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Using stem strategies to boost student motivation in English language acquisition

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Abstract: This article examines the role of STEM technologies in increasing motivation within the context of foreign language learning. Motivation is one of the most influential psychological and pedagogical factors affecting learners' academic performance. Contemporary educational systems are shifting toward interdisciplinary approaches, making STEM an effective model for engaging learners through practical, inquiry-based, and problem-solving activities. The article provides an overview of major motivational theories, discusses the pedagogical advantages of STEM integration, analyses the mechanisms by which STEM tasks enhance intrinsic motivation, and offers classroom examples relevant to English language acquisition. Findings demonstrate that STEM-based instruction strengthens students' cognitive engagement, autonomy, and real-world application of language skills, resulting in sustained motivation and deeper learning.

Résumé: Cet article analyse le rôle des technologies STEM dans l'augmentation de la

motivation des apprenants en cours de langue étrangère. La motivation constitue l’un des facteurs psychopédagogiques les plus importants influençant la réussite scolaire. Avec l’évolution de l’éducation moderne vers des approches interdisciplinaires, le modèle STEM apparaît comme une solution efficace pour favoriser l’engagement à travers des activités pratiques et basées sur la résolution de problèmes. L’article présente les principales théories de la motivation, les avantages pédagogiques de l’intégration STEM, ainsi que des exemples d’activités applicables à l’apprentissage de l’anglais. Les résultats montrent que les activités STEM renforcent l’engagement cognitif, l’autonomie et l’utilisation réelle de la langue, ce qui contribue à une motivation durable.

Аннотация: Бұл мақалада STEM технологияларының шетел тілін оқытудағы мотивацияға әсері қарастырылады. Мотивация – білім алушылардың жетістікке жетуіне тікелей ықпал ететін психологиялық фактор. Қазіргі білім беру жүйесінде пәнаралық әдістер кең таралғандықтан, STEM тәсілі оқушыларды тәжірибелік жұмысқа, зерттеуге және оқу мәселелерін шешуге жаңа бағыт ашады. Мақалада мотивация теориялары, STEM элементтерінің тиімділігі, сондай-ақ тілдік дағдыларды тәжірибеге бағытталған практикалық тапсырма мысалдар берілген. Зерттеу нәтижелері Теориялық талдау барысында STEM-ге негізделген тапсырмалар студенттердің қызығушылығын, белсенділігін және тілді өмірде қолдану қабілетін күшейтетінін көрсетеді.

Keywords: STEM education, motivation, foreign language learning, interdisciplinary methods, student engagement.

INTRODUCTION

With the rapid development of technology, educational institutions worldwide are increasingly incorporating innovative methodologies to cultivate learners’ interest. One such methodology is STEM — an interdisciplinary approach integrating Science, Technology, Engineering, and Mathematics. Although traditionally associated with scientific and technical fields, STEM has expanded into the humanities and language education because of its emphasis on inquiry, experimentation, and real-world application. Foreign language teachers today adopt STEM-oriented tasks to transform lessons from passive theoretical instruction into active, project-based, student-centered learning environments. This shift reflects global educational trends requiring learners to navigate complex social and technological landscapes, and it reinforces the idea that learning is most meaningful when connected to authentic contexts.

Motivation in education has been a central topic in psychology and pedagogy for several decades. Scholars such as Zoltán Dörnyei [3], Edward Deci and Richard Ryan [1], [2] emphasize that motivated learners show greater persistence, increased effort, and higher academic achievement. Motivation is generally understood as the internal psychological force that directs and sustains behavior, determining students’ willingness to engage, the effort they

invest, and their persistence when facing difficulties in language acquisition. Deci and Ryan argue that without intrinsic motivation, students are likely to rely solely on external rewards, which reduces long-term success. From this, we conclude that motivation must be nurtured through meaningful, engaging tasks that help learners perceive English as a valuable and relevant tool.

According to Deci and Ryan's Self-Determination Theory [1], motivation is strongest when three basic psychological needs are satisfied: autonomy, competence, and relatedness. Autonomy allows students to feel ownership over their learning; competence enhances their belief in successful performance; and relatedness ensures social support and connection. Ryan and Deci [2] further argued that classrooms designed to satisfy these needs significantly increase intrinsic motivation and deepen cognitive engagement. STEM tasks naturally support these principles because they require independent decision-making, collaboration, creative thinking, and active exploration. When students conduct experiments or create engineering prototypes using English as a communicative tool, they simultaneously experience autonomy, competence, and social interaction—three critical pillars of intrinsic motivation.

Dörnyei's L2 Motivational Self System [3], [4] provides a language-specific perspective. According to Dörnyei, the Ideal L2 Self motivates learners by helping them visualize themselves as proficient language users, while the Ought-to L2 Self represents external expectations from parents, teachers, and society. The L2 Learning Experience relates directly to learners' attitudes toward classroom tasks. STEM-based lessons greatly influence this dimension because they transform language learning into an active, meaningful, and purposeful process. Thus, we conclude that STEM tasks strengthen the L2 Learning Experience by showing students that English is not merely a subject to memorize but a practical tool for inquiry and problem-solving.

STEM aligns strongly with constructivist theories of learning. Piaget [5] stated that knowledge is constructed through interaction with real objects and experiences. He emphasized that learning occurs when students confront new challenges and work through cognitive conflict. From this, it follows that STEM tasks — which often involve building, testing, and revising — naturally support constructivist learning by immersing students in hands-on activities requiring reflection and adaptation.

Vygotsky's sociocultural theory [6] introduced the concept of the Zone of Proximal Development (ZPD), where learners achieve more with guidance and collaboration than independently. STEM activities — particularly team-based engineering challenges, simulations, and coding — place learners directly within the ZPD. Working together, students negotiate meaning, communicate in English, and co-construct solutions, which enhances both linguistic and cognitive development. Therefore, we conclude that STEM tasks operationalize Vygotsky's principles by structuring learning as a socially mediated process.

Bruner’s discovery learning theory [7], [8] emphasizes that individuals learn more deeply when they discover knowledge through exploration. In his view, education should not focus on rote memorization but on problem-solving processes. Dewey [9] further argued that education must connect with real-life experiences to be effective. STEM deeply reflects these philosophies because it situates learners in authentic scenarios where English is required to explain procedures, present data, and justify reasoning. This suggests that STEM not only enhances linguistic development but also strengthens critical and creative thinking, as learners formulate hypotheses, interpret results, and communicate findings.

Bybee [10] argues that STEM cultivates the analytical reasoning and interdisciplinary communication skills essential for 21st-century learners. English [11] highlights that STEM-integrated education promotes deep conceptual understanding because it links language with hands-on scientific exploration. Practical tasks — such as project-based learning — have been shown to significantly increase motivation and academic performance. Bell [12] and Thomas [13] documented that students retain more information and engage more deeply when participating in long-term, inquiry-based projects.

Practical STEM-based activities in English classrooms include constructing weather instruments, designing prototypes, running small experiments, coding basic programs, and modeling mathematical data. During these tasks, students must use English to collaborate, give instructions, interpret information, and present results. Thus, English becomes a functional tool rather than an abstract academic requirement. This functional use enhances confidence, improves fluency, and promotes deeper language processing because students apply English in authentic contexts requiring precision and clarity.

STEM environments foster growth mindsets by encouraging learners to view mistakes as natural and valuable parts of learning. Complex tasks often involve trial and error, reinforcing the idea that progress results from persistence. Through collaboration, students share responsibilities, support each other, and engage in meaningful dialogue, which strengthens linguistic competence and social motivation. These experiences positively influence students’ beliefs about themselves as capable learners and communicators.

As modern education increasingly adopts interdisciplinary and technology-driven approaches, STEM provides a robust framework for developing motivated, autonomous, and globally competent learners. By aligning with constructivism, sociocultural theory, discovery learning, and experiential education, STEM enhances not only language learning but also critical thinking, creativity, and collaborative problem-solving. Therefore, we can conclude that integrating STEM into English language instruction significantly enriches the learning process and equips students with skills essential for the demands of the contemporary world.

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