International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 03 March 2025
DOI: 10.47191/ijcsrr/V8-i3-23, Impact Factor: 8.048
IJCSRR @ 2025
www.ijcsrr.org

The Process of Teaching STEM Application Oriented Towards Developing the Competence of Applying Learned Knowledge and Skills in Science for Primary School Students

Pham Thi Thuong[1], Nguyen Bao Hoang Thanh[2], Nguyen Minh Giam[3]
[1]Master's student, University of Science and Education - the University of Da Nang, Vietnam
[2]Associate Professor, Ph.D., University of Science and Education - the University of Da Nang, Vietnam
[3]PhD in Education Science, Faculty of Education, Thu Dau Mot University, Vietnam
https://orcid.org/0009-0002-9895-2079

ABSTRACT: STEM education encompasses four main areas: Science, Technology, Engineering and Mathematics, which are important elements in the learning process of all students, especially in science and mathematics. An effective STEM education will help students better understand how things work and enhance their ability to use technology. The article presents the research results on a teaching method for the Science subject at the primary school level based on STEM education. The research focuses on designing a process for the topic "Energy" in Science. The process includes five main steps: defining objectives, establishing foundational knowledge, planning, implementation, and evaluation. This method not only helps students understand the knowledge but also encourages application through products such as a "mini movie theater." The research demonstrates that this method is feasible, develops scientific competencies, and connects school knowledge with real life.

KEYWORDS: Competence of Applying Learned Knowledge and Skills, Interdisciplinary Integration, Primary School Students, STEM, Teaching Science.

1. INTRODUCTION

In the context of modern education, teaching methods are gradually being innovated to focus on developing students' competencies. STEM education (Science, Technology, Engineering, and Mathematics) is considered one of the advanced approaches, emphasizing interdisciplinarity and practical application to equip students with essential skills in the digital age. In Vietnam, the new general education curriculum has clearly defined the goal of shifting from knowledge transmission to competency development, in which the ability to apply learned knowledge and skills is regarded as a key competency that needs to be emphasized. Particularly at the primary school level, the Science subject plays an important role in stimulating curiosity, the ability to explore, and the application of knowledge to real-life situations for students.

However, the reality of teaching in Vietnam shows that applying STEM in Science teaching still faces many challenges, including the lack of specific teaching processes and limitations in connecting theory with practice. Faced with this situation, the research focuses on developing a teaching process incorporating STEM education aimed at fostering the ability to apply learned knowledge and skills for primary school students, specifically through the topic "Energy" in the 4th-grade Science curriculum. The research aims not only to provide concepts but also to propose a practical process that can be widely applied in primary education. The article will present the theoretical foundation, the teaching process, and specific illustrations, thereby evaluating the effectiveness of this method in improving the quality of Science teaching.

2. RESEARCH RESULTS

2.1 STEM Education

STEM education emphasizes the subjects of Science, Technology, Engineering, and Mathematics. A notable concept of STEM education from the U.S. Department of Education defines it as "a program designed to provide support and enhance education in Science, Technology, Engineering, and Mathematics at the elementary, secondary, and post-secondary levels" (U.S. Department of Education, 2016).

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 03 March 2025
DOI: 10.47191/ijcsrr/V8-i3-23, Impact Factor: 8.048
IJCSRR @ 2025
www.ijcsrr.org

From an integrated (interdisciplinary) perspective, STEM education involves the integration of two or more fields/subjects, such as Science, Technology, or Engineering, and Mathematics. According to this view, STEM education is defined by Sanders (2009) as: "STEM education is an approach to teaching and learning that integrates two or more STEM disciplines, or a STEM discipline with one or more other school subjects."

From the methodological perspective, Tsupros & Hallinen (2009) define STEM education as: An interdisciplinary learning approach in which academic knowledge is closely tied to practical lessons. Students apply their knowledge of Science, Technology, Engineering, and Mathematics in specific contexts, creating a connection between schools, communities, and businesses. This allows learners to develop STEM skills and enhance their competitiveness in the new economy.

Based on these perspectives, STEM education can be understood as an interdisciplinary approach. In this approach, theoretical concepts in lessons are integrated into real-world situations. Students must mobilize and synthesize knowledge from various fields such as science, technology, arts, and mathematics to propose and implement technical solutions in specific contexts. In teaching, STEM education serves as an inspiring teaching method; it helps students integrate knowledge from different sub-disciplines, highlights the practical applications of school knowledge in real life, and provides learners with opportunities for hands-on practice, transforming theoretical understanding into practical tools.

2.2 Competence and the Ability to Apply Learned Knowledge and Skills

Some researchers define competence based on the elements that constitute the ability to act. For example, F.E. Weinert (2001) considers competence as the skills and techniques acquired by each individual and defines it as: Competence is the learned or inherent skills and techniques of an individual to solve specific situations, as well as the readiness in motivation and the ability to apply problem-solving methods responsibly and effectively in flexible situations. According to X. Roegiers (2000), Competence is the integration of skills that naturally influence the content in a given type of situation to solve the problems posed by that situation.

According to Nguyen Minh Giam (2024) defines competence as the synthesis of knowledge, skills, and attitudes that are either learned or inherent in an individual, enabling responsible actions to quickly and easily achieve high efficiency in a specific field. Competence is formed and developed through education, training, self-improvement, and practical experiences of each individual.

According to Nguyen Thi Thu Hang and Phan Thi Thanh Hoi (2018), the application of learned knowledge and skills is the ability of individuals to identify real-world problems, mobilize relevant knowledge, or explore and discover new knowledge to effectively solve practical problems. Le Thanh Huy and Le Thi Thao (2018) state that "The ability to apply knowledge is the learner's ability to independently solve posed problems quickly and effectively by applying acquired knowledge to practical situations and activities to explore and transform the surrounding world.

Based on these perspectives, the ability to apply learned knowledge and skills can be understood as the learner's capacity to flexibly combine acquired knowledge and skills to effectively solve real-life situations. In the context of the Science subject, this ability involves solving learning tasks in new contexts or situations related to real life, appropriate to the capacity of students. It creates opportunities for students to connect and apply knowledge and skills learned from various fields.

2.3 Designing the Teaching Process for the "Energy" Topic in Science Using STEM to Develop the Ability to Apply Learned Knowledge and Skills for Students

2.3.1 The "Energy" Topic in Science

The "Energy" topic focuses on the fundamental issues of natural energy sources, their roles, and human applications in daily life. Through basic knowledge about energy, students can understand and apply it to simple problems in their daily lives. According to the 4th-grade Science textbook by the Ministry of Education and Training of Vietnam (2022), the "Energy" topic includes three fundamental contents: Light, Sound, and Heat, which are divided into the following lessons: Light and the transmission of light; The role of light; Sound and the transmission of sound; Sound in life; Temperature and the transmission of heat; Good and poor heat conductors.

2.3.2 Teaching Process

The process of applying STEM education in teaching Science, in general, and 4th-grade Science, in particular, closely aligns with the process of teaching STEM lessons. However, our research does not aim to implement a complete STEM lesson but rather

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 03 March 2025
DOI: 10.47191/ijcsrr/V8-i3-23, Impact Factor: 8.048
IJCSRR @ 2025
www.ijcsrr.org

applies STEM education to teaching in Science, specifically in the "Energy" topic. This involves integrating the scientific knowledge of the lessons with previously learned knowledge of technology, engineering, and mathematics to help students thoroughly understand the lessons and develop the ability to apply this learned knowledge and skills to create simple products or solve basic real-life problems. Therefore, the teaching process for the "Energy" topic in 4th-grade Science, oriented towards STEM lessons, has some differences compared to the teaching process of a standard STEM lesson.

Based on theoretical research on the teaching process of STEM lessons and the practical application of STEM in teaching the "Energy" topic, the authors have developed a teaching process for the lessons in the topic, as illustrated in the following diagram:

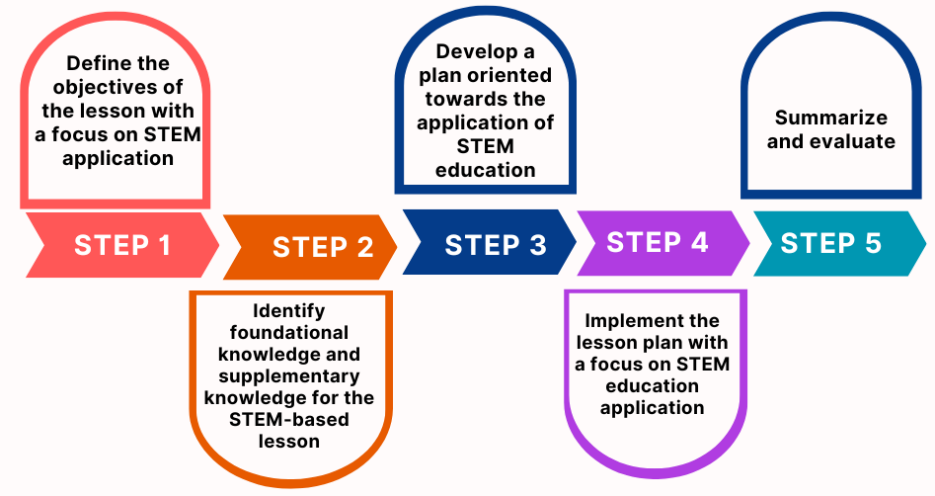

Figure 1. Teaching Process for the Lessons in the "Energy" Topic in Science Using STEM Application

Step 1: Define the objectives of the lesson with a focus on STEM application

Defining lesson objectives based on STEM education in teaching the "Energy" topic (Science, Grade 4) plays a foundational role, as it sets the competency goals that students need to achieve. These objectives not only reflect the expected outcomes of the lesson but also guide students in applying integrated knowledge from the fields of science, technology, engineering, and mathematics to create specific products that demonstrate understanding and practical skills.

Principles for Defining Lesson Objectives:

- Objectives should be constructed based on the required outcomes in the curriculum and the lesson content, ensuring clarity, specificity, and measurability.

- Objectives must reflect different levels of knowledge (understanding), skills (practical application), and attitudes (behavior), while focusing on developing students' core competencies.

- In the STEM context, objectives should emphasize the integration of interdisciplinary knowledge to solve real-world problems, leading to a meaningful final product.

Example: Defining Objectives for the Lesson "Sound in Life"

To build STEM-oriented objectives, teachers should analyze the required outcomes of the lesson, including:

Knowledge: Students should describe the role of sound in daily life, recognize the importance of preventing noise pollution, and know how to select materials and tools to create sound from simple musical instruments.

Skills: Develop skills in observation (musical instruments), listening (sounds), practical manipulation (creating instruments), and teamwork.

Attitude: Students should demonstrate diligence in learning and responsibility when participating in group activities.

Competencies: Develop general competencies such as self-control and self-learning, collaboration, problem-solving, and creativity. Additionally, develop components of scientific competence, including scientific understanding (knowledge of sound) and the ability to apply learned knowledge and skills to real-life situations.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 03 March 2025
DOI: 10.47191/ijcsrr/V8-i3-23, Impact Factor: 8.048
IJCSRR @ 2025
www.ijcsrr.org

STEM-Oriented Lesson Objective: Based on the above requirements, the lesson objective is defined as follows: "Students apply scientific knowledge about sound, combined with insights from related subjects such as Technology (tool usage) and Arts (creative design), to select suitable materials and tools and create a simple musical instrument safely and accurately, demonstrating creativity and teamwork skills."

Step 2: Identify foundational knowledge and supplementary knowledge for the STEM-based lesson

In STEM-based teaching, integrating interdisciplinary knowledge is a core element for developing students' competencies. Foundational knowledge acts as the "main pillar," providing theoretical and practical foundations for the lesson, while supplementary knowledge from other subjects supports and enriches students' ability to create a complete learning product or solve practical problems. Typically, foundational knowledge is derived from the main subject content (in this case, Science), while supplementary knowledge comes from related subjects that students have already learned or need to be introduced to.

Process for Identifying Foundational and Supplementary Knowledge:

Identify Foundational Knowledge: Teachers thoroughly study the lesson content in Science to pinpoint core knowledge that forms the basis for all learning activities. This is what students need to master to understand the lesson and complete related tasks.

Identify Supplementary Knowledge: From the foundational knowledge, teachers ask, "What additional knowledge from other subjects do students need to apply foundational knowledge to solve practical problems or create products?" Supplementary knowledge must closely link with foundational knowledge to help students achieve STEM-oriented lesson objectives.

Example: Identifying Foundational and Supplementary Knowledge for the Lesson "Sound in Life":

Foundational Knowledge: Knowledge about sound, its characteristics, and how it propagates through air; understanding the role and benefits of sound in daily life (e.g., communication, entertainment, warnings); basic knowledge of familiar musical instruments (e.g., flute, drum) and how they produce sound.

Supplementary Knowledge (from other subjects):

Technology: Selecting appropriate materials (bamboo, plastic, rubber bands) and tools (knives, scissors, glue) for making musical instruments; understanding the step-by-step process (cutting, assembling) and ensuring safety and technical accuracy.

Mathematics: Using measurement skills (length, dimensions) within 100 cm to determine parts of the instrument (e.g., flute length); using rulers, compasses, or basic measuring tools for precise calculations.

Arts: Decorating the product to achieve balance and harmony in shape and color (e.g., painting, engraving patterns); learning to present and introduce the product aesthetically and share design ideas.

Music: Understanding the characteristics of sounds (high, low, deep, sharp) produced by self-made instruments; basic knowledge of how to use the instrument and guide peers to play it simply.

Scientific and Logical Nature of Identifying Foundational and Supplementary Knowledge:

Interdisciplinarity: Foundational knowledge (Science) is supplemented by Technology (instrument-making techniques), Mathematics (measurement), Arts (aesthetics), and Music (sound application), forming an integrated knowledge system suitable for STEM education.

Practicality: Supplementary knowledge not only supports theory but also enables students to practice, creating specific products (musical instruments) that connect learning with real life.

Competency Development: Combining these knowledge areas helps students develop problem-solving, creativity, teamwork, and scientific thinking skills.

Step 3: Develop a plan oriented towards the application of STEM education

After defining objectives, foundational knowledge, and supplementary knowledge, teachers design STEM-based lesson plans, including preparation, stages, and specific learning activities. This plan aims to organize an active learning process, encouraging students to apply interdisciplinary knowledge to create products or solve practical problems while developing self-learning and creativity competencies.

Preparation by Teachers and Students for the Lesson

Teacher Preparation: Develop the lesson plan and prepare PowerPoint presentations; Prepare teaching materials: textbooks, teacher guides, reference materials (if needed); Prepare teaching tools and equipment: pictures, drawings, videos, real objects; Develop guiding questions, exercises, learning tasks, and worksheets.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 03 March 2025
DOI: 10.47191/ijcsrr/V8-i3-23, Impact Factor: 8.048
IJCSRR @ 2025
www.ijcsrr.org

Student Preparation: Bring textbooks, notebooks, and learning tools for note-taking; Prepare tools and materials as requested by the teacher.

Teachers guide students to self-study the lesson "Sound in Life" before coming to class by: Asking and guiding students to read the textbook and watch video lectures on YouTube via provided links; Assigning self-study tasks and guiding students on how to complete them.

Main Teaching Activities:

(1) Pre-Class Phase:

Students self-study according to the teacher's guidance: Read materials and watch video lectures; Complete tasks assigned by the teacher, such as answering multiple-choice questions, completing worksheets, or taking notes; Submit notes on the lesson content and experimental process at home; Provide feedback and questions to the teacher and share ideas or concerns with classmates via a Padlet link.

(2) In-Class Phase:

This phase involves implementing the lesson plan in the classroom, designed using active teaching methods and techniques. It typically consists of the following five learning activities:

Activity 1: Warm-Up: The teacher introduces the lesson topic, creates a fun and engaging atmosphere, and stimulates students' curiosity to explore the lesson content.

Activity 2: Research and Confirm Foundational Knowledge: Students recall foundational knowledge from previous lessons; For knowledge self-studied at home, the teacher evaluates and confirms students' understanding.

Activity 3: Problem Posing and Proposing Solutions: The teacher poses a problem: "How can the knowledge you've learned be applied to create simple products for daily life or solve basic real-life problems?", Students propose solutions, discuss in groups, and select the most optimal solution.

Activity 4: Creating Products or Solving Problems: Students implement the selected solution, create products, conduct experiments, and evaluate results.

Activity 5: Product or Solution Evaluation: Students present and explain their products or solutions; The teacher evaluates the products based on specific criteria.

(3) Post-Class Phase:

This phase aims to not only help students consolidate their knowledge but also encourage deeper exploration through practical and creative activities. Teachers may assign extended tasks, such as: Investigating the causes of noise pollution in urban areas; Exploring various types of traditional musical instruments; Practicing creating a favorite musical instrument at home.

These activities enhance scientific understanding, develop self-research skills, critical thinking, and the ability to apply knowledge to daily life, clearly demonstrating the effectiveness and comprehensive educational goals of STEM.

Significance of STEM-Based Lesson Planning: This step is crucial for realizing educational goals and transforming theoretical knowledge into practical skills for students. Thorough preparation by both teachers and students, along with logically organized activities before, during, and after the lesson, allows students to apply interdisciplinary knowledge to specific products, such as in the lesson "Sound in Life." The activities of warm-up, research, experimentation, and evaluation not only ignite students' enthusiasm for learning but also foster creativity, problem-solving, and collaboration skills. Thus, Step 3 not only reinforces lesson knowledge but also supports the comprehensive development of students' competencies in alignment with modern STEM education.

Step 4: Implement the lesson plan with a focus on STEM education application

Step 4 is the core phase, conducted mainly in the classroom with the longest duration, aiming to implement the entire teaching process planned in Step 3. This step realizes STEM objectives by integrating interdisciplinary knowledge and developing students' practical competencies. The process includes five main classroom activities, designed flexibly and divided into smaller activities to effectively address each lesson's content.

The teaching process consists of five main activities (warm-up, research foundational knowledge, problem posing, practical application, and evaluation). Teachers can further break these into smaller activities to ensure logical flow and alignment with specific lesson content.

Example: Activity 2 - Research and Confirm Foundational Knowledge

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 03 March 2025
DOI: 10.47191/ijcsrr/V8-i3-23, Impact Factor: 8.048
IJCSRR @ 2025
www.ijcsrr.org

The teacher can divide this activity into smaller tasks, such as: Checking students' self-study results at home; Deepening and expanding knowledge about the benefits of sound in life; Discussing the harmful effects of noise pollution and measures to prevent it.

Similarly, Activities 3 and 4 can also be divided into specific tasks that align with the lesson content.

- For practical experiments: Teachers should guide students through the following steps: Prepare experimental tools and materials; Arrange the tools in the correct positions; Use the materials in the proper order to ensure safety; Observe carefully, take notes, and analyze the results.

- For group discussions and presentations: During group discussions and presentations, teachers should create a positive learning environment, encouraging students to ask questions, share opinions, and defend their viewpoints. The teacher acts as a facilitator, allowing students to develop critical thinking and communication skills while using guiding questions to direct the discussion.

Thus, Step 4 is where the entire teaching and learning process is implemented in the classroom, transforming objectives and plans into specific actions. It allows students to experience integrated and practical learning. With five main activities divided flexibly—from exploring foundational knowledge and creating products to discussions and evaluations—this step not only reinforces scientific understanding of "Sound in Life" but also hones practical skills, critical thinking, and group collaboration. By carefully guiding experiments and creating a positive discussion environment, teachers ensure safety, effectiveness, and encourage students' creativity. Therefore, Step 4 clearly demonstrates the scientific nature and comprehensive competency development orientation of STEM education, contributing to improving the quality of advanced education.

Step 5: Summarize and Evaluate

The Importance of Summarizing and Evaluating in the STEM Teaching Process: The final and equally important step in the STEM teaching process is summarizing knowledge and evaluating students' learning outcomes. Teachers consolidate what students have learned, including the knowledge and skills they have acquired through the lesson on "Sound in Life." Specifically, this involves understanding sound, its role, and how to create simple musical instruments. At the same time, teachers assess students' progress based on concrete evidence from assignments, presentations, practical products, and students' active participation. This step helps affirm the effectiveness of teaching and learning while guiding students to develop independent learning abilities and creativity for the future.

Diverse Evaluation Methods: Teachers apply various methods to evaluate students comprehensively and fairly, aligned with STEM education goals. First, written explanations or multiple-choice tests are used to assess theoretical knowledge, such as the role of sound or the harmful effects of noise. Additionally, observing group discussions and practical activities helps teachers evaluate students' collaboration skills, learning attitudes, and practical abilities. Furthermore, specific products like self-made musical instruments are assessed based on clear criteria for creativity, aesthetics, and sound production capabilities. Finally, a transparent grading rubric provides specific scoring criteria, ensuring the evaluation of knowledge, skills, and competencies is conducted transparently, scientifically, and fairly.

The Significance of Applying STEM Methods in Education: Integrating STEM into the 4th-grade Natural Science subject, with the central topic of "Energy," has shown positive effects in helping students not only master knowledge but also develop creative skills through practical applications, such as creating simple musical instruments. Compared to traditional STEM methods that often require modern facilities, this approach is more flexible, suitable for teaching and learning conditions in Vietnam, especially at the primary level. The combination of theoretical learning, practical creation, and diverse evaluations creates a tightly integrated learning process with higher efficiency, contributing to improving education quality and fostering the comprehensive development of students' competencies.

Scientific Nature and Practical Applicability: The final step of summarizing and evaluating demonstrates scientific rigor by measuring both learning outcomes and the learning process, fully reflecting students' progress in multiple aspects such as knowledge, skills, and attitudes. Adjusting the STEM method to fit Vietnam's conditions ensures feasibility and opens up the potential for widespread application at other educational levels. Moreover, by evaluating products and encouraging students to explore independently, this step reinforces foundational knowledge while motivating students to learn, preparing them to solve practical problems in real life.

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 08 Issue 03 March 2025
DOI: 10.47191/ijcsrr/V8-i3-23, Impact Factor: 8.048
IJCSRR @ 2025
www.ijcsrr.org

3. CONCLUSION

This study has developed a teaching process that applies STEM education to enhance the ability of primary school students to apply learned knowledge and skills in Science, specifically through the topic of "Energy." This process not only fully reflects the principles of STEM education but also ensures interdisciplinary integration and practical application, enabling primary school students to not only master theoretical knowledge but also creatively apply it to specific situations. Examples such as creating a "Mini Movie Theater" or simple musical instruments have demonstrated that students can develop scientific competencies, problem-solving skills, and creativity through active learning activities.

The research results confirm the feasibility and effectiveness of the proposed method in improving the quality of Science teaching at the primary level. However, for widespread implementation, additional support in terms of facilities, instructional materials, and teacher training is needed. This study opens a new direction for improving teaching methods aligned with STEM education in Vietnam and lays the foundation for further research on expanding the method to other topics and subjects at the primary level.

REFERENCES

1. Ministry of Education and Training of Vietnam (2022), Science 4, Connecting Knowledge and Life, Vietnam Education Publishing House.
2. Tran Khanh Duc (2013), Theory and Methods of Modern Teaching, Hanoi: Hanoi National University of Education Publishing House.
3. Nguyen Minh Giam (2024), Competency-Oriented Teaching to Develop Self-Learning Ability in Chemistry with the Support of Artificial Intelligence Technology, Doctoral Dissertation, Hanoi University of Science and Technology.
4. Nguyen Thi Thu Hang, Phan Thi Thanh Hoi (2018), Evaluating Students' Ability to Apply Knowledge to Practice in Teaching the Microbiology Section - Biology 10, Education Journal, Issue 432, pp. 52-56.
5. Nguyen Huu Hieu (2022), Training Skills in Designing STEM Educational Activities for Primary Education Students at Tay Nguyen University, Master's Thesis, University of Education, Danang University.
6. Dinh Thu Hong (2021), STEM and STEM Education in the United States, Vietnam Science and Technology Electronic Journal.
7. Le Thanh Huy, Le Thi Thao (2018), Fostering the Ability to Apply Knowledge to Practical Situations for Students through Teaching the Chapter "Eyes and Optical Instruments" (Physics 11), Education Journal, Special Issue June 2018, pp. 176-181.
8. Weinert, F. E. (2001). Concept of competence: A conceptual clarification. In D. S. Rychen & L. H. Salganik (Eds.), Defining and selecting key competencies (pp. 45–65). Hogrefe & Huber Publishers.
9. Ong, E. T., Keok, B. L., Yingprayoon, J., Singh, C. K. S., Borhan, M. T., & Tho, S. W. (2020). The effect of 5E inquiry learning model on the science achievement in the learning of â€ œMagnetâ€ among year 3 students. Jurnal Pendidikan IPA Indonesia, 9(1), 1-10.
10. Tsupros, N. & Hallinen, J. (2009). STEM education: A project to identify the missing components. Intermediate Unit 1: Center for STEM Education and Leonard Gelfand Center for Service Learning and Outreach, Carnegie Mellon University, Pennsylvania.
11. Roegiers, X. (2000). A conceptual framework for competencies assessment. Revue française de pédagogie, (130), 43-55.
12. The American Institutes of Research, & The U.S. Sanders (2016), STEM 2026: A vision for Innovation in STEM Education. Washington, DC: The U.S. Department of Education
13. Sanders, M (2009), STEM, STEM Education, STEMmania. Technology Teacher, 68 (4), 20-26.

Cite this Article: Thuong, P.T., Hoang Thanh, N.B., Giam, N.M. (2025). The Process of Teaching STEM Application Oriented Towards Developing the Competence of Applying Learned Knowledge and Skills in Science for Primary School Students. International Journal of Current Science Research and Review, 8(3), pp. 1196-1202. DOI: https://doi.org/10.47191/ijcsrr/V8-i3-23