# SWOT Analysis of The Current State of STEM Education in Vietnam, Focusing on Education Management And Teacher Professional Development

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**Abstract**
In the context of international integration and breakthroughs in the Internet of Things and Artificial Intelligence, STEM education has become a global trend that contributes to improving teaching quality, enhancing learner competence, and increasing international competitiveness. In Vietnam, the term "STEM education" has appeared in relevant studies for over a decade. Vietnam initiated the reform of its General Education Program in 2018. Through SWOT analysis and from the perspective of educational management and professional development, this study outlines an overview of the strengths, weaknesses, opportunities, and challenges in implementing STEM education in recent years. Based on this, the research team proposes several policy recommendations to improve the quality and effectiveness of STEM education. Additionally, it suggests topics for future research to enrich and further strengthen studies on STEM education in Vietnam.

**Keywords:** Education management, STEM education, 2018 General Education Program, STEM lesson, STEM teaching, STEM topics, STEM integration, STEM models

## 1. Introduction

### *1.1. The Process of Adopting STEM Education in Vietnam*

STEM education originated in the United States approximately 30 years ago (Hudson et al., 2015), and it has consistently garnered significant attention from both the public and educators. Research has shown that integrating knowledge from science (S), technology (T), engineering (E), and mathematics (M) enhances learners' cognitive abilities, attitudes, and behaviors. For instance, it fosters interdisciplinary thinking, critical thinking, creativity, and positive attitudes toward STEM fields (Martín-Páez et al., 2019; Yahya & Hashim, 2021). An integrative review in 2024 (Su & Chang, 2024) identified key global research topics on STEM education, such as effective STEM learning methods (e.g., project-based and inquiry-based learning), active student engagement, and the application of information technology in STEM instruction.

In Vietnam, STEM education was first introduced in some private schools in 2010 through Information Technology and Robotics courses for K-12 students in Hanoi, Da Nang, and Ho Chi Minh City (Thai Thanh, 2019). However, these activities were mainly organized by educational companies and were not officially integrated into the school system. In 2012, the Ministry of Education and Training (MOET) began organizing interdisciplinary competitions for high school students and teachers to strengthen the connection between theoretical knowledge and practical applications. By 2016, the Ministry, in collaboration with the British Council, piloted STEM education in 15 schools (British Council, 2016). STEM education was formally integrated into the new General Education Program in 2018. Between 2020 and 2022, MOET continuously issued guidance documents to implement STEM education at all levels from elementary to high school, such as Official Document No. 3089/BGDĐT–GDTrH on August 14, 2020, regarding the implementation of STEM education in secondary schools, and Official Document No. 909/BGDĐT-GDTH on March 8, 2023, providing guidance for organizing STEM education activities in primary schools. STEM education in Vietnam is understood as "an educational method" aimed at equipping learners with scientific knowledge, ensuring that students have the opportunity to apply the scientific knowledge they learn to solve real-life problems. The three main forms of STEM education include: STEM lessons, STEM experiential activities, and scientific research activities (Ministry of Education and Training, 2020).

By 2024, the first year of implementing the 2018 General Education Program across all 12 grades, awareness and understanding of the importance of STEM education in Vietnam have been increasingly raised. Several studies have recognized the benefits of STEM education in Vietnam, such as the growing connection between theoretical content and practical problem-solving (Ha & Ma, 2023; Nguyen, 2023). This shift towards more applied learning has helped students develop critical thinking, problem-solving, and teamwork skills (Nguyen, 2022). It has also fostered lifelong learning habits and contributed to building a dynamic, creative learning society (Pham et al., 2022). However, several challenges remain, such as the lack of appropriate tools and teaching materials for STEM instruction due to general financial resource limitations. Additionally, many teachers do not yet have the confidence or time to effectively connect natural science knowledge with real-life practical issues (Nguyen et al., 2024).

Given the aforementioned resource constraints, effectively implementing STEM education necessitates a greater focus on educational management. Educational management refers to the planned and purposeful actions of management authorities directed at various components of the educational system, ensuring that the system operates in accordance with established principles and optimally utilizes societal resources allocated for education to enhance public knowledge, train the workforce, and nurture talent. Educational management operates at two primary levels: state management of education (national education system) and school management (educational institutions) (Phan, 2007). Once government management policies have been issued, school management plays a crucial role in attracting and coordinating resources for the implementation of STEM education.

STEM education management at the institutional level can be understood as the planned and purposeful actions of administrators directed toward the management of resources to enhance the effectiveness of STEM education in alignment with government policies. Generally, the key elements managed at educational institutions include: people (teachers, management staff, service staff, students), human activities, and both material and non-material resources such as finances, infrastructure, teaching aids, and information resources (Phan, 2007).

Among the managed components, the OECD report has reaffirmed that teacher qualifications, including subject knowledge and pedagogical skills, play a critical role in the overall quality of education (OECD, 2009) and, consequently, significantly impact the quality of STEM education. On one hand, teacher professional development includes organized activities that provide opportunities for teachers to learn, evaluate, innovate, and improve their knowledge and skills. On the other hand, professional development is also a self-directed process whereby teachers enhance their professional capacities . Faced with teachers' uncertainties (Nguyen & Pham, 2023) in implementing STEM lessons, most publications on STEM education in Vietnam currently focus on proposing instructional designs for specific lessons, subjects, or grade levels, aimed at sharing innovations and experiences with other teachers. These contributions help expand the collection of teaching resources and suggestions, which are still lacking in many schools and localities across the country. Additionally, some publications have started evaluating the current status of STEM education implementation in certain provinces (Dinh & Nguyen, 2024), proposing STEM education management models in schools (Thai et al., 2022), recommending solutions for developing STEM education in Vietnam (Bui & Nguyen, 2022) and studying international experiences to propose their application in the Vietnamese context (Nguyen & Pham, 2020).

It is evident that research on STEM education in Vietnam is continuously evolving, both in terms of volume (increasing from 22 publications per year in 2018 to 64 publications per year in 2023, according to the research team's dataset) and in the diversity of research topics.

### *1.2. Research objectives*

This study aims to evaluate the current state of STEM education implementation in Vietnam, focusing on two key areas: STEM education management and teacher professional development. It draws on domestic publications from 2018–2024 and applies thematic analysis to identify and address relevant issues.

The research analyzes policies related to STEM education management at both local and school levels, considering factors such as financial resources, infrastructure, and the awareness and attitudes of school management teams. Additionally, it examines the current state of teacher professional development, focusing on training needs, readiness, teaching capacity, and potential for growth.

Based on these findings, the study will propose policy recommendations to improve STEM education management and teacher professional development. It will also suggest future research topics to further advance understanding of STEM education in Vietnam.

## 2. Methodology

To gather relevant literature, the research team used the "Publish or Perish" tool to search for publications in the Google Scholar database. It is common for studies in Vietnam to be published in domestic journals due to barriers such as language and publication fees for international journals. Access to full-text versions of these publications is not consolidated in one place, as each Vietnamese journal maintains its own repository, usually requiring partial or full subscription access. However, based on the research team's experience, the Google Scholar database is capable of identifying and indexing the most prominent Vietnamese journals.

The authors searched for publications using keywords such as: "Giáo dục STEM" HOẶC "Bài học STEM" HOẶC "Dạy học STEM" HOẶC "Chủ đề STEM" HOẶC "Tích hợp STEM" HOẶC "Mô hình STEM", of which the literal translation to English is "STEM education" OR "STEM lesson" OR "STEM teaching" OR "STEM topics" OR "STEM integration" OR "STEM models". The search also limits the scope to the period 2018–2024, which aligns with the formal integration of STEM education into the new General Education Program. The initial search returned a total of 360 articles.

The selection criteria for the documents were: the materials must be peer-reviewed journal articles; excluding literature reviews, reports on experiences, research project reports, theses, dissertations, or conference proceedings. At this stage, 240 articles were retained. The team then reviewed the abstracts to identify those that focused on the current state of STEM education implementation and its management. Nineteen articles were selected, but five could not be accessed in full.

Thus, the final dataset consisted of 14 full-text publications. To analyze the data using the SWOT model, the authors divided the task of reading and taking notes on each publication based on two main topics: STEM education management and teacher professional development. The analysis covered four aspects: strengths, weaknesses, opportunities, and threats. The results of the data notes were then categorized and subjected to thematic analysis.

## 3. SWOT Analysis of STEM Education in Vietnam

### *3.1. STEM Education Management*

Overall, the literature review indicates that the management of STEM education has initially leveraged its strengths and presents several opportunities to further demonstrate its role in

management functions. However, there remain certain weaknesses and challenges in improving the quality of STEM education. Specifically:

### *3.1.1. Strengths*

Vietnam is in a phase of industrialization, modernization, and international integration. In alignment with global trends, the Vietnamese Party and Government have issued numerous directives that create a legal framework to promote STEM education across the educational system since 2017 (Le, 2021). These directives have been pivotal in accelerating the development of STEM education nationwide. From macro-level policy issuance, STEM education has been formally incorporated into the 2018 General Education Program and implemented across the country at nearly every educational level, from preschool to high school.

Additionally, the guidance, training, and instruction on STEM education content provided by local Departments of Education and Training to school leaders and teachers in various regions have been well-received, with positive results (Bui et al., 2023; Dinh & Nguyen, 2024). Consequently, numerous STEM-related activities - such as STEM clubs, STEM fairs, and STEM lessons - are regularly organized on a large scale as part of community outreach efforts, connecting the social ecosystem around STEM education in Vietnam .

School administrators play a crucial role in guiding their institutions to identify their distinct characteristics and adopt solutions in alignment with those characteritics (Bui & Nguyen, 2022). The administrators have been given opportunities to participate in STEM education training sessions. Through these activities, administrators gain an accurate understanding of the current state of STEM education and collaborate with experts to pilot and evaluate the effectiveness of STEM education (Pham, 2023). Raising awareness across the educational system is key to ensuring diverse STEM education activities are successfully carried out, while maintaining output standards and overall quality within the 2018 General Education Program.

Lastly, many students actively and enthusiastically participate in STEM education activities (Ha & Ma, 2023), which significantly contributes to the effective implementation of STEM education in schools.

### *3.1.2. Weaknesses*

The most prominent weakness in STEM education implementation in Vietnam is the lack of facilities and educational equipment for STEM activities (Ha & Ma, 2023; Bui et al., 2023). Financial resources allocated to STEM education are limited, and there are no specific incentives in place for teachers and students involved in STEM (Ha & Ma, 2023).

Another challenge is the insufficient awareness and capacity among many school administrators and teachers regarding the concepts, methods, models, skills, and tools necessary to effectively teach STEM. This has led to debates about which STEM education models are appropriate for implementation in schools (Bui et al., 2023; Pham & Nguyen, 2023). Additionally, there is a disparity in the proficiency of STEM education among teachers in urban and rural schools, as well as varying levels of experience among school leaders and departmental heads, which hinders practical implementation at the local level (Pham & Nguyen, 2023).

However, it is important to acknowledge that part of this confusion stems from the novelty of STEM education management. Organizing and mobilizing resources - human, facilities, and financial - to implement STEM activities, while also addressing new demands such as promoting digital transformation in education, is a complex task (Thai et al., 2022).

*3.1.3. Opportunities*

In the broader context of international integration, breakthroughs in the Internet of Things and AI are fundamentally transforming global education. Vietnam's STEM education is presented with significant opportunities to access, develop, and integrate with global knowledge and teaching methods, opening up many employment opportunities both domestically and internationally (Nguyen & Pham, 2020).

A second opportunity arises from the financial support and cooperation offered by organizations, businesses, educational institutions and households as the result of the movement of socialization in education, which is to invite contribution from various stakeholders in the community to education (Bui et al., 2023; Thai et al., 2022; Nguyen & Dang, 2019; Pham & Nguyen, 2023). The connection and development of a STEM education ecosystem have gradually created an environment that fosters the growth of teaching and learning capacities for both teachers and students, as well as community involvement, contributing significantly to improving education quality in Vietnam (Bui et al., 2023; Pham et al., 2022).

*3.1.4. Challenges*

STEM education faces systemic challenges beyond internal weaknesses. Schools interpret STEM education management differently, which requires various stakeholders to collaborate and establish a unified model for organizing and implementing programs. This approach prevents redundancy and ensures each party's role is optimized (Nguyen T. K., 2022). Additionally, identifying teachers' training and professional development needs, along with analyzing the current state of education personnel, remains a significant challenge in clarifying the learner's role in STEM education. Determining clear objectives, content, and methods for training programs also poses an urgent issue (Thai et al., 2022).

### *3.2. Teacher professional development*

Teachers are one of the key stakeholders who determine the quality of STEM education. They are responsible for designing instruction and supporting learners in achieving the objectives outlined in the new curriculum. In light of these responsibilities, several key issues have been identified in current publications:

*3.2.1. Strengths*

The first notable strength is the teachers' willingness to embrace innovation in their teaching practices, which has been recognized in several localities. Due to policies enacted by and the training programs organized by MOET, local Departments of Education, and district-level education offices, teacher capabilities and awareness regarding STEM education have improved significantly. In some provinces, a large number of teachers have received STEM training, with many attending more than three courses (Bui et al., 2023). Young teachers, in particular, have

shown great enthusiasm, constantly seeking new knowledge related to STEM education through books, the internet, and colleagues (Ha & Ma, 2023; Doan et al., 2023)

Specific examples of teaching innovations include institutions in Hanoi that have implemented new teaching methods, such as project-based learning (PBL), applied information technology in lessons, and promoted scientific research. These institutions also organize science and technology competitions on various topics (Nguyen, T. K., 2022).

*3.2.2. Weaknesses*

Despite its strengths, the teaching workforce faces several challenges in delivering STEM education. Firstly, teachers often lack interdisciplinary knowledge and skills required for STEM education, as most are trained in single-subject disciplines. This makes it difficult to transition to interdisciplinary teaching and to select lessons that effectively integrate STEM content (Doan et al., 2023).

Secondly, preparing teaching tools within limited time is a major challenge, especially for teachers already burdened by heavy workloads. They must meet the requirements of the 2018 General Education Program while organizing lessons that foster experiential learning and skill development. The rapid pace of technological innovation further complicates this, as teachers struggle to stay updated and incorporate new advancements into their teaching. In under-resourced regions, teachers often rely on basic materials or ask students to bring their own, resulting in model-based STEM projects with minimal technological integration (Bui et al., 2023; Doan et al., 2023).

Thirdly, opportunities for STEM training and teachers' capacity to deliver it vary widely across regions. While some areas provide STEM training, many teachers in rural areas have never participated in such programs (Nguyen, 2023). Even in cities like Hanoi and Ho Chi Minh City, where more teachers receive training, many fail to apply what they have learned in the classroom (Bui et al., 2023).

*3.2.3. Opportunities*

There is an increasing number of opportunities for professional development in STEM education as Vietnam prioritizes technological innovation and development. In recent years, MOET has issued guidelines for organizing STEM education at various educational levels (Ministry of Education and Training, 2023; Ha & Ma, 2023), which serve as the foundation for schools to implement diverse professional development activities, such as regular in-person or online training sessions through Learning Management Systems (LMS). Additionally, more domestic and international conferences on STEM education are being organized by international organizations, non-governmental organizations (NGOs), and universities across the country. Current online learning platforms provide teachers with many opportunities to enhance their skills in organizing STEM education activities through online courses, regardless of their geographic location.

As a result, several STEM-related teacher communities and networks have emerged, where teachers can share resources and experiences to improve the effectiveness of STEM education activities (Nguyen, 2022; Doan et al., 2023).

*3.2.4. Challenges*

While the opportunities for teacher professional development in STEM education are expanding, there are still significant systemic challenges. Teachers in rural and disadvantaged areas

lack access to resources that would allow them to develop their professional skills, particularly in programs that update modern technology and other essential resources. This makes it difficult to keep up with the rapidly evolving STEM landscape (Doan et al., 2023). Additionally, language barriers may limit access to international STEM programs and materials, as a large proportion of advanced STEM resources are only available in English (Doan et al., 2023).

## 4. Policy Recommendations for STEM Education Development in Vietnam

To promote the development of STEM education in Vietnam, it is crucial for the Government, MOET, and relevant stakeholders to collaborate on the implementation of several coordinated solutions:

### *4.1. STEM Education Management*

First, establishing clear and specific regulations and guidelines. The state should establish specific regulations governing STEM education to ensure that adequate resources—both human and material—are available for its effective implementation. This includes financial investment to secure dedicated STEM classrooms, infrastructure, teaching materials, and consistent opportunities for STEM-related experiential activities, to avoid superficial or unstructured initiatives as seen in some localities.

Second, providing incentives. The government should introduce appropriate policies and incentives for teachers and students who produce valuable STEM educational products. Reasonable investment should be made in these groups to encourage innovation and active participation in STEM activities.

Third, raising awareness. It is essential to enhance the understanding of school administrators, teachers, students, parents, and the community regarding the role of STEM education in both learning and daily life. A well-connected and systematic approach to STEM education management is needed to avoid confusion and ensure the successful implementation of STEM activities nationwide.

Forth, developing a STEM Education Ecosystem. A cohesive ecosystem for STEM education should be developed, enabling teachers and students to exchange knowledge, receive training, and enhance their understanding of effective STEM teaching and learning methods.

Fifth, aligning with workforce needs. Policymakers must identify the future workforce requirements in STEM fields and tailor educational objectives, content, methods, and training programs accordingly to avoid wasting resources. A coordinated effort should be made between educational institutions, labor markets, and various stakeholders to build, implement, monitor, and improve STEM education programs.

### *4.2. Teacher Professional Development*

First, creating comprehensive training plans: It is essential to develop comprehensive professional development plans for teachers at all levels of STEM education. This should prioritize not only subject-specific knowledge but also pedagogical strategies that foster critical thinking, creativity, and problem-solving skills. Educational institutions with teacher training programs

should focus on developing STEM competencies in pre-service teachers so that they are well-equipped to implement STEM education upon graduation (Nguyen & Pham, 2023).

Second, enhancing language and IT skills. Continued efforts are needed to improve teachers' language and information technology skills, in line with the demands of global integration and digital transformation. This will open up more opportunities for international cooperation and career advancement in STEM-related fields. Alternatively, there should be a scheme to develop more Vietnamese-language resources to ensure that teachers have access to the necessary professional development materials. Translating important international STEM education resources into Vietnamese would help teachers keep up with global trends without being hindered by language limitations.

Third, expanding training formats. Teacher training should be expanded through partnerships between schools, technology companies, universities, and research organizations, both domestic and international. Such collaborations will allow teachers to stay updated on the latest STEM knowledge and teaching methods. Industry professionals from STEM fields could be invited to contribute to the development of specialized training programs for teachers.

In conclusion, the development of STEM education policies in Vietnam requires an integrated approach, including increasing resources and access to those resources, continuing to strengthen training programs for administrators and teachers, fostering closer alignment with the labor market and stakeholders, and addressing language barriers.

## 5. Conclusion

This review has synthesized and analyzed 14 studies on the implementation of STEM education in Vietnam, alongside related publications on education management and teacher professional development. The study highlights the strengths, weaknesses, opportunities, and challenges in STEM education from two main perspectives: education management and teacher professional development.

This is the first study to take a comprehensive approach to understanding the current state of STEM education implementation across regions in Vietnam. However, it is limited by the fact that current publications focus on small-scale studies, at individual schools or localities, rather than broader regional or national studies. As the 2018 General Education Program has only been in effect for six years, there is insufficient data and time to conduct evaluations on a larger scale.

In terms of practical implications, The study offers policy recommendations for national, local, and institutional levels. Academically, future research could focus on raising awareness and improving professional development for STEM teachers and administrators. Another key area is identifying strategies to mobilize financial, material, and human resources to support STEM lessons, activities, and research at the K-12 level, helping replicate successful models and advance STEM education in Vietnam.

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