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Modernizing Education in Research4Life Countries: Integrating STEM and Developing the Model Design Process for Secondary Education in Vietnam

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ABSTRACT: *Integrated education models, particularly the integration of STEM into secondary education programs, have a positive impact on students' critical thinking. This study emphasizes significant changes in the education systems of many countries, specifically those within the Research4Life group. By integrating STEM into secondary education, the study shows improvements in students' knowledge, skills, and attitudes. Enhancing STEM knowledge, developing creative thinking and problem-solving skills, and boosting learning spirit and confidence are key findings. The study also focuses on developing a comprehensive 6-step process from idea generation to STEM model design for secondary education. The goal of this process is to create STEM models that students from elementary to high school levels can use to solve real-life problems. To expand the research, the next step involves testing and evaluating the STEM model design process in actual secondary schools to determine its effectiveness and feasibility. The study also needs to continue exploring education policies and support measures to promote the integration of STEM into secondary education, especially in developing countries. This will help raise awareness and support from policy decisions and the education community.*

KEYWORDS: **Education modernization, STEM integration, Research4Life countries, Creative thinking, Problem solving skills, Education policy.**

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1. Introduction

The evolution of global education models has progressed through various stages, adapting and advancing over time amidst globalization and diversification among regions and countries. Traditional educational systems are gradually transitioning to more blended and flexible models, reflecting global trends in educational approaches. Similarly, Research4Life countries are actively participating in this evolution by developing adaptable models that cater to diverse student needs. Enhancing interaction and engagement within national networks is fundamental to achieving success in this endeavor. These educational models aim to foster interactive and engaging learning environments, promoting creativity, exploration, and active learning.

Among the evolving models, the integration of technology and STEM (Science, Technology, Engineering, and Mathematics) stands out as progressive steps and developmental tools pursued by Research4Life country groups. This integration aims to enhance the quality of teaching and learning, ensuring that students acquire essential knowledge and skills for the digital and technological era. However, despite advancements, Research4Life countries face challenges such as resource constraints, geographical disparities, and cultural diversity. These challenges also present opportunities to innovate and develop flexible educational methods that meet specific community needs.

International cooperation among Research4Life countries in education plays a pivotal role in sharing experiences, resources, and advanced methods. This collaboration enhances access to knowledge and skills, benefiting student communities globally.

The 21st century emphasizes knowledge

and economic globalization, highlighting the increasing importance of scientific and technological innovation. STEM education has emerged as a method that nurtures comprehensive talents, responding to the demand for highly skilled professionals in science, technology, engineering, and mathematics fields (Hu & Li, 2023). Initially introduced in the early 20th century in the United States, STEM education has gained popularity worldwide, emphasizing experiential learning through the integration of science, technology, engineering, and mathematics (Eroğlu & Bektaş, 2022; Madden et al., 2013).

STEM education differs from traditional science and mathematics education by focusing on practical problem-solving relevant to local communities. It engages students in real-world applications, encouraging them to apply theoretical knowledge to address current challenges (Glancy & Moore, 2013). Effective STEM teaching models must be locally relevant, addressing specific challenges and promoting student-centered development (Qureshi & Qureshi, 2021; Zhong et al., 2022). High school students have implemented various STEM models, such as creating scented candles, building bridge models, and designing earthquake-resistant buildings, showcasing practical applications of STEM education (Giang, 2021; Karataş & Isiksal, 2023; English et al., 2017).

Education development in Research4Life countries, including Vietnam, has made significant strides despite fluctuations. Efforts to expand access to basic education across diverse populations, including remote areas and minority groups, have been notable. Technological advancements have furthered these efforts, enhancing the quality and effectiveness of education. Integration of technology into teaching and learning processes has created modern, interactive learning environments. However, challenges remain, including adapting to global changes and meeting demands for diverse and flexible education systems.

STEM education in Research4Life countries typically encompasses STEM lessons, experiences, and science and technology competitions. STEM lessons form the foundation, requiring educators to design models aligned with secondary education curriculum objectives. However, challenges such as the academic complexity and time-consuming nature of current STEM models hinder broader implementation. Therefore, developing locally relevant STEM themes is crucial for lesson effectiveness. Educators must also adapt curricula to provide practical learning opportunities that empower students as knowledge producers in today's digital age. Teachers play a pivotal role in bridging STEM education gaps by fostering student learning through interdisciplinary approaches.

In addressing these challenges, our research aims to assist educators by answering two critical questions:

1. How to identify STEM topics relevant to the local context?

a. What community problems need addressing?

b. How can these issues be resolved?

2. How can foundational research on designing STEM models be integrated into each lesson?

a. How can science, technology, engineering, and mathematics (STEM) elements be effectively integrated into each topic?

b. What educational resources can guide educators through the model design process?

Through specific examples and practical applications, this research seeks to deepen high school educators' and students' understanding of STEM education while providing insights into effective STEM model design. Furthermore, it highlights the practical application of STEM models in students' lives and future career paths, aligning with the development goals of countries like Vietnam as tested and applied models in real-world scenarios.

2. Literature Review

One of the notable characteristics contributing to the high evaluation of STEM education is its interdisciplinary nature (Chiang et al., 2022; Madden et al., 2013; Tytler, 2020). In recent years, STEM education has become a focal point in education policies, workforce development, and educational research in the United States, gradually gaining momentum in many countries worldwide (Liu & Wang, 2023; Widya et al., 2019). According to the report "Status and Trends of STEM Education in Highly Competitive Countries: Country Reports and International Comparison" by Yi-Fang Lee, Lung-Sheng Lee, and colleagues (Lee et al., 2022), research on the current situation and trends of STEM education was conducted in 10 countries, including the United States, Canada, Finland, Germany, Hong Kong, Singapore, Sweden, Taiwan, Ireland, and the United Arab Emirates. The research findings indicated similar trends in STEM education across these countries, with eight common themes: (1) Increasing motivation and support for professional development and preparation of STEM teaching staff; (2) Enhancing networks or partnerships with external organizations to diversify students' STEM experiential activities in extracurricular classes; (3) Elevating the importance of STEM education by incorporating STEM teaching programs into regular classes, proposing STEM reforms and policies, and national investment in STEM research; (4) Promoting the participation of women in STEM fields; (5) Applying digital devices, e-learning, or social networks in STEM teaching and learning processes; (6) Strengthening the provision of comprehensive and integrated STEM environments such as project-based learning, real-world problem solving, emphasizing holistic or continuous development, or proposing well-structured STEM teaching design models; (7) Enhancing technology subjects such as programming and computer technology in formal teaching programs; (8) Emphasizing the development or career aspirations of science and engineering in schools. The study highlighted the universal recognition among these countries of the importance of building STEM fields and themes. Additionally, it underscored the significance of students' STEM learning experiences both within and outside schools (Baran et al., 2016; Baran et al., 2019; Council et al., 2015), with technology engineering being a critical component of STEM education (Strimel & Grubbs, 2016).

3. Methodology

- Theoretical research method: Reviewing STEM education literature to establish the foundation for STEM models. Analyzing curricula and textbooks from grades 10-12 to identify factors relevant to STEM models.
- Observation method: Employing observational techniques to identify real-life issues in Vietnam. These issues, while technical in nature, must be linked to local contexts. Observing phenomena, objects, and issues closely related to students' lives helps identify STEM themes, encouraging problem recognition and stimulating curiosity for potential solutions.
- Analysis and evaluation method: Each identified issue is categorized as a STEM theme and analyzed based on science (S), technology (T), engineering (E), and mathematics (M) aspects. This process identifies technological solutions for these issues.
- Puzzle piece technique: After identifying the issue and its solution and analyzing STEM factors, a complete STEM model is constructed using the puzzle piece technique.

4. Results and Discussion

4.1. Identifying STEM Themes within the STEM Education Model

In the secondary education curriculum, STEM themes are identified based on practical issues that common knowledge can address. These themes must be tailored to the students' age and regional characteristics. This study proposes STEM themes suitable for high school students, providing them with the necessary knowledge, skills, and attitudes to solve real-life problems and prepare for future STEM careers. Furthermore, STEM themes introduced in lessons may vary across different localities due to unique life issues. Table 1 presents some STEM themes in the secondary education curriculum that are suitable considering knowledge, age appropriateness, and local characteristics. Moreover, these STEM themes are closely related to daily life and familiar to students, indicating that STEM education is relevant and accessible from early childhood through high school and into STEM careers. STEM themes serve as practical solutions to life's challenges.

Table 1. Some Titles of STEM Model in K-12 Education

Life problems	STEM topic	Necessary knowledge	Ages
Fermented fruit wine not only offers enticing and unique flavors, but also enhances the durability and preservation of nutrients in fruits. Instead of traditional rice wine, fermented fruit wine is encouraged for its health benefits to the cardiovascular and digestive systems.	Fruit Fermentation	Technological process of fruit fermentation; Effects of alcohol on the human body; Microbial culture process and environment	16-18
The phenomenon of images being magnified multiple times due to the light reflection properties of certain materials is a fascinating one. This phenomenon goes beyond creating artistic illusions and is also utilized in architecture to design and expand narrow spaces.	Light Reflection	Refraction of light, Partial reflection; Graphic design; Construction and image creation, Filmmaking	16-18
Most households in rural areas still rely on water from drilled wells for daily use. However, the current water condition, often characterized by a reddish-brown color and musty odor, is a common problem that causes discomfort, inconvenience and significant expenses for residents. Developing a purification system to address water pollution using locally available materials is a suitable and cost-effective solution.	Filter column for aluminum treatment	The strong oxidizing property of Mn(VI) in compounds; The adsorption capacity of activated carbon; System filtration design layout; Water filter core structure	16-18

4.2. Analyzing Factors within the STEM Education Model

When designing a STEM lesson, it is crucial to identify the real-life problem the model addresses and the scientific, technological, engineering, and mathematical knowledge students acquire during the learning process. The focus should be on the solution and a detailed analysis of the Science (S), Technology (T), Engineering (E), and Math (M) factors for each STEM lesson (Fig. 1). However, these STEM models primarily serve as a general introduction to the implementation process or existing lessons rather than optimizing the model (STEM experience) or developing the model further (STEM competition).

• **Solution**: This refers to the methods used to solve real-life problems. In designing STEM lessons, understanding the problem as real-life situations requiring solutions involves employing methods and approaches based on the knowledge, skills, and attitudes acquired during high school education.

• **Science (S)**: Foundational knowledge in subjects such as chemistry, biology, and physics at the high school level provides a solid scientific basis for problem-solving and solution development.

• **Technology (T)**: Materials, tools, equipment, machinery, and inventions used in designing STEM models.

• **Engineering (E)**: Specific technical processes across various fields to address real-life problems.

• **Math (M)**: Expressions, formulas, calculations, graphs, and mathematical knowledge essential for constructing models.

Therefore, to solve real-life problems, students must apply scientific knowledge (S), utilize available technologies (T), develop technical processes (E), and incorporate mathematics (M) to provide optimal solutions. Analyzing the S, T, E, M factors in each topic is crucial for designing effective STEM models. Table 2 presents the S, T, E, and M factors in three STEM models: fruit fermentation, light reflection, and iron removal column. Scientific knowledge relevant to high school students in Vietnam includes microbiological technology (Biology

10), alcohol chemistry (Chemistry 11), light reflection (Physics 11), and carbon adsorption properties (Chemistry 11), among others. The technical processes (E) and technologies (T) are age-appropriate and relevant to daily life, while mathematical knowledge (M) is fundamental. These models help develop students' problem-solving skills from an early age, preparing them for future STEM careers in fields such as food technology, electronics, or environmental engineering. Moreover, designing these STEM models enhances education quality based on life-oriented educational criteria.

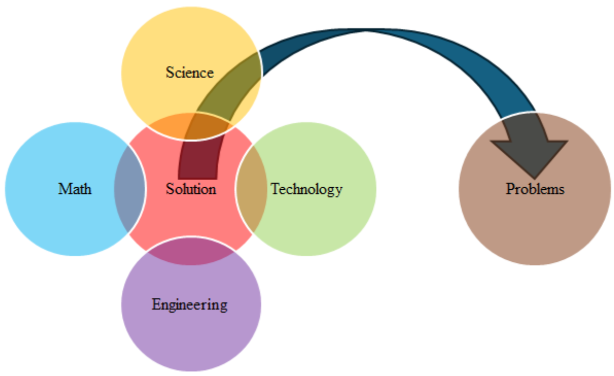

Figure 1. Model of STEM Education in K-12 Program

4.3. The Steps to Construct STEM Models within the Secondary Education Curriculum

Through the construction of the three aforementioned STEM models (fruit fermentation, light reflection, iron removal column), we propose a general process for building a STEM model in the high school curriculum consisting of six steps as shown in Fig. 2:

Step 1: Identify challenging or urgent problems that require effective solutions. Emphasize that these issues should not be generic or hypothetical but closely related to local realities and relevant to students. These could include environmental problems, resource limitations, or infrastructure challenges. Focusing on these problems helps students see the direct application of STEM in their lives.

Step 2: Propose simple and feasible solutions

Table 2. Factors of some STEM Models in this Study

STEM topic	S	T	E	M
Fruit fermentation	Technology (Fruit fermentation); Chemistry (Alcohol); Biology (Microbiology)	Ingredients (fruit, sugar), tools (glass jar), environment (temperature, light, humidity)	Raw material selection techniques; Preliminary processing techniques; Techniques for adjusting the fermentation environment; Product evaluation techniques	Determine the fruit and sugar mass ratio; Determine parameters of factors affecting product quality using graphs
Light reflection	Physics (Partial Reflection), Computer Science (Graphic Design)	Materials (reflector, one-way mirror, scene, electric light)	Incident light design techniques; Decorative techniques to create virtual images	Calculate the distance between the scene and each type of mirror; Calculate the number of electric lights
Filter column for alum-contaminated water treatment	Chemistry (Chemical properties of MnO42-, MnO2) (Carbon); Technology (Technical drawings);	Materials (quartz sand and gravel, biochar, manganese soil); Raw materials (plastic pipes, foam sheets, water valves); Filter system design drawing	Filter system design techniques, Material layer creation techniques; Techniques for arranging material layer positions; Techniques to optimize the contact process (Structure, length, column radius)	Determine the ratio of ingredients; Survey the volume and flow of alum-contaminated water that can be treated on a fixed volume of material

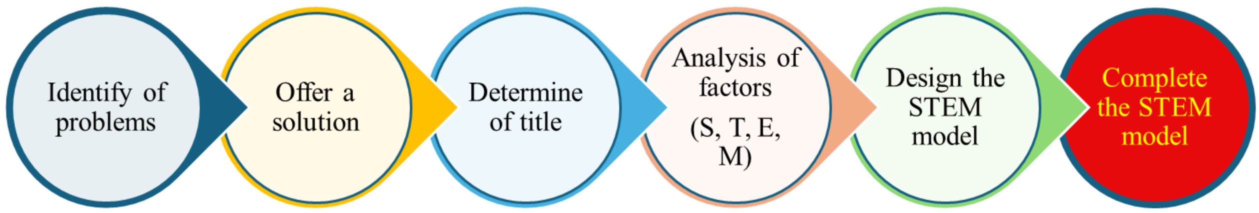

Figure 2. 6 steps in building a STEM model in the general education program

for students to implement. Having identified a real-life issue, students should now brainstorm solutions, fostering critical thinking, creativity, and problem-solving skills. Consider students' age, abilities, and available resources like materials and tools. Solutions should be practical and executable rather than theoretical.

Step 3: Choose a suitable name for the model that reflects the nature of the problem and the intended solution.

Step 4: Analyze the S, T, E, M factors related to the model based on the issues and solutions identified in Steps 1 and 2.

Step 5: Design the STEM model once sufficient data on the model name and related factors are gathered.

Step 6: Test, adjust, and draw lessons from the real-world application of the STEM model. Complete the STEM model.

Based on the proposed steps for building STEM models, we have applied them to design three specific STEM models. These models utilize knowledge from Mathematics, Chemistry, Physics, and Biology subjects in the curriculum from grades 10 to 12, combined with an analysis of technological engineering factors. The successful design of these three models demonstrates the feasibility of applying this process to design additional models, leveraging other knowledge areas in the high school curriculum.

4.4. Application

4.4.1. Fruit Fermentation

Solution: Fermenting fruits to make alcohol is an effective solution to use fruits. The fruit fermentation process not only produces delicious beverages but also adds value to agricultural products and income. The processing of fruits in fermented alcohol helps preserve them longer and prevents spoilage caused by microbial decomposition. Microbial technology is applied in this process, including knowledge of microbial cultivation, processing, and preservation of agricultural products. This STEM model combines knowledge from subjects such as biology, chemistry, and mathematics to produce fruit-based fermented alcohol at home with a high success rate.

Science: Microbial technology plays a key role in this model. Fruits are commonly used as a source of sugar during fermentation. Bacteria containing specific enzymes convert sugar into lactic acid. This type of compound creates an acidic environment that limits harmful bacteria and protects the product from contamination by other microorganisms. Yeasts are responsible for the conversion of sugar in fruits into ethyl alcohol (1) and the production of water for the fermentation mixture. Additionally, yeasts also produce other organic compounds with special flavors and aromas. As a result of the conversion from ethyl alcohol to aldehyde (a compound that can cause neurological toxicity in humans), fruit alcohol can replace traditional rice alcohol (high alcohol content) when compared in the same volume of use. Furthermore, the nutrient content in fermented fruit alcohol is something traditional rice alcohol cannot provide.

Alcohol fermentation reaction:

$$C_6H_{12}O_6 \xrightarrow{\text{Alcohol fermentation}} 2C_2H_5OH + 2CO_2 \quad (1)$$

Technology: The materials for designing this model are relatively simple, including: ripe fruits (such as grapes, strawberries, pineapples, kiwis, etc.); granulated sugar; microbial yeast (if available). Glass jars with tight fitting lids and a thermometer are essential tools used throughout the fermentation process. The fermentation environment depends on factors such as

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temperature, humidity, and direct sunlight. Additionally, fermentation time is a critical factor affecting the quality of the product.

Engineering: The input materials and pre-processing techniques are the first steps that need special attention. Fruits should be selected when they are just ripe and free of damage. Then remove any excess parts around the fruit and rinse it several times with clean water to remove any impurities that adhere to the fruit. Slice the fruit into slices while maintaining its characteristic shape and easy arrangement in the jar. The layering technique is applied to create a uniform distribution of sugar and fruits in the jar, which means that a layer of fruit will be covered with a thin layer of sugar on the surface, as shown in **Fig. 3**. The fermentation environment must ensure that the temperature is not too high or too low (ideally between 25^{o}C and 35°C), avoid placing the jars in high humidity conditions (avoiding places with stagnant water and temperatures > 30^{o}C), and avoid direct sunlight from the sun. Product evaluation techniques are performed based on criteria such as purpose of use, for example: sweetness, alcohol content, flavor, aesthetics for consumers, etc.

Math: The mathematical factor is often determined through the results regarding volume efficiency and product quality in a specific survey area (targeted at consumers). In this, determining the mass of sugar and fruit is based on formulas (2) and (3):

$$A = \frac{m_{sugar}}{m_{fruit}} \times 100\% \qquad (2)$$

and $m_s = m_{sugar} + m_{fruit}$ (3)

In which, A represents the percentage ratio of sugar mass to fruit mass (%) (for example: 10% < "A_{grape}" < 20% for grapes, 10% < "$A_{strawberry}$" < 15% for strawberries), 'm_s' is the total mass of ingredients contained in the jar (g), 'm_{sugar}' and 'm_{fruit}' are the masses of sugar and fruit, respectively (g). The fermentation time is proportional to the quality and sweetness of the wine. However, this graph is bounded at a certain point, depending on each type of fruit; in other words, the wine will spoil if it exceeds this limit. For example: Grapes need to ferment for about 1 to 3 weeks (bound at 21 days); strawberries from 5 to 8 days (bound at 8 days); apples from 1 to 3 months (bound at 90 days); pears from 3 to 8 weeks (bound at 56 days).

4.4.2. Light Reflection

Solution: To create a sense of expanded space in interior design, the technique of using reflective mirrors and parallel mirrors can be employed. When light shines onto a one-way mirror, only a portion of it is reflected back, whereas the rest passes through the mirror. This creates an intriguing effect, where the image of the space is repeatedly reflected in the mirror, giving the impression of endless depth. This technique utilizes principles of light refraction and partial reflection, as taught in high school physics curriculum. Applying this knowledge in interior design helps create a living space with a unique and engaging experiential quality.

Science: The law of light refraction is applied

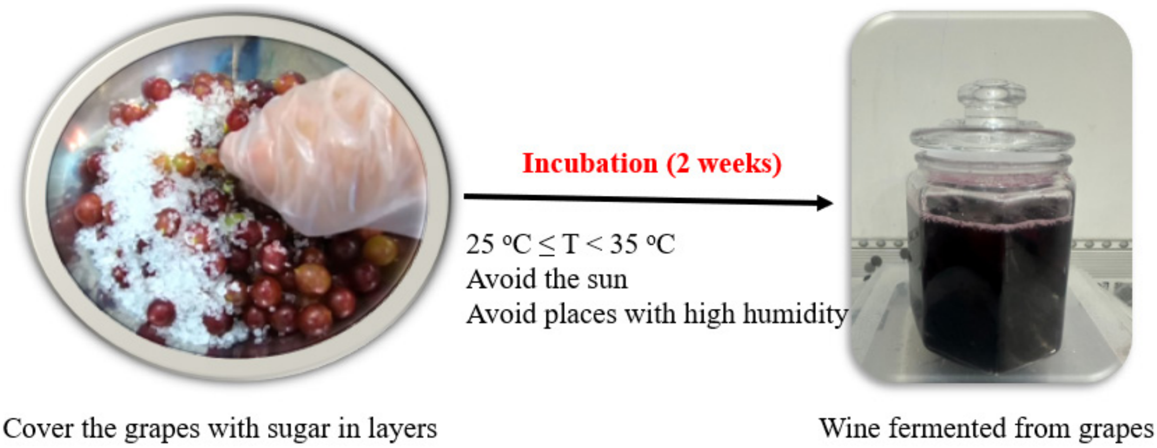


Figure 3. Wine fermented from grapes

in this model, where the refracted ray (R) lies in the plane of incidence and on the opposite side of the normal ray (N) to the incident ray (S). Additionally, because light partially refracts through the reflective mirror, the reflected ray (S') has less transmitted energy compared to the incident ray (S). The reflected image of light will be continuously reflected, displaying multiple and diminishing images on the reflective mirror as shown in **Fig. 4**.

Technology: Materials include a backdrop (enhanced with light from electric lamps), a partially reflective mirror, and a one-way mirror. The backdrop will be positioned between two parallel mirrors of different types so that when looking at the partially reflective mirror, objects in the one-way mirror can still be seen as shown in **Fig. 4b**.

Engineering: The lighting design technique coming from the backdrop plays a crucial role in the viewer's perception. The backdrop scenery is designed around the mirror frame to minimize any scene that obscures the image in the one-way mirror. The intensity of light in the background (environment 2) must be higher than the intensity of light (environment 1) to clearly simulate the virtual image on the reflective mirror.

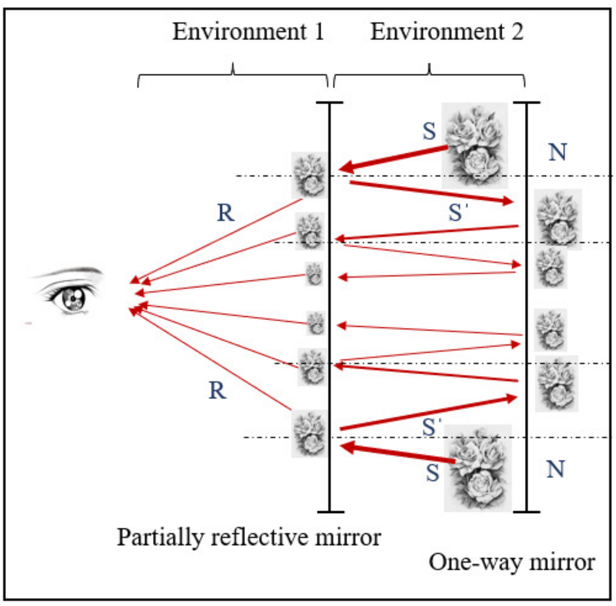
Math: When the image is reflected on the one-way mirror, we have the ratio between the sine of the angle of incidence *sin(i)* and the sine of the angle of refraction *sin(r)*. They are expressed through the law of refraction formula as in Equation (4).

$$\frac{\sin(i)}{\sin(r)} = n_{21} = \frac{n_2}{n_1} \quad (4)$$

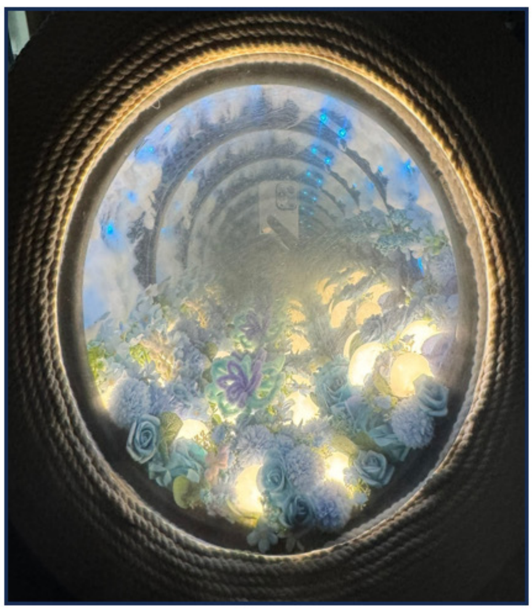
Where i and r are, respectively, the angle of incidence and the angle of refraction (in degrees), n_{21} is the relative refractive index of environment 2 to environment 1, and n_1 and n_2 are the absolute refractive indices of environments 1 and 2, respectively.

4.4.3. Filter Column for Alum Contaminated Water Treatment

Solution: Iron and aluminium-contaminated water is characterized by high levels of Al(III) and Fe(II), resulting in yellowish color, musty odor, sour taste, low pH, and frequent staining of materials in contact with the water. Meanwhile, manganese-rich soil contains significant amounts of Mn compounds (Mn(VI) and Mn(IV)), which are strong oxidizing agents. Due to the change in pH during the reaction, Al^{3+} and Fe^{3+} ions precipitate into solid compounds and easily adhere to other materials. The use of manganese rich soil and natural ingredients to make home



(a)



(b)

Figure 4. (a) Simulation of the model structure and operating principles; (b) STEM model of reflecting light

water filtration columns provides students with the opportunity to apply theoretical scientific knowledge and address local environmental issues.

Science: In iron-contaminated water, Fe exists predominantly in the form of Fe(II) in an acidic environment. Passing through a layer of manganese soil, Fe(II) ions are oxidized to Fe(III) according to the chemical reaction (5). Both Fe(II) and Fe(III) ions precipitate or adsorb onto the surface of biochar, sand, and quartzite. If the concentrations of Fe(II) and Al(III) in the solution decrease, the pH of the solution increases (moving toward neutral). Therefore, the efficiency of the filtration process can be assessed by using litmus paper and observing the color change (from yellow to colorless). The iron removal process by the filtration column model is illustrated in **Fig. 5**.

Chemical reaction:

$$\overset{+6}{Mn}O_4^{2-} + 5\overset{+2}{Fe}{}^{2+} + 8H^+ \longrightarrow \overset{+2}{Mn}{}^{2+} + 5\overset{+2}{Fe}{}^{2+} + 4H_2O \quad (5)$$

Technology: Filter materials are familiar components in daily life, such as manganese soil, biochar, sand, and quartzite. These materials are arranged in layers to perform their functions more effectively at each stage of filtration. However, the impact of manganese soil must occur first, so it is placed last in the plastic tube (in contact with iron-contaminated water before other materials). The filter materials in the column are fixed with foam sheets to facilitate and stabilize the filtration layers during column movement.

Engineering: Techniques for precipitate formation and coagulation due to pH changes are essential factors in the filtration system. The use of manganese soil to convert Fe(II) to Fe(III) and increase the pH of the solution leads to the formation of Al(III) and Fe(III) hydroxide precipitates. These forms are retained by quartzite and sand. Adsorption also occurs as iron-contaminated water passes through the biochar layer. Here, Fe^{2+} ions not converted by manganese soil are adsorbed on the biochar material. This enhances the filtration efficiency of the column. Layering techniques are applied to provide a clear separation for each type of material. Following scientific principles, the filter material layers are arranged in the order of contact with the iron-contaminated water flow as follows: quartzite sand, manganese soil, quartzite sand, biochar quartzite, and sand quartzite gravel.

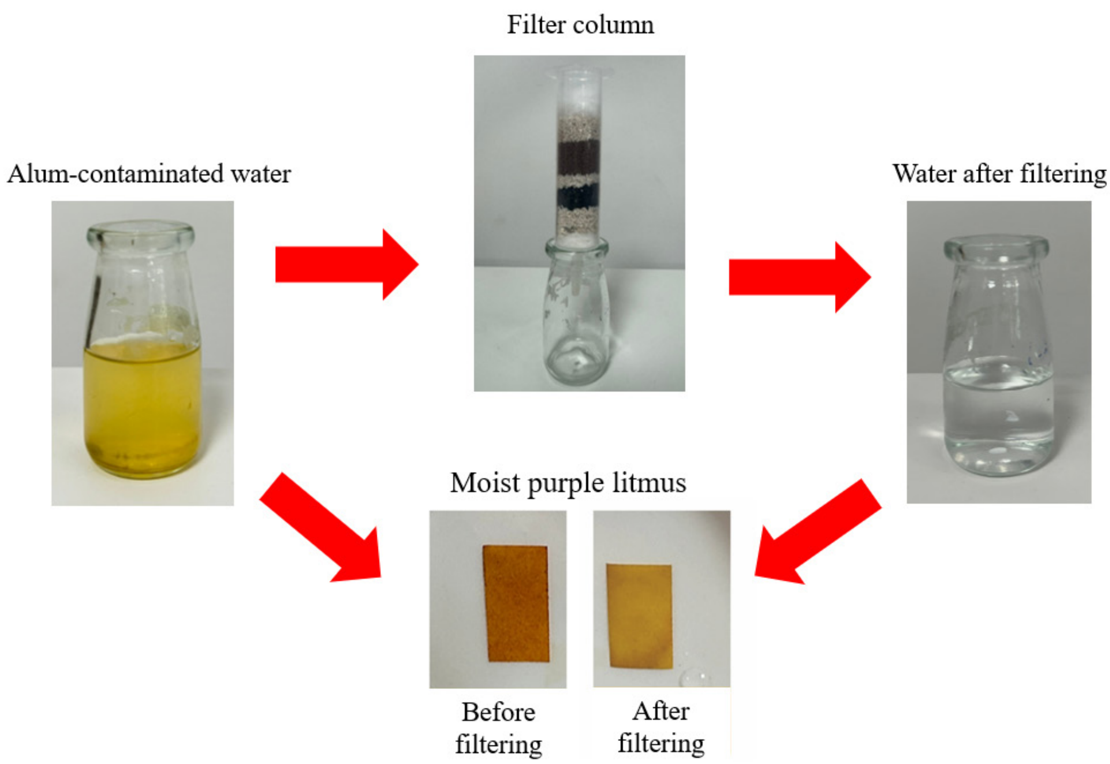


Figure 5. Alum filtration process from the filter column model

Math: The mass of each filter material in fixed ratios and the total mass of suitable materials for the tube (or filtration system) are simultaneously determined. The ratio could be quartzite sand: manganese soil: quartzite sand: biochar: quartzite sand: quartzite gravel = 3: 5: 5: 2: 5. Additionally, the volume of water that the filter column can filter (total mass of fixed materials) also needs to be determined to ensure that the variation in efficiency is not too large (indicated by the water color after filtration). The flow rate is inversely correlated with the iron removal efficiency, so the flow rate into the column system must be fixed and ensure the high iron removal efficiency. The materials are compressed and cleaned with clean water before the iron-containing water is introduced. The volume of iron-contaminated water is directly proportional to the size of the filtration system (diameter and length of the filter column; total mass of materials in the filter core).

In summary, this research serves as a guide for teachers to construct STEM topics centered around practical experience models for students to address local issues in Vietnam, such as ripening fruits, groundwater contamination by iron, or decorative handicrafts. It analyzes the scientific, technological, engineering, and mathematical elements in each specific topic, thereby motivating the practical design efforts of high school teachers worldwide. Teachers can gain profound insights into their own classrooms and the countries they reside in, supporting the design process. The topics covered in this study can provide excellent suggestions for countries with development contexts similar to Vietnam, helping students better understand STEM education and how to handle similar issues in their lives.

5. Conclusions and Recommendations

STEM education is an instructional approach that places students at the center to develop interdisciplinary problem-solving skills. Educational models in STEM attract the interest of many students, fostering excitement and stimulating their curiosity and creativity. Through the analysis of three themes: fruit fermentation, light reflection, and alum-contaminated water filtration, it is evident that to develop a model that captures students' attention, several key issues need clarification: (1) Why choose this model?; (2) What scientific knowledge is associated with the model?; (3) What techniques are used to construct the model?; (4) How is the model implemented?; (5) How are calculations performed for the model? This study not only provides specific examples of the steps involved in constructing STEM topics but also contributes to the teaching process based on three models related to physics, chemistry, and biology for high school students. The products created have practical significance, benefiting both health and aesthetic enhancement, while also providing ideas for addressing water pollution issues in areas where drinking water is heavily contaminated with iron and aluminum. Additionally, this research contributes to the advancement of STEM education by providing a simple, flexible design process that can be applied not only in Vietnam but also in various learning environments worldwide. This approach allows teachers to easily integrate theoretical knowledge with practical models, enhancing their ability to effectively convey information to their students. Consequently, students can gain a clearer and more accessible understanding of otherwise "dry" theoretical concepts.

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