

DESIGNING AND ORGANISING STEM EDUCATION LEARNING ACTIVITIES FOR STUDENTS BASED ON THE ENVIRONMENTAL TOPIC IN THE TEXTBOOK 'ENGLISH 10'

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ABSTRACT

STEM education learning activities have recently been introduced in many schools in Vietnam with numerous benefits. The current study focuses on the design and organization of STEM education learning activities through the environmental topic in English textbook grade 10. Whereby, students are provided with an English environment to improve not only language skills but also many other essential skills needed to succeed in the twenty-first century. One sample of the study included 15 students at 10th grade level in Luong Ngoc Quyen high school divided into 5 teams and 3 teachers. The quantitative method was employed in this action research. After the design and organization of the activities, feedback from teachers and students concerning same was collected via questionnaires and interviews. Based on the feedback, authors proposed some suggestions to improve the quality of the STEM education learning activities design and organization in an English classroom, aiming to improve the methodology for teaching and learning English thereby helping both teachers and students.

Keywords: *STEM education; design and organization; teaching and learning English; textbook English 10; environmental topic.*

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THIẾT KẾ VÀ TỔ CHỨC HOẠT ĐỘNG GIÁO DỤC STEM CHO HỌC SINH VỚI CHỦ ĐỀ MÔI TRƯỜNG, SÁCH GIÁO KHOA TIẾNG ANH 10

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TÓM TẮT

Hiện nay nhiều trường học ở Việt Nam triển khai hoạt động giáo dục STEM và đã mang lại nhiều hiệu quả. Nghiên cứu này tập trung vào việc thiết kế và tổ chức các hoạt động giáo dục STEM lồng ghép với hoạt động giảng dạy tiếng Anh lớp 10 với chủ đề môi trường. Qua đó, người học có một môi trường luyện tập tiếng Anh để cải thiện các kỹ năng ngôn ngữ và nâng cao các kỹ năng cần thiết cho thế kỷ 21. Đối tượng nghiên cứu gồm 15 học sinh lớp 10 và 03 giáo viên tiếng Anh trường THPT Lương Ngọc Quyến. Tác giả sử dụng phương pháp định tính trong nghiên cứu hành động bao gồm khảo sát và phỏng vấn để thu thập dữ liệu. Sau khi thiết kế và tổ chức các hoạt động STEM lồng ghép với hoạt động giảng dạy tiếng Anh 10 với chủ đề môi trường, phản hồi của học sinh và giáo viên về việc thiết kế và tổ chức các hoạt động được thu thập. Dựa trên những phản hồi này, tác giả đưa ra những gợi ý nhằm cải thiện chất lượng thiết kế và tổ chức các hoạt động giáo dục STEM trong lớp học tiếng Anh từ đó nâng cao phương pháp dạy và học tiếng Anh cho cả thầy và trò.

Từ khóa: *giáo dục STEM; thiết kế và tổ chức; dạy-học tiếng Anh; sách giáo khoa Tiếng Anh 10; chủ đề môi trường.*

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1. Introduction

Teaching and learning English is currently an urgent topic that concerns teachers, students and even students' parents. In many parts of the world English is observed to be the second or foreign language desired. Though acquiring that language only in school, students can eventually communicate in English perfectly. However, in Vietnam, along with studying in schools, many students are sent to private English classrooms learning with their tutors or to English centres with the hope that students can be better at using the language and be able to obtain an appropriate level to enter universities domestically or abroad.

The above mentioned situations concern the anxiety of many English teachers faced with the question as to why many students cannot communicate in English more fluently. That concern makes English teachers worry and it is essential to find solutions to this problem. Changing and adapting new teaching methods in teaching English are the crucial activities that every teacher needs to do. Teachers should not only attempt to organize a variety of classroom activities to improve student's target language skills, but also create an English environment outside of the classroom for students to practice those skills. One of the contemporary approaches that teachers in general employ in teaching other subjects is STEM one.

It is always correct when teachers prepare their students for the STEM (Science, Technology, Engineering, and Mathematics) field in general. Taking part in STEM learning activities, students will have opportunities to experience real-life situations and solve problems since forming their improved English language capabilities. For learning foreign languages, STEM will offer students real English environments in which to practice the target language. These activities will also provide them with a

desire for and interest in the field they are keen on and will be the basic for their chosen future career.

Being aware of the advantages of STEM education in language classroom, the authors conducted research concerning the designing and organization of STEM learning activities in the projects section of the English textbook grade 10 with the hope of introducing a new teaching method to students. By taking part in the project, such students would acquire a profound interest in studying English; and STEM will also create an English environment for them in which to improve their target language skills, life skills and the orientation needed to opt for their future career. The research question is: What is the feedback from teachers and students on the designing and organization of STEM learning activities in the projects section in relation to an environmental topic?

2. Literature review

2.1. STEM education

STEM is an acronym related to the collective academic disciplines of Science, Technology, Engineering, and Mathematics. To satisfy changing requirements in our society and the rapid economic, scientific and technological developments in the 21st century, it is necessary to equip students with the knowledge of related subjects and develop their competence to meet the changes and challenges in their society. In recent years, the essence of providing students with a strong education in Science, Technology, Engineering and Mathematics (STEM) is being stressed.

STEM education was created originally by the National Science Foundation. This approach was generated to equip students with critical thinking skills to tackle real-life problems and to suit the demand of the labor market [1]. Living in the 21st-century, students should gain a lot more skills to tackle more serious

challenges in the real world. STEM education will enable them to apply skills such as problem-solving, critical thinking, flexibility, data interpretation, collaboration, soft-skills like leadership, team work, self-management, out-of-the-box thinking, persistence, in order to succeed in the workforce as well as to have a bright future [2].

2.2. STEM education and English language learning

It is no doubt that the STEM education approach cannot only apply to scientific disciplines but also to teaching languages. It can be used as a bridge for students to express their understanding of these related subjects in the target language. Therefore, students will improve not only their language skills but also other important skills that one needs to survive in the technology era. Students may tackle some problems in relation to the technical terminologies but this can be solved by the support of other disciplinary teachers.

Learning English for technical and scientific fields is not an easy procedure to do. As for STEM subjects, students will learn the essential new patterns and expressions of the language and engagement in STEM disciplinary practices. However, with the teachers' assistance and students' background information, students "can learn STEM contents and practice STEM applications while simultaneously building their proficiency in English beyond STEM [3]".

There have been a number of studies such as [4], [5], [6], and [7] on integration of STEM disciplines with teaching foreign languages. The results indicate that students develop both their language competencies and knowledge of the related STEM subjects.

Hoffman and her colleague [8] suggested that the five following strategies can be used to support language development among English language learners as well as improve their literacy: (a) build background of new concepts,

(b) support students' vocabulary-building skills, (c) model how STEM vocabulary should be used, (d) encourage student language production through increasing interaction opportunities, and (e) use different grouping strategies for distinct purposes.

It is necessary for English language learners to equip themselves with plenty of concrete representations such as with manipulative, pictorial or graphical, numerical or algebraic, and real-world applications [9]. These STEM areas are really common and useful to each individual in society.

According to Haynes as cited in Hoffman "English learners must learn three tiers of vocabulary. The first tier is common vocabulary used in social or daily life interactions. The second tier is the vocabulary needed for school that students might not encounter in their everyday lives or social interactions; examples might include words like seldom or classify. The third tier of vocabulary consists of academic content words which have STEM-precise definitions used in specific situations [8]". By scaffolding the lessons, teachers can gradually help students to gain deep concepts related to STEM fields.

In short, the integration of STEM in language teaching is an effective way to help students achieve the aims of the lessons related to technology, science and engineering without much difficulty. This method brings students the passion to exploring science in particular and the world in general, which equips students with the crucial skills needed to solve real world problems.

3. Methodology

To search for the answers to the research question, the authors would like to divide the study into two parts. In the first part, the author would present several concepts and contents related to the topic of the study. The integration of STEM and English language

learning is also discussed to be the framework for the study. Furthermore, this section also provides the stages of designing and organizing STEM learning activities by choosing the topic related to protecting the environment in the English textbook grade ten, which is suitable for STEM learning activities. 15 students at 10th grade level in Luong Ngoc Quyen high school were divided into 5 teams to complete the projects tasks. The students were asked to actively take part in the group discussions, designing and implementation of the project to make final products and give a presentation on the effect of plastic rubbish on the environment and suggestions for protecting the environment by recycling the plastic items. The students were finally asked for feedback on the organization of the project by completing the questionnaires. 3 teachers at the school where the lessons were delivered were also interviewed for their comments on the design and organization of the activities.

4. Research design

4.1. An investigation into lesson plans and the topics

Before designing and organizing the STEM learning activities for students, the researchers surveyed lesson plans designed by English teachers in Luong Ngoc Quyen high schools to explore whether or not applying integrated STEM education activities in teaching English project section using the English textbook of grade 10. The results shown that the project sections were planned mostly based on the guidance in the teacher's book. Hardly ever were the sections delivered using STEM learning activities. Therefore, this was a meaningful opportunity for the researchers to carry out the research.

In addition, a look at English textbook grade 10 was implemented by the researchers to help comprehend more about the contents of each unit in the textbook. The researchers also desired to look for the units that can be used

to design and organize STEM activities. As a result, units 2, 5 and 9 in Tieng Anh 10 were considered to be suitable for organizing STEM education activities since the topics of these units are related to STEM subjects. However, in this research, the researchers paid attention to merely unit 9 with the topic "Preserving the environment" with the hope that students would love to explore the unknown world, apply their own skills and were willing to learning new skills in dealing with the problems concerning conservation of the environment. More importantly, students would acquire a passion for learning English.

4.2. Designing STEM learning activities based on the environmental pollution topic

The researchers based on the 7 stages of creating a lesson plan given by Theerasan and Yuenyong [10] including identification of social issues, identification of potential solutions, need for knowledge, decision making, development of prototype or product, test and evaluation of the solution, socialization and completion decision stage.

Stage 1. Identification of social issues

Activities:

- Having students discuss the types of environmental pollution especially plastic rubbish and how each type of pollution damages our environment.
- Teachers raise the issue "How can we reduce environmental pollution?"
- Teachers raise the more specific issue "Can we decrease plastic rubbish by using it to make pots for planting flowers/plants?"

Stage 2. Identification of potential solution

Activities:

- Teachers and students collect used plastic cans.
- Students may discuss their possible designing of a plastic pot with regards to form, size, decoration, planting purpose (the pot can be used to grow plants, flowers). If

you can use reusable plastic bottles or cans, how can you design them for planting?" Where can you put the pots for decoration? How many pots do you need?

Stage 3. Need for knowledge

Activities:

- Students may watch a clip showing the way to make pots from used bottles or cans.
- Students discuss the place to decorate with the pots made from used bottles or cans and the amount of bottles or cans they need.

Stage 4. Decision making

Activities:

- Teachers assign each group of students to design pots to decorate the school garden or the balcony of their house.
- Students in groups discuss deciding on the type of rubbish they will use (bottles or cans) and the decoration styles they like.

Stage 5. Development of prototype or product

Activities:

- Students create a model pot by using used plastic can or bottle. Materials can be included as follows: a knife; a pair of scissors; a used plastic can or bottle; a ruler; color pens.

Stage 6. Test and evaluation of the solution

Activities:

- Students will be asked to develop some ideas on how plants can grow in a pot:
 - + How can plants grow in a pot?
 - + What should be done in order that plants grown in a pot will not die?

Stage 7. Socialization and completion decision stage

Activities:

- Present the types of environmental pollution
- Present the ideas to design pots for planting plants from used plastic bottles or cans and decorate their school garden or balcony with them.
- Present the types of plants which can be grown in these pots.

- Present the lessons they learn during the project.

After finishing the design of the STEM activities, the researcher organized these activities for 15 students (6 boys and 9 girls) in grade 10th at Luong Ngoc Quyen school for 4 weeks.

4.3. Organization of STEM learning activities based on the environmental pollution topic

Nga et. al. [11] instructed the organization of STEM learning activities including three steps: Preparation, Implementation, and Evaluation.

Preparation

Period 1: Introduce the project, grouping and deciding the types of the project product.

Duration of time: 45 minutes

Products suggestion:

- Making pots from used detergent cans for planting moss roses.
- Making pots from used detergent cans for planting rain lilies.
- Making pots from used plastic bottles for planting green onions.

Requirement:

- Each group designs a number of pots for planting
- Each group present one type of environmental pollution, how to make a pot from used plastic bottles or cans and lessons learnt from the project.
- Group work: The group leader manages and makes a project plan together with the group members.

Implementation

Period 2: Design the project product

Duration of time: 45 minutes

Group work: The group leader assigns duties to the group members.

Step 1: Searching for information

- Groups find information in relation to the design of the pot on the Internet.

Step 2: Deciding on the type of the pot the group makes, the number of pots, the plants to grow and the place to put the pots.

- The group leader works with the members to synthesize, analyze the information, and sketch the project product.

Step 3: Presenting the plan for the project product

Each group presents its plan for the project product and completes the design after receiving other groups' comments.

Period 3: Measure, cut the used plastic bottles or cans to make pots for planting.

Duration of time: 90 minutes

Group work:

- The teacher supports students by preparing some used plastic bottles or cans. Students prepare other materials including knives, scissors, ruler, color pens.

- Group members measure and cut the used plastic bottles or cans to make pots as designed.

- Group members complete the presentation at home by working together on Google docs.

Evaluating the project

Period 4: Present the products and evaluate the project

Duration of time: 45 minutes

Group work:

A group member of each team takes turns to present a type of environmental pollution, its group products and lessons they learn from the project. The other groups give comments. The teacher remarks and evaluates the project.

After finishing the organization of the STEM activities, feedback from students and teachers was collected for better design and implementation.

5. Findings and Discussion

5.1. Students' feedback

After organizing the STEM activities in the project named preserving the environment,

the researchers got feedback from the participants by asking them to answer the questionnaires. The students were asked about the objectives, the form of organization, the suitability of the contents, the organizational methods and the evaluation methods of the STEM activities.

Table 1: *Students' feedback on the integration of STEM education activities into the project named preserving the environment*

Contents	Agree (%)	Disagree (%)
The objectives	100	0
The form of organization	100	0
The suitability of the contents	100	0
The organizational methods	93	7
The evaluation methods	93	7

It is interestingly displayed in table 1 that most surveyed students had the same agreement opinion. 100% of the students consented that the objectives, the form of organization, and the suitability of the contents were suitable for them. There was only one student who disagreed with the organizational methods that there should be four members in each group taking part in carrying out the project and the evaluation methods of integrated STEM education activities with the idea that students should be given a separate mark. In addition, there was the idea that the time to carry out the research was too short; they could not complete all the tasks in a month since they had to do many other activities concerning other subjects.

5.2. Teachers' comments

In order to obtain more information on the design and organization of the STEM activities for students, the researchers interviewed three teachers in the school where the research was done. The teachers' opinions to support the project were mainly concerning the duration of time needed to carry out the project, the organizational form and the contents of the STEM activities. Related to the time duration, the project

section is required by the Education and Training Ministry to deliver in merely one period (45 minutes), therefore, if teachers organize STEM activities in five periods, students will have to do the project at home. If so, the group work activities will not be done effectively.

In terms of the organizational form of the activities, the teachers recommended that the project should be organized in other ways such as extracurricular activities to minimize environmental pollution, for example, a practical experience of plastic waste collection or a contest to learn about the effects of plastic waste pollution on the environment.

Concerning the contents of the STEM activities, the teachers suggested that students should discover more ways to recycle and reuse plastic waste such as using plastic bottles for decoration, for example to make a Christmas tree.

5.3. Some corrections about the project implemented after receiving the teachers' supporting opinions

Based on the supportive feedback from both the students and teachers, the researchers would like to adjust some parts to have better implementation of the environmental project.

Related to the organizational form of the STEM Education activities in teaching and learning project section the researchers agree that there should be four to five members in each group to take part in the project. By doing this, students have more friends to share their work with and make the project's result better. Regarding the student's idea about the short time for carrying out the research, the researchers think that a period of four weeks is enough for students to make reusable pots and prepare the presentation if students have a detailed action plan.

In terms of organizational methods, it is desirable to give more extracurricular activities. For example, investigate the current situation of

environmental pollution caused by plastic waste in the locality, collect plastic waste in the public place. This will promote creativity, ability to learn from reality as well as develop students' capability to express their opinions in English and be aware of appropriate solutions contributing to reducing the harmful effects of plastic waste on the environment.

In relation to assessment methods, the researchers concluded that both assessing consciousness and evaluating achievement are important. By evaluating students' attitudes and results, students will put more effort into completing their tasks thereby bringing high educational efficiency for them. Furthermore, it is reasonable when all surveyed teachers and students recommended that a separate mark should be given to the students to boost students' motivation and interest in learning English via project section.

6. Conclusion

To conclude, the design and organization of the integration of STEM learning activities with respect to teaching the English language were accomplished with great support from both teachers and students. The researchers had received useful feedback from them concerning the project execution. This can be employed as meaningful guides for the implementation of STEM learning activities with respect to any other English lessons. By doing so, English lessons will not prove so tedious and students as well as teachers will more completely develop their own knowledge about the world as well as acquire indispensable skills for living successfully in this 21st century.

REFERENCES

- [1]. D. W. White, "What Is STEM Education and Why Is It Important?," *Florida Association of Teacher Educators Journal*, vol. 1 (14), pp. 1-8, 2014.
- [2]. J. Cox, "21st-Century STEM Skills Students Need to Know," [Online]. Available: <https://www.teachhub.com/21st-century-stem->

- skills-students-need-know. [Accessed Aug. 17, 2019].
- [3]. National Academies of Sciences, Engineering, and Medicine, *English Learners in STEM Subjects: Transforming Classrooms, Schools, and Lives*. Washington, DC: The National Academies Press, 2018, doi: <https://doi.org/10.17226/25182>.
- [4]. S. Banerjee, "STEM – A Tool for Teaching and Learning a Foreign Language," in IEEE Integrated STEM Education Conference, 2016.
- [5]. T. Han, "Foreign Language Learning Strategies in the Context of STEM Education," *Gist Education and Learning Research Journal*, vol. 11, pp. 79-102, 2015.
- [6]. S. D. Schoettler, "STEM Education in the Foreign Language Classroom with Special Attention to the L2 German Classroom," Dissertations and Theses, 2015, Paper 2313. [Online]. Available: https://pdxscholar.library.pdx.edu/open_access_etds/2313 HYPERLINK, doi: <https://doi.org/10.15760/etd.2310>. [Accessed Dec. 14, 2019].
- [7]. F. Petersen and J. Rebecca, "The effects of STEM inquiry practices on English language acquisition in a first grade classroom in Thailand," *Graduate Research Papers* 36. 2013. [Online]. Available: <https://scholarworks.uni.edu/grp/36>. [Accessed Jan. 15, 2020].
- [8]. L. Hoffman and A. Zollman, "What STEM Teachers Need to Know and Do for English Language Learners (ELLs): Using Literacy to Learn," *Journal of STEM Teacher Education*, vol. 51, no. 1, pp. 83-94, 2016.
- [9]. A. Zollman, "Learning for STEM literacy: STEM literacy for learning," *School Science and Mathematics*, vol. 112, no. 1, p. 12-19, 2012.
- [10]. C. Theerasan and C. Yuenyong, "Developing the Floating Restaurant STEM Education Learning Activities for Thai Secondary School Students," AIP Conference Proceedings, 2019, doi: <https://doi.org/10.1063/1.5094021>.
- [11]. N. T. Nga, H. P. Muoi, P. V. Hai, N. Q. Linh, N. A. Dung and N. T. Tue, *Teaching STEM topics for lower and upper secondary school students*. Ho Chi Minh City University of Education (in Vietnamese), 2018.