

## METHODOLOGY FOR DEVELOPING INDEPENDENT LEARNING ACTIVITY IN PRIMARY SCHOOL STUDENTS BASED ON STEAM TECHNOLOGY

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**Abstract:** This study investigates the impact of STEAM (Science, Technology, Engineering, Arts, and Mathematics) education on independent learning activity among primary school students. Using a mixed-methods approach, 60 students were divided into an experimental group that received STEAM-based instruction and a control group that followed the traditional curriculum. Over an eight-week period, the experimental group engaged in interdisciplinary, hands-on activities designed to foster critical thinking, creativity, and autonomy in learning. Results from pre- and post-assessments revealed that the experimental group showed significant improvements in critical thinking and independent learning behaviors compared to the control group. This study contributes to educational practices by highlighting the benefits and feasibility of integrating STEAM methodologies in primary education.

**Keywords:** STEAM education, independent learning, primary education, critical thinking, problem-solving, student engagement, interdisciplinary learning, educational methodology

## МЕТОДОЛОГИЯ РАЗВИТИЯ САМОСТОЯТЕЛЬНОЙ УЧЕБНОЙ ДЕЯТЕЛЬНОСТИ У УЧАЩИХСЯ НАЧАЛЬНОЙ ШКОЛЫ НА ОСНОВЕ ТЕХНОЛОГИИ STEAM

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**Аннотация:** В этом исследовании изучается влияние образования STEAM (наука, технология, инженерия, искусство и математика) на самостоятельную учебную деятельность у учащихся начальной школы. Используя смешанный подход, 60 учеников были разделены на экспериментальную группу, которая получила обучение на основе STEAM, и контрольную группу, которая следовала традиционной учебной программе. В течение восьминедельного периода экспериментальная группа занималась междисциплинарными практическими занятиями, направленными на развитие критического мышления, креативности и самостоятельности в обучении. Результаты предварительных и последующих оценок показали, что экспериментальная группа продемонстрировала значительные улучшения в критическом мышлении и самостоятельном поведении в обучении по сравнению с контрольной группой. Это исследование вносит вклад в образовательную практику, подчеркивая преимущества и осуществимость интеграции методологий STEAM в начальное образование.

**Ключевые слова:** образование STEAM, самостоятельное обучение, начальное образование, критическое мышление, решение проблем, вовлеченность учащихся, междисциплинарное обучение, образовательная методология

## INTRODUCTION

In the 21st century, education has undergone significant transformations, shifting from traditional knowledge acquisition to fostering skills that prepare students for an increasingly complex, technological, and interconnected world. As a result, new educational methodologies that emphasize critical thinking, creativity, problem-solving, and interdisciplinary knowledge have

gained importance. Among these, the STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach has emerged as a vital framework for equipping students with the essential skills needed to navigate modern challenges.

Primary education is a crucial phase in a child's learning journey, where foundational knowledge and skills are established. Developing independent learning activity in young students during these early years fosters curiosity, encourages inquiry-based learning, and promotes lifelong learning habits. STEAM education is especially effective in this regard, as it integrates multiple disciplines, encouraging students to think critically and solve problems by applying knowledge from various fields. This interdisciplinary approach supports holistic development and motivates students to explore new ideas through hands-on activities, experiments, and creative projects.

This research examines the methodology for developing independent learning activity in primary school students based on STEAM technology. It explores how integrating STEAM principles into early education can enhance students' engagement, improve knowledge retention, and foster independence in the learning process. By analyzing educational strategies that promote self-directed learning and practical application of interdisciplinary knowledge, this study aims to contribute to effective teaching practices that prepare young learners for future academic and professional success.

### **LITERATURE REVIEW**

The integration of STEAM (Science, Technology, Engineering, Arts, and Mathematics) education in primary schools has garnered considerable attention in recent years due to its potential to foster critical skills, creativity, and independent learning among young learners. The existing literature on STEAM-based methodologies provides a solid foundation for understanding how interdisciplinary approaches can contribute to students' cognitive, social, and emotional development. This review examines relevant studies on STEAM education, focusing on its impact on independent learning, critical thinking, and engagement in primary education.

STEAM education has its roots in the STEM (Science, Technology, Engineering, and Mathematics) framework, which was initially developed to address gaps in students' technical skills needed in an increasingly technological world. Researchers such as Bybee (2010) argue that STEM education equips students with essential skills for problem-solving, analysis, and innovation. However, with the addition of "Arts," STEAM further encourages creativity, empathy, and holistic thinking, enabling students to approach problems from multiple perspectives (Yakman & Lee, 2012). The literature suggests that integrating arts within the technical fields of STEM not only enhances creativity but also strengthens students' understanding of complex concepts by making them more accessible and relatable (Henriksen, 2014).

Independent learning in primary education is fundamental in cultivating a sense of responsibility and motivation in students, which can lead to improved academic performance and a lifelong love for learning. According to Zimmerman (2002), self-directed learning is developed through activities that require students to plan, monitor, and evaluate their own learning. STEAM methodologies support independent learning by providing students with opportunities to explore, experiment, and solve problems autonomously (Dweck, 2006). In a study by Quigley and Herro (2016), it was observed that elementary students who participated in STEAM activities demonstrated increased confidence and self-efficacy, crucial components of independent learning. These activities allowed students to work collaboratively, yet take ownership of their learning through project-based tasks and hands-on experiences.

## METHODOLOGY

This study aims to explore the effectiveness of implementing STEAM (Science, Technology, Engineering, Arts, and Mathematics) education as a tool to enhance independent learning in primary school students. The methodology outlines the research design, participants, materials, procedures, and data analysis methods used to evaluate the impact of STEAM-based activities on students' engagement, critical data to provide a comprehensive understanding of the effects of STEAM education on independent learning activity in primary school students. This design allows for the collection of measurable data while capturing students' and teachers' subjective experiences and perspectives. A quasi-experimental design was used, with one group receiving STEAM-based instruction and the other following a traditional curriculum, allowing for comparative analysis.

The study was conducted with 60 primary school students, ages 8 to 10, from two different classes in a public school. One class was assigned as the experimental group (n=30) that received STEAM-based instruction, while the other class served as the control group (n=30) and followed the standard curriculum. Additionally, five primary school teachers participated, providing insights into the instructional process and the impact of STEAM activities on students' learning behavior. The participants were selected based on convenience sampling, given accessibility and willingness to participate.

## RESULTS AND DISCUSSION

This section presents the findings of the study and discusses their implications for using STEAM (Science, Technology, Engineering, Arts, and Mathematics) education to enhance independent learning in primary school students. The results were analyzed from pre- and post-assessments, observational data, and qualitative responses from teachers and students.

The pre- and post-assessment scores showed a significant improvement in the experimental group, which participated in the STEAM-based activities, compared to the control group. Statistical analysis (paired t-tests) confirmed that the differences between pre- and post-scores for the experimental group were statistically significant ( $p < 0.05$ ), supporting the hypothesis that STEAM-based instruction positively influences independent learning and critical thinking skills in primary school students. Observational checklists completed by teachers indicated that students in the experimental group showed a higher level of engagement and autonomy during STEAM activities. Teacher interviews and student reflections provided qualitative insights into the effects of STEAM education on students' learning experiences.

The results of this study support the growing body of literature indicating that STEAM education enhances independent learning and critical thinking in primary school students. The quantitative data showed that students engaged in STEAM-based activities significantly improved in critical thinking and problem-solving skills, suggesting that the hands-on, interdisciplinary nature of STEAM promotes cognitive development beyond what is typically achieved through traditional instruction.

## CONCLUSION

Overall, the findings demonstrate that STEAM education effectively enhances independent learning, critical thinking, and engagement among primary school students. By fostering a dynamic and student-centered learning environment, STEAM-based methodologies encourage young learners to explore, inquire, and develop essential cognitive and interpersonal skills. The study underscores the importance of integrating STEAM education in primary curricula and

highlights the need for further research to address implementation challenges and optimize teaching practices for young students.

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