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Interdisciplinary education in the context of protection of water resources: A case study in Vietnam

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Abstract

The incorporation of interdisciplinary education, a topic of significant global interest, is increasingly being recognized as a key aspect of educational innovation in Vietnam. This recognition extends to several fields, including STEM (Science, Technology, Engineering, and Mathematics) education.This research aims to design and implement a STEM situation associated with the context of water protection in Vietnam for 10th-grade students in which students mobilize the knowledge of Physics (specific gravity, Archimedes' principle) and Mathematics (volume) to design a salinometer. This device measures the salinity of the water. The research methodology is based on the observed increase in saline levels in the coastal regions of Vietnam in recent years, which has had a substantial impact on agriculture and the livelihoods of millions of people. This methodology aims to provide realistic scenarios for students to address and resolve these problems. A total of forty students in the 10th grade were involved in a teaching situation that consisted of five distinct phases. Forty 10th-grade students participated in a teaching situation conducted in five phases. The results showed that the situation helped students strengthen and connect their physics and mathematics knowledge, create a vibrant learning atmosphere, enhance communication, and develop problem-solving competency. Furthermore, the teaching situation also needs to be revised regarding the measurement practices of Vietnamese students. The situation contributes to educating students' awareness of current events, protecting Vietnamese water resources, and the importance of sustainable development. In addition, we can use the same teaching process as in this research to develop other STEM teaching situations.

Keywords: Archimedes' principle, Education for sustainable development, Interdisciplinary education, STEM education, Volume, Water resources.

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Contents

Contribution of this paper to the literature
This research contributes to promoting the application of STEM education in high schools in the direction of education for sustainable development, in which students can mobilize the synthesis of interdisciplinary knowledge of many subjects to solve problems of current global issues.

1. Introduction

1.1. Interdisciplinary Education

A growing global educational phenomenon is the integration of real-life scenarios into classroom instruction, which is gaining popularity among educators worldwide. Within this particular context, educators often propose interdisciplinary education as a potential remedy for the deficiencies associated with teaching in a manner that is only focused on certain media disciplines. This approach is seen as necessary due to the fact that students are confronted with complex and interconnected realities that transcend traditional disciplinary boundaries.

The concept of interdisciplinary education has existed for some time, as reflected in the report of the International Symposium on Interdisciplinarity in General Education, published by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) in May 1985. Nowadays, educators consider interdisciplinary education an approach to combining and integrating many subjects that engage in a common task and allow the emergence and evolution of new knowledge through their combination. It involves the interaction and mutual integration of different concepts, methods, data, terms, and epistemologies from two or more disciplines. It aims to solve problems and answer questions that are too broad or complex to be addressed by a single discipline or profession (Liu, Watabe, & Goto, 2022).

In teaching mathematics associated with applications, mathematics educators are increasingly interested in how mathematics interrelates with other disciplines and their contexts. Williams et al. (2016) argue that mathematics education should primarily focus on 'interdisciplinarity' as a critical topic and that it will gain more importance and visibility in educational research and practice.

1.2. STEM Education

One of the ways to implement interdisciplinary education that emerged as an educational trend in the last two decades, attracted the attention of educators, and has begun to appear in many current curricula as well as the education policies of many countries is STEM education. STEM education is considered an interdisciplinary approach to solving problems in a real context by integrating concepts, procedures, tools, skills, and values of Science (S), Technology (T), Engineering (E), and Mathematics (M) in various ways and levels (Honey, Pearson, & Schweingruber, 2014; Jolly, 2017; Maass, Geiger, Ariza, & Goos, 2019; Suh & Han, 2019). STEM education uses pedagogical practices such as problem-based learning, design-based approaches, and digital technologies to enhance students' engagement and understanding of S-T-E-M subjects (Nguyen, Nguyen, & Tran, 2020). It respects the epistemic nature of each discipline and fosters the development of STEM literacy and skills among students (Rico, Agirre-Basurko, Ruiz-González, Palacios-Agundez, & Zuazagoitia, 2021). STEM education addresses socio-political challenges such as the lack of vocation towards STEM professions and scientific literacy in the general public (Kelley & Knowles, 2016).

1.3. Education for Sustainable Development

One of the questions that STEM educators are concerned with is the need to select and exploit real-world contexts that are relevant and meaningful to students' lives and interests. Sustainable development, as a global problem, could be the answer. Indeed, sustainable development is a paradigm that aims to balance the environmental, social, and economic aspects of human well-being and progress. It recognizes that current and future generations depend on the health and resilience of natural systems and that human actions must not compromise the ability of future generations to meet their own needs.

The idea of sustainable development has evolved in response to growing environmental and social concerns. It emerged from the growing awareness of pollution and ecological damage in the mid-20th century. The first international conference to address these issues was the Stockholm Summit in 1972. In 1987, the Brundtland Report defined sustainable development as meeting current needs without compromising future generations' ability to meet their own. The report emphasized the importance of economic growth that is socially and environmentally sustainable. The Rio Summit in 1992 identified social, economic, and environmental sustainability as key components and established principles for global cooperation. The Johannesburg Summit in 2002 focused on the role of local communities and their responsibility in achieving sustainable development. In 2015, the Sustainable Development Goals (SDGs) were adopted, setting 17 goals and 169 targets for a better world by 2030. The 2030 Agenda for Sustainable Development calls for action at all levels to achieve these goals (Gavari-Starkie, Espinosa-Gutiérrez, & Lucini-Baquero, 2022).

Sustainable development takes a holistic approach that recognizes the interdependence of various fields and stakeholders. Education is not only one of the 17 Sustainable Development Goals (SDGs) but is also considered a crucial instrument for achieving the other goals (Hallinger & Nguyen, 2020). SDG 4, which emphasizes quality education, is closely linked to numerous international declarations that regard education as vital for the well-being of individuals, nations, and the world. Education is a fundamental tool for achieving sustainable development. Teachers can use classrooms to instill values and attitudes that support the attainment of the SDGs (Jamali, Ale Ebrahim, & Jamali, 2023). Each SDG necessitates education to provide individuals with the knowledge, abilities, skills, and values required for personal growth and societal contribution (Nguyen et al., 2020).

Education for Sustainable Development (ESD) is a transformative educational approach that offers new ways of looking at the world and promotes systemic, critical, and creative thinking while empowering individuals to make choices that lead to alternative sustainable futures (Rico et al., 2021). ESD seeks to enable current and future generations to meet their needs through a balanced and integrated approach to sustainable development's economic, social, and environmental dimensions. In other words, ESD helps students understand real-world changes, anticipate the future, identify issues in present and future societies, and make collaborative decisions (Suh & Han, 2019).

The ESD and interdisciplinary/STEM education are closely related and mutually beneficial. Liu et al. (2022) suggest that interdisciplinary education can be seen as either a tool for understanding sustainable development or a complementary way of enhancing students' competencies. Similarly, Nguyen et al. (2020), Suh and Han (2019), and Urválková and Surynková (2021) argue that STEM education can support students in developing the knowledge, skills, and attitudes needed to tackle the complex challenges of sustainable development, while ESD can enrich STEM learning by offering real-world contexts and interdisciplinary perspectives that stimulate students' interest and creativity.

1.4. Case of Vietnam

In integrating with world education, Vietnamese education in the last decade has adopted interdisciplinary education in general and STEM education in particular (Chen, Lutomia, & Pham, 2021). In 2018, the Vietnamese Ministry of Education and Training issued a mandate to pivot mathematics education to competency-based learning and, in particular, emphasized interdisciplinary mathematics education and STEM education as follows (Vietnamese Ministry of Education and Training, 2018): "The mathematics program focuses on the applicability, relevance to real life or other subjects, and educational activities, especially for subjects to implement STEM education, in association with the modern development trend of the economy, science, social life, and urgent global issues (such as climate change, sustainable development, and financial education). The mathematics program implements interdisciplinary integration through related content, topics, or mathematical knowledge exploited and used in other subjects such as Physics, Chemistry, Biology, Geography, Informatics, Technology, History, Art, etc." Furthermore, to prepare for the implementation of the 2018 program, Vietnamese mathematics educators have proposed many empirical studies related to interdisciplinary teaching students to develop the competencies needed for solving complex issues (e.g., (Le & Le, 2019; Nguyen, Tang, Nhu, Bao, & Lam, 2019; Tang & Duong, 2019)). However, finding STEM ideas and integrating them into the curriculum was often challenging for Vietnamese teachers. For example, the in-depth semi-structured interview in the qualitative study of Le, Tran, and Tran (2021) shows the challenges of finding interesting STEM teaching ideas that suit the curriculum and the insufficiency and incompatibility of practical guides and concrete examples in the Vietnamese context.

This paper presents an empirical study that involves a STEM education that helped students strengthen and connect physics and mathematics knowledge, creating a vibrant learning atmosphere, enhancing communication, and developing problem-solving competency. It also aims to raise awareness for Sustainable Development, especially water protection. The study provides students with first-hand experiences relating to creating a simple salinometer. Our teaching situation begins with:

(1) current teaching status about volumes in the current program and textbooks. The shapes' volume is a mathematical object that has been interesting to humans since ancient times due to the practical and popular needs of calculation and measurement in everyday life. However, in the current mathematics textbooks in Vietnam, this object is only approached from a purely mathematical perspective. In particular, the textbooks focus on applying and exploiting the formula for calculating the shapes' volume differently, ignoring the context and the need to pay attention to the volume in practice, as in other disciplines.

(2) the context of the negative impacts of climate change and the exploitation of natural resources in Vietnam today. Specifically, the issue we are interested in is saltwater (saline) intrusion along the coastline. It is a severe problem for an agricultural country like Vietnam, which depends on freshwater. In particular, this problem is increasing in the context of groundwater resources being overexploited for irrigation and climate change (National Agency for Science and Technology Information, 2016; Prince Edward Island Department of Environment Labour and Justice, 2011).

From the above guidelines, we developed a teaching situation where the student's task is to mobilize Mathematics and Physics knowledge to create a simple salinometer.

2. Methodology

2.1. Research Design

This study used qualitative research methodology to investigate a sample of 10th-grade pupils. The focus of our instructional setting pertains to the field of STEM education within the specific domain of water resources. Students engage in collaborative group work for a duration of 135 minutes. The teaching situation includes 5 phases designed as follows (Nguyen & Phan, 2019). We demonstrate the teaching details with the activities' goals and contents in each phase below.

2.1.1. Phase 1: Questioning

Students tried to drop an egg into three different liquids (alcohol, pure water, and saline), each producing a different result. The students were tasked with explaining the scientific rationale behind the different outcomes. The expected knowledge is an interpretation of an object's emerging based on specific gravity and Archimedes' principle. In the lesson "12. Emerging" (Textbook of Physics 8, p.44), students studied this problem.

> Knowing $P=d_V.V$ (where d_V is the specific gravity of the material, and V is the volume of the object) and $F_A=d_l.V$ (where d_l is the specific gravity of the liquid), prove that if the object is a solid mass immersed in the liquid, then:
>
> - The object will sink when: $d_V>d_l$.
> - The object will suspend in the liquid when: $d_V=d_l$.
> - The object will float to the surface of the liquid when: $d_V<d_l$.

Thus, the experiment of floating an egg in different liquids will allow for establishing a link between the object's emergence and the specific gravity of the liquid. Supporting this connection is the physics knowledge students were taught in 8th grade.

Next, the students were shown a short news video clip of 1 minute, 25 seconds (link: https://youtu.be/0B-LvdrEJZs) in the news section of the VTC14 channel about the evolution of the most severe saline intrusion in this century in the Mekong Delta in 2016. It should be added that in the lesson "36. Mekong Delta (continued)" (Geography 9, p.129-130), students were taught as follows:

> The Mekong Delta is the country's largest rice-growing region. The Mekong Delta has been our country's most significant rice export region. The Mekong Delta accounts for over 50% of the country's fishery production.

The video clip proved a powerful educational tool and a cornerstone of the situation. The video clip highlights the severe impact of the saline intrusion on the agricultural industry and warns of a potential threat to Vietnam's future food security. On the one hand, the news clip draws students' attention to the national, sustainable exploitation of water resources. On the other hand, it also creates a real-world context for the teacher to pose the problem that requires developing a device to determine if the water is saline.

Each group received one dynamometer of 1N, a 50g weight, a bamboo straw, one piece of clay, a pen, and a ruler.

2.1.2. Phase 2: Exploring Ideas and Finding Out Related Knowledge

The student groups searched the internet to learn more about the saltwater/saline water phenomenon and identify it using specific devices. The task should be to create a device to measure the specific gravity of the liquid. Students must clarify the operation principle of the device they intend to design.

First, students need to measure Archimedes' principle (F_A) on a heavy object by calculating the difference between the weight (P) of a 50g object and the synergy (F) of the weight and the Archimedes' Principle applied to the massive object when the object is immersed in the liquid. That is F_A=P-F. This is a practical activity presented in the lesson "11. Practice: Re-experimenting the Archimedes' principle" (Physics 8).

Next, based on the formula for calculating Archimedes' principle F_A=d.V (where d is the specific gravity of the liquid, and V is the volume of liquid part occupied) presented in the lesson "10. Archimedes' principle" (Physics 8), students can calculate d=F_A/V=(P-F)/V. Thus, the remaining problem is calculating the volume (V) of the weight according to a mathematical formula.

2.1.3. Phase 3: Presenting the Design Plan

Students introduced their design, and the teacher questioned them to clarify the construction, operation principle, and materials needed to build the device.

2.1.4. Phase 4: Creating a Product

All groups started making the device and measuring the specific gravity of their liquid.

2.1.5. Phase 5: Presenting, Reviewing, and Improving the Product

All of the groups presented their product and the result of their calculation. Other groups compared these results against their findings and provided feedback.

The research aims to examine the feasibility of the above-designed situation. Specifically, how will students solve the problem posed? Will they mobilize knowledge of the volume in Mathematics and the Archimedes' principle in Physique when solving problems?

2.2. Participants

The participants of this study consisted of an ensemble of 40 students enrolled in the 10th grade at Tran Khai Nguyen High School, located in Ho Chi Minh City, Vietnam. The students were organised into eight groups, each consisting of five individuals. The teaching situation took place in March 2019, during a period when pupils possessed a comprehensive understanding of volume in Mathematics and Archimedes' principle in Physics.

2.3. Collecting and Analyzing Data

The collected data includes students' handouts, groups' products (salinometers), video of the experiment sessions, and audio records of groups' conversations.

The flexibility of the teaching situation is verified through the data on students' answers in each phase. Specifically, students can fully perform the experimental phases, and the output is a salinometer that can measure the specific gravity of the liquid received.

The mobilization of mathematics and physics knowledge is shown in phase 2 of the teaching situation. The saltwater/saline water phenomenon, the way to identify this phenomenon, and the salinometer device's operating principle allow the measurement of the liquid's specific gravity, which students learn through the internet.

The result is that the students' salinometer can measure approximately the specific gravity of their liquid. The measurement results can be compared with information on the internet to validate the results.

3. Findings

3.1. Phase 1

In turn, students were tasked with dropping an egg into three different liquids with different gravities (Figure 1). At the end of this phase, the teacher and student groups agreed on the three main criteria for building a device designed to measure the liquids' gravity: measuring the liquid's gravity, being easy to use, and being economical to create (Table 1).

Table 1. Handout of group 1.

Model	Model 1 (Pure water)	Model 2 (Alcohol)	Model 3 (Saltwater)
Result	The egg sinks slowly into the bottom of the cup.	The egg sinks into the bottom of the cup.	The egg floats on the surface of the liquid.
Explain	The egg is more massive than pure water.	The egg is more massive than alcohol.	The egg is lighter than saltwater → floating.

Figure 1. The experiment in phase 1 of group 1.

3.2. Phase 2

Students identified the device and its operation principle with the teacher's instruction and the information discovered on the internet. For example, group 2 wrote into the handout as follows:
Hydrometer operates based on Archimedes' principle.

F_A=d.V; d: specific gravity; V: volume of the displaced liquid.

3.3. Phase 3

The student groups presented their findings and their proposal for designing a device to measure the fluid's gravity. Specifically, there were two ideas for the design. Group 2 and Group 3 had the same plan (Figure 2).

Student (group 2): Our group intends to make a device based on the hydrometer's operation principle. We will use a bamboo straw the teacher provides to make the stem and a clay piece to fix the other straw's other head. The operation principle of this device is based on Archimedes' principle. We will drop the device into the liquid and observe how deep it sinks. Thus, we can calculate the specific gravity of that liquid.

Student (group 1): So, how can we measure that specific gravity?

Student (group 2): Based on the operation principle of the hydrometer and Archimedes' principle, the part of the device that sinks into the liquid is a cylinder so that we can measure its volume. Archimedes' principle is equal to the difference between the gravity of the device outside and inside the liquid.

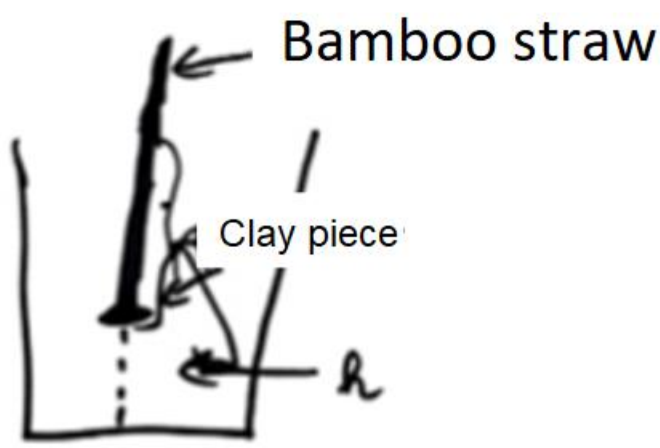

Figure 2. The design of group 2

The teacher explained to the students that the way group 2 used to measure Archimedes' principle is that the device is submerged entirely into the liquid (but in this case, the hydrometer is only suspended in the liquid, so we could not apply this way).

Then, group 4 introduced another design (Figure 3). That design was similar to group 1's and group 5's.

Student (group 4): We also apply Archimedes' principle, but we use a 50 grams weight instead of a bamboo straw because the masses can sink into the liquid quickly. Then we can easily calculate Archimedes' principle effects on the weight by using a dynamometer, so to measure the specific gravity of the liquid, we only need to calculate the volume of the weight.

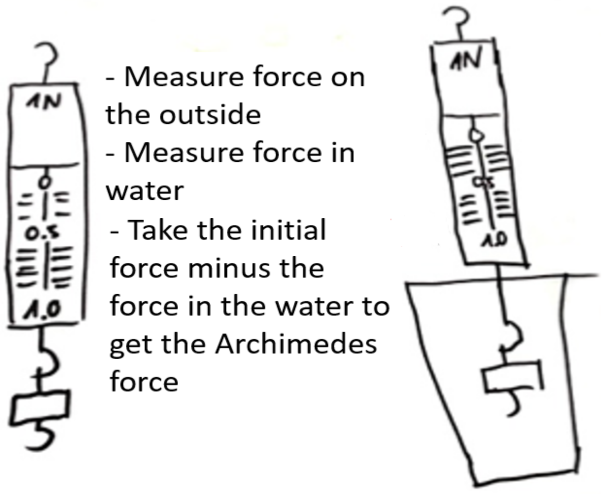

Figure 3. The design of group 4.

The teacher guides the students in applying the formula to calculate the cylinder's volume from this design.

> Teacher: Is the weight's shape unusual or not, so that we can apply the formula to calculate its volume?
>
> Student: Cylinder.

3.4. Phase 4

Groups designed the device according to the design agreed upon in Phase 3. (Figure 4).

Figure 4. The device of group 5.

Then, all of the groups used their devices to measure and calculate the specific gravity of the liquids they received in phase 1: pure water (group 1 and group 4), alcohol (group 2 and group 5), and saltwater (group 3). Some groups finished the task quickly, allowing them to take multiple measurements and then find the average to reduce error.

3.5. Phase 5

Because the products of the groups were similar, the teacher appointed one group to present their product. Other groups compared the results and gave comments.

> Student (group 1): With the optimal idea, our group has made a device to measure the specific gravity of the liquid, including a 50 grams weight hanging on the teacher's dynamometer 1N. We will have three steps: in step 1, we calculate Archimedes' principle that the liquid affects the weight by using the difference between the gravity of the device outside and inside the liquid; in step 2, we measure the sizes of the cylinder weight, like height and the radius of the bottom, so that we can calculate the volume of the weight; and in the final step, we use the formula F_A=d.V to calculate the specific gravity of the liquid. To reduce the error, our group measured five times and found the average. Our result is 0,058 N/m^3.
>
> Student (group 4): I agree with how group 1 makes and measures, but I think this result is unreasonable for pure water's specific gravity. Maybe group 1 was wrong in calculating because our group's result is 11085 N/m^3, and as we know, the specific gravity of pure water is about 10000 N/m^3.

The teacher asked two groups to compare the results together. As a result, they discovered that they made the dynamometer stretch incorrectly during lab time, producing inaccurate results. Then, group 1 borrowed the dynamometer of group 4 to remake and measure again. Finally, the results were approximate.

Then the teacher asked other groups to report their results. The results of the specific gravity of alcohol in groups 2 and 5 were approximately 11883,569 N/m³ and 11883,56908 N/m³ (Figure 5); the specific gravity of saline in group 3 was 14485 N/m³.

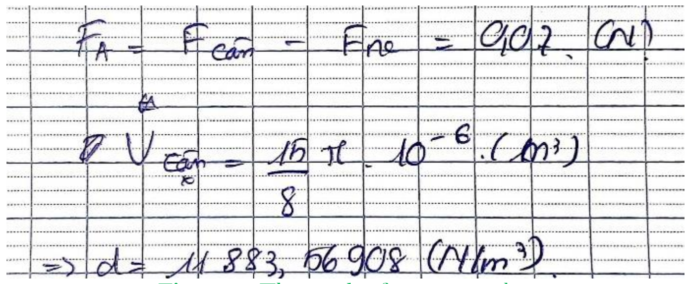

Figure 5. The result of group 2 and 5.

At the end of the activity, all of the groups could summarize the knowledge aimed at in the activity: Archimedes' principle affects the object wholly submerged in the liquid; the saline water phenomenon; how to make a simple device to measure the specific gravity of the liquid; and the formula to calculate the volume of the cylinder. The majority of students who were asked what they found challenging about the experiment said reading or interrupting the experimental data.

4. Discussion

Using a STEM situation associated with a water protection context created an exciting and engaging context for students to participate in the problem-solving process. The situation is familiar and close, making students see the need to solve it. Thus, it creates excitement and positivity for students participating in all experiment phases.

Our STEM situation illustrates the interdisciplinary math-physics approach by creating a device to detect saline water. Within Physics, students must find a way to calculate the specific gravity of a liquid by exploring the knowledge of Archimedes' principle F_A=d.V. Next, within the mathematical range, the volume V of a heavy is calculated by the cylindrical volume formula (Figure 6). Thus, the volume calculation is not to satisfy the "administrative orders" of the teacher but comes from the requirements of the situation.

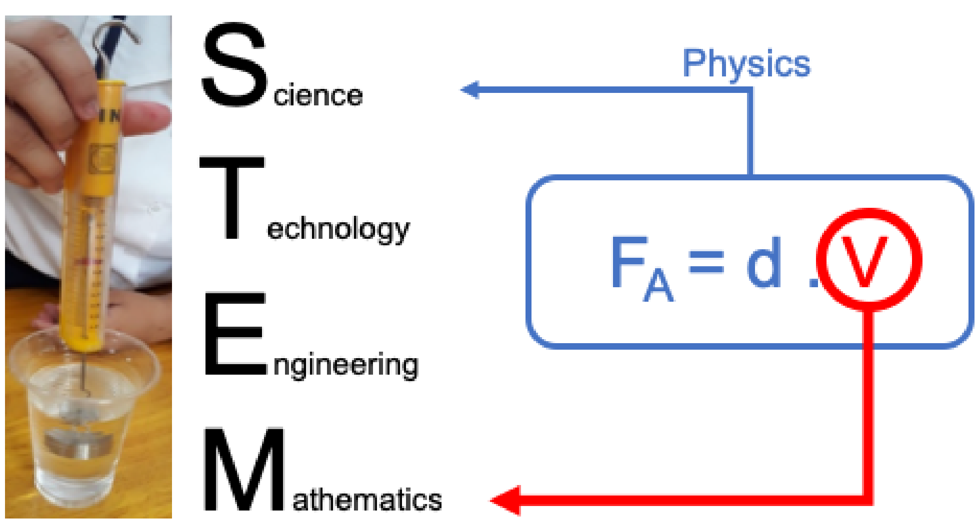

Figure 6. Interdisciplinarity in the STEM teaching situation.

Note that we do not require that students build a complete device during class time, either in a technical or commercial sense. Instead, the product in this situation is more educational. Specifically, it enables the activation of the fields of Technology (T) and Engineering (E). It allows the concepts of Science (S) and Mathematics (M) to be mobilized in an authentic context.

Indeed, after the teaching situation, when surveying what students had learned during the class, they excitedly listed the following ideas:

- Review the Archimedean repulsive force acting on the object immersed in the liquid.
- Learn about the situation of saline water.
- Know how to make a simple instrument to measure the specific gravity of a liquid.
- Review the formula for calculating the volume of a cylinder.
- Practice teamwork and presentation skills in front of the class.

Although the results show that the situation can be implemented in practice and is suitable for the mathematics education program in 2018, we can consider two broad directions.

First (about Science), the students' designed device can provide the liquid's specific gravity and then detect saline water when the measured value differs from 9800 N/m3. Next, based on the device, the teacher could organize the study of the relationship between salinity and specific gravity (is this a linear relationship?).

Secondly (about Mathematics), we recognize that students have difficulty processing and making decisions when errors occur in the teaching situation. This difficulty is also consistent with Tang and Pham (2017) judgment about Vietnamese students' problem-solving competency in learning about measurement errors. Vietnamese students are used to studying in a period with many theories and a lack of practice with minimal opportunity to apply Mathematical knowledge to real-world situations. This empirical study can create a suitable research perspective to include and connect to understanding error and statistics. Also, note that there is a planned change in teaching mathematics in 10th grade in the new program compared to the current program.

On the other hand, the context of the problem in phase 1 refers to global challenges for sustainable development in the 21st century (see Leleux and Van Der Kaaij (2019)). Specifically, it is associated with the saline water phenomenon increasing in the Mekong River's lower section, which presents a severe threat. Additionally, it develops students' sense of ethics and a social conscience, following Jolly (2017) and Ling, Pang, and Lajium (2019) for STEM education, making learning more meaningful for students than performing individual subjects. Last, phases 2-5 created a good condition for students to improve critical thinking, problem-solving competency, and social collaboration skills, as Jolly (2017) stated, and helped the teacher create a working atmosphere in the classroom.

5. Conclusion

Predictions of the high demand for STEM careers in the future workforce have made countries increasingly pay attention to STEM education worldwide. In this trend in Southeast Asia, the new educational program of these countries started to mention it in the last ten years, for example, the curriculum in 2013 of Indonesia (see Suwarma and Kumano (2019)), the curriculum in 2014 of Thailand (see Promboon, Finley, and Kaweekijmanee (2018)), the curriculum in 2017 of Malaysia (see Ramli, Talib, Hassan, and Manaf (2020)), the curriculum in 2018 of Vietnam (see Nguyen et al. (2019)). STEM education forced mathematics teachers to change their outlook on mathematics instruction according to an interdisciplinary approach. Our study contributes to realizing this approach by showing the feasibility of a STEM education situation. In the context of environmental protection, namely the prevention of mangroves in the Mekong Delta, we have successfully designed and implemented the STEM teaching scenario, which allows students to mobilize knowledge of mathematics, physics, technology, and engineering through the task of making a salinometer that allows measuring the specific gravity of the liquid.

The results indicates that students effectively utilise multidisciplinary knowledge in problem-solving scenarios. The students exhibit enthusiasm for engaging in the given scenario, hence enhancing their aptitude in communication, teamwork, and problem-solving. These skills align with the current demands of educational innovation in Vietnam, namely focusing on teaching methods that aim to cultivate learners' overall quality and capabilities.

According to Tang, Nguyen, and Le (2017), designing the STEM teaching situation is challenging for teachers because it often involves many fields. Therefore, this requires the cooperation of subject teachers to create teaching situations. Our research provides a concrete example of how teachers can use STEM teaching under the new curriculum.

6. Recommendations

Suggestions from researchers to the teacher, namely to deploy teaching in a STEM situation, can be performed in 5 phases: Phase 1 (Questioning), Phase 2 (Exploring ideas and finding out related knowledge), Phase 3 (Presenting the design plan), Phase 4 (Creating a product), and Phase 5 (Presenting, reviewing, and improving the product): to solve problems in STEM teaching situations, we should come from familiar situations associated with the local context and needs of the country to create motivation and excitement for students to participate in solving problems.

7. Limitations

The case study was conducted in a large class (40 students divided into eight groups). Implementing the teaching situation in a classroom setting in Vietnam, particularly with a class size of about 45 students, might provide significant challenges for many pupils. Undoubtedly, teachers have challenges in effectively observing, offering timely assistance, providing guidance, and addressing students' inquiries during stages 2, 3, and 4. Simultaneously, a considerable amount of effort will be required to coordinate the many organisations involved in generating reports on the goods.

On the other hand, the student's salinometer is just a simple device for measuring the liquid's specific gravity. Therefore, the measurement error will be quite large. It leads to a reasonable explanation to avoid students' disappointment about their products compared with professional scientists' measurement information.

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