

## ORGANIZING THE CONTEST “EXPERIENCING STEM IN NATURAL SCIENCE” FOR STUDENTS AT NGUYEN TU SECONDARY SCHOOL, CAO LANH CITY, DONG THAP PROVINCE

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### **Abstract**

*Experiencing is an activity that helps students approach reality, and directly experience by synthesizing existing knowledge and skills to perform tasks and solve problems. STEM education is a modern educational orientation, an educational model that is widely concerned and deployed around the world to adapt to industry 4.0. The contest “Experiencing STEM in Natural Science” is an activity aimed at fostering the quality, forming, and developing students' capacity based on STEM education for natural sciences. This experiential activity contributes to meeting the current requirements of the comprehensive educational reform and training high-quality human resources, capable of applying interdisciplinary knowledge to solve practical problems. The contest is both a learning environment and a creative playground, helping students develop their abilities, strengthen their passion for scientific research, and affirm their self-worth. The contest was held at Nguyen Tu Secondary School, Cao Lanh city, Dong Thap province.*

**Keywords:** *Experience, contest, natural science, STEM.*

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# TỔ CHỨC HỘI THI “TRẢI NGHIỆM STEM KHOA HỌC TỰ NHIÊN” CHO HỌC SINH Ở TRƯỜNG TRUNG HỌC CƠ SỞ NGUYỄN TÚ, THÀNH PHỐ CAO LÃNH, TỈNH ĐỒNG THÁP

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## **Lịch sử bài báo**

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## **Tóm tắt**

*Trải nghiệm là hoạt động giúp học sinh tiếp cận thực tế, trực tiếp trải nghiệm bằng cách tổng hợp kiến thức, kỹ năng hiện có để thực hiện nhiệm vụ và giải quyết vấn đề. Giáo dục STEM là định hướng giáo dục hiện đại, là mô hình giáo dục được quan tâm và triển khai rộng rãi trên thế giới nhằm thích ứng nền công nghiệp 4.0. Hội thi “Trải nghiệm STEM Khoa học tự nhiên” là hoạt động nhằm hướng tới bồi dưỡng phẩm chất, hình thành và phát triển năng lực của học sinh trên nền tảng giáo dục STEM đối với các môn Khoa học tự nhiên. Hoạt động trải nghiệm này góp phần đáp ứng yêu cầu đổi mới toàn diện giáo dục phổ thông hiện nay và yêu cầu đào tạo nguồn nhân lực chất lượng cao, có khả năng vận dụng kiến thức liên môn để giải quyết các vấn đề thực tiễn. Hội thi vừa là môi trường học tập vừa là sân chơi sáng tạo, giúp học sinh phát huy năng lực, củng cố niềm đam mê nghiên cứu khoa học và khẳng định giá trị bản thân. Kết luận thông qua nghiên cứu trường hợp hội thi tổ chức tại Trường Trung học cơ sở Nguyễn Tú, thành phố Cao Lãnh, tỉnh Đồng Tháp.*

**Từ khoá:** *Hội thi, khoa học tự nhiên, STEM, trải nghiệm.*

## 1. Introduction

In the context of comprehensive educational innovation to adapt to the trend of globalization and industry 4.0, STEM education has become more and more well-known; experiential activities are officially incorporated as compulsory contents in the General Education Program in 2018; and Natural Science is an integration of Physics, Chemistry, and Biology subjects at the lower secondary level (Ministry of Education and Training, 2018b). This educational innovation perspective clearly states that there is a strong transition from knowledge-based education to the one that develops the quality and capacity of learners; promote interdisciplinary integration combined with experiential activities to solve academic and practical problems (Communist Party of Vietnam, 2011). With that in mind, the author realizes it is necessary to research experiential activities for the Natural Science subject in the direction of STEM education. Therefore, organizing the “Experiencing STEM in Natural Science” contest at Nguyen Tu Secondary School, Cao Lanh City, Dong Thap Province is a practical activity that contributes to fostering quality, forming, and capacity development for students.

## 2. Contents

### 2.1. The concept

#### 2.1.1. Experiences and experiential activities

The simplest understanding of experience is what people have actually experienced, known, and suffered (Hoang, 2004) from their real-life activities. Then, obtained experience in its turn serve people’s life in the subsequent ongoing stages. Thus, living and experiencing are two inseparable aspects, complementing and completing each other. (Pham, 2013).

In the 2018 General Education Program, experiential and career-oriented activities are social and practical ones helping students autonomously experience in groups, thereby forming and demonstrating quality and competence. This activity emphasizes experience, promotes the creativity of learners, and is organized in a flexible and creative way. (Ministry of Education and Training, 2018a).

#### 2.1.2. STEM education

The term STEM is an abbreviation in English of four words: Science, Technology, Engineering, and

Mathematics. STEM education is an interdisciplinary approach to learning, in which principled academic concepts are integrated with real-world lessons, where students apply knowledge in science, technology, engineering, and math into specific contexts, helping to connect schools, communities, workplaces, and global organizations, thereby developing competencies in the STEM field and competitive practices in the new economy (Nguyen, 2019). STEM education is an educational model based on an interdisciplinary approach, helping students apply their knowledge of science, technology, engineering, and mathematics to solve a number of practical problems in a specific context. (Ministry of Education and Training, 2019).

#### 2.1.3. Natural Sciences

Natural Science is built and developed on the basis of Physics, Chemistry, Biology, and Earth Sciences. Research objects of Natural Science are things, phenomena, processes, basic properties of existence, and movement of the natural world. (Ministry of Education and Training, 2018b).

#### 2.1.4. Natural Science STEM experience

STEM experiential activities are organized through clubs or hands-on activities; organized according to students' interests, aptitudes, and choices voluntarily. The school organizes a STEM experience space for students to learn and explore experiments and applications of science and technology in real-life (Ministry of Education and Training, 2020). Natural Science STEM experience is a student's activity that integrates knowledge of Natural Science to experience creativity, and make products for learning activities.

The content of the contest is to ask students to apply their knowledge in the field of natural sciences to design and manufacture products in the form of models, illustrating theoretical knowledge, and simulating things and phenomena. Criteria for evaluating STEM-experienced products should be consistent with scientific knowledge (identify the correct scientific content related to the product), technology application (know how to use tools, equipment, and machines to manufacture products), implementing a reasonable technical process, knowing how to measure and calculate accurately, and be humane in terms of aesthetics.

## 2.2. The meaning of organizing the contest “Experiencing STEM in Natural Science”

The contest is believed to be conducive to students’ practices:

*Firstly, fostering hard-work.* Natural science knowledge takes time to explore, learn and discover. Through experience, students transform scientific knowledge into scientific products. This activity helps students solve new problems in learning as well as in practice. Therefore, it requires students to work hard, persevere, and overcome initial failures to create a STEM product of natural science.

*Second, fostering honesty.* Products created from STEM experiences in Natural Science are authentic results that accurately and fully reflect the students’ self-study, self-research, and self-assessment process. The truth in science is reflected in the product, the elements of science, technology, engineering, and math integrate harmoniously together to make a complete product.

*Third, fostering responsibility.* Students should be responsible for the research product. Responsibility for determining the correct scientific content in the product; responsibility for using technology as tools to create products; responsible for a reasonable technical process, without disturbing the product’s features; Responsible for accurate calculation and measurement to help products harmonize and balance. Besides, aesthetics and humanity need to be focused on by students because this is the first impression for viewers interested in their products.

*Fourth, developing self-study.* To complete the product, students need to read books, learn knowledge online, discuss with friends, and ask for the support of instructors. All is the process of self-study, self-research, self-discovery of problems, and self-proposing measures to solve problems. Thus, the product of the Natural Science STEM experience is the result of developing students’ self-study and self-research capacity.

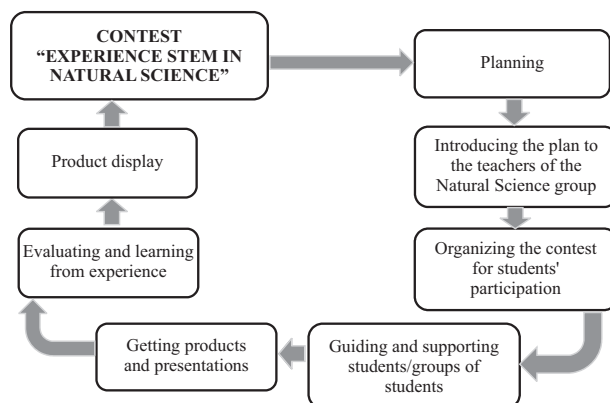
*Fifth, developing creative problem-solving skills.* The teacher poses a problem for students to participate in the “Experience STEM in Natural Science” contest. Therefore, to solve the problem, students must create products according to the requirements of the competition, which is to apply interdisciplinary knowledge, combined with skills,

and apply scientific and technological achievements to make products. new, serving life, and learning. Thus, the competition “STEM Experience in Natural Science” contributes to the development of problem-solving and creativity for students.

*Sixth, developing communication and cooperation skills.* Product of STEM experience Natural Science is a project, implemented for a certain long time. Therefore, students participating in the project need to work in groups to cooperate with each other, and exchange and learn information from relatives, friends, teachers, and experts... to complete the project’s product. Thereby, students gradually form and develop communication and cooperation abilities.

## 2.3. The process of organizing the contest “STEM Experience in Natural Science” at Nguyen Tu secondary School, Cao Lanh City, Dong Thap Province

### 2.3.1. Build the process



**Diagram 1. The process of organizing the contest “Experience STEM in Natural Science”**

### 2.3.2. Process analysis

#### a. Planning

- Determining the goal of the contest to be achieved within a certain period of time: The contest “STEM Experience in Natural Science” aims to have students apply knowledge in the field of Natural Science subjects to experience make creative products with all the elements of Science, Technology, Engineering, and Mathematics to serve learning activities or solve practical problems.

- Identify the right way to achieve that goal: The “STEM Natural Science Experience” competition uses a combination of collaborative, problem-solving, and project-based approaches.

- Identify resources: Competition “STEM Experience in Natural Science” organized by the Natural Science teacher in charge of Physics, Chemistry, Biology, and Technology. STEM products are displayed in the Physics - Technology function room; The contest is communicated to students through social networking sites and school radio.

- Budgeting: The contest “Experience STEM Natural Science” uses funds from the school's operating budget.

*b. Introducing the plan for the teachers of the Natural Science Group*

Organizing a meeting of the professional team to implement the plan of the Competition “STEM Experience in Natural Science”. Assigning tasks to members, setting start and end times to receive products, evaluate products and display time.

*c. Organizing the contest for students' participation*

Teachers of Physics, Chemistry, Biology, and Technology subjects deploy the contest plan “STEM Experience in Natural Science” to students; general in charge of integrating contest information into school radio; homeroom teacher propagates and encourages students to actively participate in the competition.

*d. Guiding and supporting students/groups of students*

Teachers of Physics, Chemistry, Biology, and Technology guide students/groups of students to implement models and projects according to students' ideas or teachers' suggestions for students to implement with their own creativity. Counseling and helping students who have difficulty solving problems related to scientific knowledge, applying technology in accordance with technical processes, and contributing to creating STEM experience products.

Note: Teachers only guide and support students, not help students.

*e. Getting products and presentations*

The reception department displays products from a group of fields of Physics, Chemistry, Biology, and Technology. Each product has a presentation board showing the field of competition; specifying scientific knowledge related to the product; the materials that make up the product and the meaning of the product in serving learning activities or solving practical problems.

*f. Evaluating and learning from experience*

Scale: 5 - Absolutely good; 4 - Good; 3 - Normal; 2 - Not good; 1 - Not good at all

**Table 1. Product evaluation criteria table**

Order	Indicators of capacity assessment	Level				
		5	4	3	2	1
1	Students correctly identify scientific content related to the product (Science)					
2	Students know how to use tools, equipment, and machinery to make products (Technology)					
3	Students perform a rational product manufacturing process (Engineering)					
4	Students know how to measure and apply mathematics in the process of assembling product parts (Math)					
5	Students decorate products in harmony with function, with the surrounding environment (Aesthetics)					

The evaluation team records the performance results of each student/group of students based on the evaluation criteria table corresponding to 5 levels. The evaluation team commented on the advantages and disadvantages of the products, thereby giving an overview of the overall quality of the competition. It is important to note the lessons learned for the next contest.

*g. Displaying products*

In order to maintain and connect more ideas, the Competition “Experience STEM in Natural Science” organizes a display of products for teachers and students of the whole school to visit. Thereby, receiving more comments for the contest, and at the same time attracting more students who are passionate about science and love to support the contest in the

coming time. Building a tradition of creative and scientific research experiences for students in Natural Science subject to STEM education.

**2.4. Results of the contest “Experience STEM in Natural Science” at Nguyen Tu Secondary School, Cao Lanh City, Dong Thap Province**

*2.4.1. About the quantity*

The contest “Experience STEM in Natural Science” received the participation of 240 students (mainly 9<sup>th</sup> graders, and 7<sup>th</sup> graders) with 48 STEM products in the fields of Physics, Chemistry, Biology, and Technology. Based on the evaluation criteria, there are 24 products that meet the requirements of the contest.

*2.4.2. About the quality*

The products submitted for the competition are time-invested and have integrated research and scientific knowledge in the fields of Physics, Chemistry, Biology, and Technology in accordance with the current high school curriculum. Some products are highly creative, diverse in model types as well as in diverse sources of materials. Each product meets the relative requirements of STEM education. However, students need to continue to be facilitated to develop their qualities and perfect their capabilities in order to improve the quality of STEM-oriented experiential activities in particular and the quality of general education in general.

*2.4.3. Survey on the organization of the competition “STEM Experience in Natural Science” of students*

Organize the contest “Experiencing STEM in Natural Science” with a hierarchical scale of 5 levels with corresponding points as follows:

- Level 5 (5 points): Absolutely necessary / Completely feasible / Completely successful;

- Level 4 (4 points): Necessary/ Feasible/ Successful;
- Level 3 (3 points): Normal;
- Level 2 (2 points): Not necessary/ Not feasible/ Failed;
- Level 1 (1 point): Totally unnecessary/ Totally not possible/ Totally unsuccessful.

The author conducted a survey of evaluation opinions and received 232 responses from students, the specific results are as follows:

*a. Results of a survey of student's opinions on the necessity, feasibility, and success of the competition “STEM Experience in Natural Science”*

**Table 2. Necessity, feasibility, and success survey results**

	Medium score	Standard deviation
Necessary level	4.21	0.802
Feasibility level	4.37	0.801
The level of success	4.28	0.787

The average score results show that organizing the contest “STEM Experience in Natural Science” is necessary and feasible for students of Nguyen Tu Middle School, Cao Lanh City, Dong Thap Province. At the same time, the students rated the competition “Experiencing STEM in Natural Science” as a success. In addition, the data on standard deviation shows that the difference between the assessments is not much, the difference is not too large, and the majority of students highly appreciate the results of the contest. The above results show that organizing the competition “STEM Experience in Natural Science” is necessary, can be maintained, developed on a broader scale, and achieve a certain level of success.

*b. Results of a survey of student's opinions on the meaning of organizing the contest “STEM Experience in Natural Science”*

**Table 3. Survey results on the meaning of contest organization**

Order	Meaning	Medium score	Standard deviation	The level
1	Nurturing students with hard-working qualities	4.33	0.885	4
2	Fostering for students the quality of honesty	4.26	0.999	6
3	Fostering quality and responsibility for students	4.34	0.941	2
4	Developing for students the ability to self-study and self-research	4.33	0.938	3
5	Developing students' ability to solve problems and be creative	4.37	0.911	1
6	Developing students' ability to communicate and cooperate	4.27	0.988	5

The results from Table 3 show that the majority of students realize the meaning of organizing the competition “STEM Experience in Natural Sciences” as a contribution to fostering quality and developing students' capacity. In the problem-solving and creativity, capacity is assessed by students as the most meaningful. Besides, the ability to self-study and self-research; The ability to communicate and cooperate is also meaningful to students. Organizing

the contest also contributes to fostering the qualities of responsibility, hard work, and honesty. The standard deviation value reflects the evaluation results of the majority of students, which are close to the mean, which means that the contest has practical significance in fostering some qualities and competencies for students of the Nguyen Tu Secondary School, Cao Lanh City, Dong Thap Province.

*c. The results of the survey of students' aspirations*

**Table 4. Aspiration survey results**

Order	Wish	Medium score	Standard deviation	The level
1	Continuing to organize STEM experiential activities in Natural Science	4.08	0.984	1
2	Organizing STEM experiences for Maths	4.05	0.922	2
3	Organizing STEM experiences for Informatics subject	4.02	1.017	3

At the end of the Contest, students see many meanings in fostering personal qualities and competencies. Therefore, the survey results in Table 4 show that students' aspirations in the next school years are to continue to organize STEM experiential activities and at the same time, expand it to Mathematics and Informatics subjects. The data on rank and standard deviation show that the majority of students want to maintain STEM experiences in Natural Science.

### 2.5. Lessons learned and recommendations

Note that the time of organizing the contest is far from the midterm and final exams; preferably right after the final exam of term I. The product evaluation criteria table can add criteria on the scope of using eco-friendly materials; deliver products on time. At the end of the contest, it is necessary to widely propagate to students throughout the school to visit the product at an appropriate time (eg recess time for each lesson for 1 week). It is recommended that managers affiliated with the Faculty of Natural Sciences Pedagogy, Dong Thap University, a specialized high school to seek the advice and support of experts on the content as well as the scope for organizing STEM experiential activities in Natural Science.

### 3. Conclusion

The contest “STEM Experience in Natural Science” is representative of modern educational trends, integrating science (Natural Science), technology, engineering, and mathematics; is an experiential learning environment, creating conditions for students to develop their capacity and strengthen their belief in science. The contest has achieved the set goal, attracting many students to participate; Diverse products show the creativity, positivity, and dynamism of junior high school students. Organizing the contest “STEM Experience in Natural Science” is to contribute to fostering the quality, forming, and developing the capacity of students according to the requirements of reforming the General Education Program in 2018 at Nguyen Tu Secondary School, Cao Lanh City, Dong Thap Province.

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