunities for collaborative reflection and peer support, all critical for fostering meaningful changes in teaching practice and confidence in managing math anxiety in classrooms [10].

The RbtcsInEdu platform exemplifies a well-designed blended professional development (PD) environment that aligns with contemporary research on effective teacher learning by combining flexibility, interactivity, and authentic practice (fig. 2).

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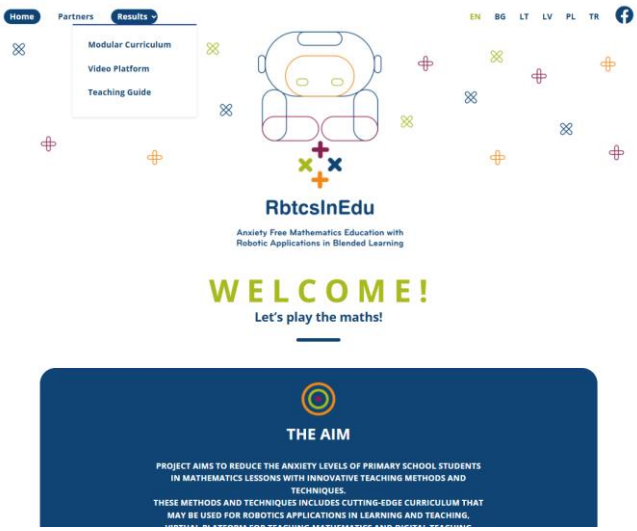

Fig. 2. RbtcsInEdu platform with access to professional development resources for mathematics teachers (available at: rbtcsinedu.eu)

Its modular curriculum, delivered as an electronic book, enables teachers to engage deeply with theoretical foundations on math anxiety and pedagogical strategies at their own pace. This self-directed format respects adult learning principles, allowing educators to reflect and revisit content as needed, which enhances knowledge retention and supports individualized learning pathways [11][12]. The platform's filmed videos of real classroom implementations of educational robotics serve a critical role in bridging theory and practice. By observing authentic teaching scenarios, teachers gain concrete models of how robotics can be integrated to foster engagement and reduce math anxiety, which research shows increases teacher self-efficacy and readiness to adopt new instructional practices [13]. These videos also provide vicarious experiences, a key source of self-efficacy according to Bandura's theory, by allowing teachers to witness successful strategies in context before applying them themselves [12]. Animations and infographics based on the curriculum modules further enhance cognitive processing by distilling complex concepts into accessible, visually engaging formats. Such multimedia resources accommodate diverse learning styles and improve comprehension, which is essential in online and blended learning settings where direct instructor presence is limited [14]. These visual aids complement textual content and videos, creating multiple entry points for understanding and application.

In sum, the RbtcsInEdu platform's blended professional development model leverages evidence-based strategies to create a comprehensive, flexible, and interactive learning environment. Its integration of modular content, authentic video exemplars and collaborative spaces supports teachers in developing both the knowledge and confidence necessary to implement anxiety-sensitive, robotics-enhanced mathematics instruction. Figure 3 summarizes the core components of this approach, illustrating how theoretical foundations, scenario-based videos, and classroom practice are interconnected within the blended model.

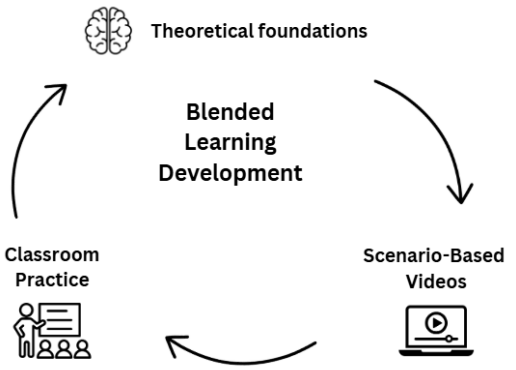

Fig. 3. Diagram of the blended professional development model used in RbtcsInEdu

This holistic approach addresses both cognitive and emotional dimensions of teaching, fostering meaningful and sustained improvements in classroom practice.

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IV. EXPECTED IMPACT

The Smart Video Platform with Robotics Productions developed in this project is expected to have a multifaceted impact on mathematics education, teacher training, and broader STEM engagement. By integrating robotics-based video content into blended learning environments, the platform addresses the pervasive issue of mathematics anxiety, which has been shown to negatively affect students' motivation and achievement in mathematics [15]. The use of robotics as a tangible and interactive tool facilitates conceptual understanding and reduces abstractness, thereby enhancing student engagement and lowering anxiety levels [16].

From an educational technology perspective, the platform supports the professional development of both pre-service and in-service teachers by providing accessible, modular, and visually rich instructional materials. This aligns with findings that digital resources and blended learning approaches improve teachers' digital competence and instructional efficacy [17]. The platform's open-access design ensures that these benefits can be widely disseminated and adapted across diverse educational contexts, fostering equity in access to innovative teaching tools [18].

Moreover, early exposure to robotics and programming through the platform is anticipated to stimulate student interest in STEM fields, contributing to the development of a future workforce equipped with essential digital skills [19]. The project's outputs thus support strategic educational goals at the European level, including the promotion of digital literacy and STEM education as outlined in the Digital Education Action Plan 2021–2027 [20].
Finally, the platform will generate valuable data on the effectiveness of robotics-based interventions in reducing mathematics anxiety and improving learning outcomes. This evidence base can inform future research and policy-making, contributing to the sustainable integration of digital technologies in education systems.

V. CONCLUSION

This study highlights the potential of robotics video tools as effective resources for empowering teachers to address mathematics anxiety in their classrooms. By integrating robotics-based videos into blended learning, teachers gain practical strategies and visual exemplars that enhance their confidence and instructional skills. These tools make complex mathematical concepts more concrete and engaging for students, contributing to reduced anxiety and increased motivation in mathematics learning.

The findings underscore the importance of combining technological innovation with teacher professional development to foster positive learning environments. Empowering teachers through accessible and well-designed robotics video materials supports both digital competence and pedagogical growth. Ultimately, this approach offers a scalable and sustainable pathway to improve mathematics education, promote STEM engagement, and mitigate the negative effects of math anxiety

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