

Design Some Stem Topics Integrating AI & IoT Technology in Teaching Informatics and Technology Grade 10

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Abstract

According to the current general education program in Vietnam, in addition to the clear goal of program development, STEM education is specifically oriented to be applied at all levels of high school education to develop qualities and abilities. students have promoted interdisciplinary education in the fields of science, technology, engineering and mathematics. In addition, according to Official Dispatch No. 3089/BGDĐT-GDTrH, dated August 14, 2020 of the Ministry of Education and Training on implementing STEM education in secondary education [5]. STEM education content is an educational method to equip students with scientific knowledge associated with their application in practice, thereby contributing to the formation of students' qualities and abilities. In particular, for the subject of Informatics and Technology, which converges all four elements of STEM education, the subject of Informatics and Technology plays a central role in connecting other subjects. In particular, designing STEM topics that integrate AI & IoT technology will help you understand real-world applications and understand the operating principles of control circuits, understanding automation to help monitor equipment well. more, career orientation and training creative thinking skills and capacity development for students. In particular, to achieve this content, the authors would like to sincerely thank Hung Vuong University, Phu Tho for creating conditions for the author to conduct research on this article under the topic code HV24.2023.

Keywords: STEM education, AI artificial intelligence, AI & IoT technology.

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1. Some Basic Concepts of Stem Education

1.1. STEM Terminology

STEM is an acronym for the words Science (S), Technology (T), Engineering (E) and Mathematics (M); is a shortened term used when discussing US development policies on Science, Technology, Engineering and Mathematics. The term was first introduced by the US Science Foundation (NSF) in 2001 [4].

1.2. STEM Cycle

Natural sciences, engineering and technology are closely related and use mathematics as an important tool. This connection is demonstrated through the STEM cycle (Figure 1)

In the STEM cycle, science is considered a field that creates knowledge about the natural world on the basis of mathematical tools and existing technologies. Engineering uses mathematics and relies on existing

scientific and technological knowledge to solve practical problems. The result of engineering is the creation of new technologies.

Examining the relationship between science and technology, it can be affirmed that science is the basis for the development of technology, conversely, the development of technology has a positive impact on the development of science.

Science in the STEM cycle is depicted by an arrow from Technology to Knowledge representing the scientific creative process. Facing reality with current technology, scientists, with the ability to think critically, always raise questions and issues that need to be further researched, as a basis for perfecting and developing technology, those are scientific questions and problems. Answering scientific questions or solving scientific problems will invent Scientific Knowledge. In contrast, Engineering in the STEM cycle is depicted by an arrow

from Knowledge to Technology representing the engineering process. Engineers use scientific knowledge to design and create new technology to solve practical problems. The characteristic of Science is the scientific method. The characteristic of Engineering is technical design. The two above-mentioned processes follow each other, closing into a cycle of scientific and technical creativity according to the "spiral" model that continues. After each cycle, the amount of scientific knowledge

increases and with it technology develops at a higher level.

The close connection of STEM fields shown in the cycle is the basis for implementing STEM education in high schools in an integrated interdisciplinary manner.

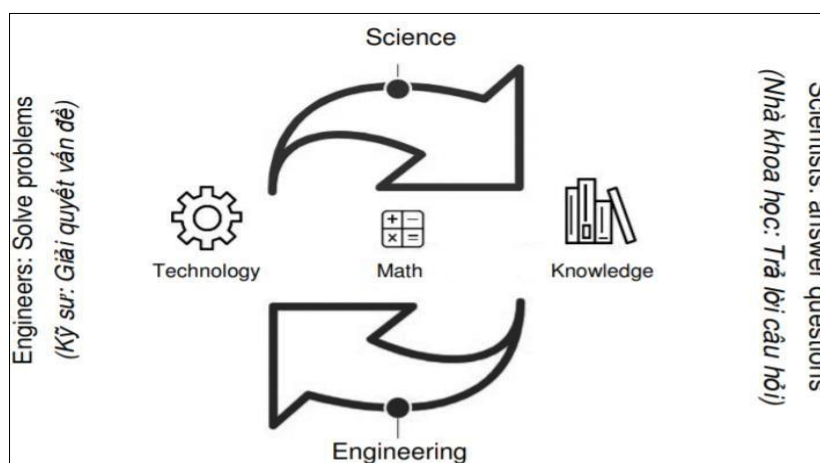


Figure 1: STEM cycle

1.3. STEM Education

STEM education is an educational model based on an interdisciplinary approach, helping students apply science, technology, engineering and mathematics knowledge to solve practical problems in specific contexts.

1.4. STEM Topic

STEM topic is aimed at applying knowledge integrating the fields of Math, Science, Engineering and Technology to solve practical problems in life. In the high school program, these fields are represented in the subjects Math, Natural Sciences (for middle school), Physics, Chemistry, Biology (for high school), Engineering Technology and Information Technology. A STEM topic that fully participates in all four areas S, T, E, M is called a full STEM topic, otherwise it is called a missing STEM topic.

The STEM topic is the basis for implementing STEM educational activities in high schools in many different organizational forms such as: teaching science subjects according to STEM lessons, organizing STEM experience activities, organizing scientific and technical research activities.

2. Role and Meaning of Stem Education in High Schools

STEM education into high schools brings many meanings, consistent with the direction of general education innovation [3]:

- Ensure comprehensive education

The practice of teaching STEM subjects in high schools shows that there are differences in roles and positions between these subjects. Specifically, math and science are areas of interest and investment. Meanwhile, technology and techniques have not been given due attention. In the context of the fourth industrial revolution, with the spirit of innovation in the general education program, this issue needs to be thoroughly resolved. One of the solutions is to promote STEM education in high schools.

- Increase interest in learning STEM subjects

Interest in learning is one of the particularly important psychological factors in learning, contributing to the formation and development of student capacity. Thanks to interest, students will be self-aware and active in learning and that is also the seed of creativity. Interest in learning a certain subject not only positively affects the academic achievement of that subject, but is also a factor that greatly influences the student's tendency to choose a career after finishing their education. General education.

STEM educational activities aim to apply interdisciplinary knowledge to solve practical problems, students can operate, experience and see the meaning of knowledge in life, thereby increasing their excitement. Students' interest in studying STEM subjects and the tendency to choose appropriate careers appear.

- Form and develop students' abilities and qualities

Teaching to develop students' abilities and qualities is one of the main innovative ideas of

Vietnamese education and training. For general education, this ideology is fully and comprehensively expressed in the General Education Program. There are many methods to develop the qualities and abilities of learners, of which STEM education is one of the most appropriate and effective methods.

When implementing STEM lessons, students can cooperate with each other, proactively and independently perform learning tasks; get acquainted with activities of scientific and technical research nature. The above activities actively contribute to the formation and development of students' qualities and abilities. These are core general competencies (autonomy and self-learning, communication and collaboration, problem solving and creativity); Specific competencies such as mathematical competency, scientific competency, technological competency and information technology competency.

– Connecting schools to the community

In some situations, high school resources are limited and do not fully promote the idea of promoting STEM education in schools. Connecting with society is necessary to exploit resources, to help students have practical social experiences; General education establishments need to connect with vocational education establishments, higher education establishments, research establishments, and local production establishments to exploit human, physical, and financial resources. Main implementation of STEM education activities.

– Career guidance and streamlining

Career guidance and streamlining is one of the very important issues of general education. Implementing this activity well will not only help students choose a career suitable for themselves and their families, but also help orient the workforce to occupations that are in demand. With the initial goal of STEM education being to develop human resources in these fields, STEM education in high schools must be closely connected with vocational education and streamlining.

3. Stem Education Orientation in Informatics and Technology

3.1. Orientation for STEM Education in Informatics

In Information Technology, STEM education is being implemented as an important direction in education and training in many countries around the world. As a foundational technology, converging all four elements of STEM education [Science (S), Technology (T), Engineering (E) and Mathematics (M)], Informatics has central role in connecting other subjects, promoting STEM education, promoting student creativity to create digital products with high ICT content.

Thus, STEM education in Informatics is suitable for teaching Problem solving with the help of

computers; especially good content in the subject of studying Computer Science.

3.2. Orientation for STEM Education in Technology Subjects

Promoting STEM education is one of the four core values of Technology subjects in the General Education Program including: (1) Technology education helps students learn and work effectively in a technological environment at home, family, community and society; (2) Technology education promotes STEM education, has the advantage of forming and developing problem-solving, creativity and design capabilities; (3) Technology education is one of the main paths for vocational education; (4) Technology education prepares students with foundational knowledge to choose a career or continue studying engineering or technology fields.

In the General Education Program, the Technology subject reflects two components, T (technology) and E (engineering), in the four components of STEM. Therefore, Technology plays an important role in expressing STEM education ideology in the general education program. The technology products and processes mentioned in the subject are always integrated, linked to practice, and closely related to mathematics and science. This characteristic is the basis for strengthening STEM education right in teaching Technology subjects based on technical design activities and scientific and technical research activities.

4. Design Some Stem Topics in Teaching Informatics and Technology Grade 10 Using Ai & Iot Technology Integration

4.1. STEM Topic/lesson Design Process [5]

Based on STEM education goals, STEM lesson plans are built based on the technical design process with a process of 8 steps: identify the problem, research background knowledge, propose solutions, select solutions, create models, test and evaluate, share and discuss, and adjust designs.

The process of implementing a STEM topic/lesson plan is divided into 5 main activities, clearly demonstrating the 8 steps of the specific technical design process such as:

- + Activity 1: Identify the problem - build ideas
- + Activity 2: Research background knowledge and propose solutions
- + Activity 3: Choose a design option
- + Activity 4: Manufacturing, testing features and evaluating
- + Activity 5: Discuss and improve products

4.2. Applying the STEM Topic/Lesson Design Process, Designing a Number of Topics Integrating AI & IoT Technology in Teaching 10th Grade Informatics and Technology

Based on the research and analysis of the computer science-oriented Informatics and industrial-

oriented technology subjects for grade 10. From the process of implementing STEM topic/lesson plans, we build a summary. Turn off the STEM topic according to the following example:

Topic: Smart Home Using Ai & Iot Control Technology

Duration: 12 periods (45 minutes/1 period)

Topic Description

In this topic, students will design a "smart" home with automation features depending on their creativity. Accordingly, students must apply the knowledge they have learned in Topic 2 - Designing control circuits for smart homes (under Technology Learning Topic 10), and at the same time relate it to the content of class Informatics. 10 - Poster design, programming.

i. Teaching Goals

1. About knowledge

- Block diagram and operating principle of a control system for a smart home.
- Structure and operating principles of some types of sensors used for smart homes.
- Design a control system for a smart home using AI&IoT technology.

2. About Capacity

2.1. Technological Capacity

- Outline the concept of a smart home, summarize and describe it, using some types of sensors.
- Describe the control system block diagram
- Choose the right sensor in the smart home.
- Evaluate some technology development trends for control systems; Evaluation of function, durability, aesthetics, efficiency, and security for smart homes.
- Design a control system using AI & IoT technology for smart homes.

2.2. Information Technology Capacity

- Have understanding of AI & IoT technology.
- Use software to write and execute control programs

3. About Quality

- Hardworking: Conscious of exploring and proactively applying knowledge learned about control and researching smart home control technologies using AI & IoT.
- Responsibility: Be proactive, self-aware and serious to learn the characteristics and applications of sensor technology, AI & IoT technology to control smart homes.

ii. Teaching Equipment and Learning Materials

Learning activities	Teacher	Student
Activity 1: Identify ideas for creating a smart home	- Projector, computer, learning materials, Video - Product request - Types of study sheets	- Pen. - A4 paper
Activity 2: Research background knowledge and propose solutions.	- Knowledge about smart homes - Ohstem smart home implementation kit	- Pens, pencils - A4 paper - Laptop - Smartphone. - Product: Study sheet
Activity 3: Choose a smart home design option	- Projector, computer - Controllers, sensors - Study sheet - Evaluation form.	- Controllers, sensors - Laptop - Product: control system design, describing basic features of the house.
Activity 4: Manufacturing, programming and testing smart home features controlled by AI & IoT	- Controllers, sensors. - Assessment sheet for group activities	- Laptop. - Smartphone. - Programming code. - Programming code controlled by AI & IoT
Activity 5: Discuss AI & IoT control features and product improvements	- Types of evaluation forms.	- Smart home model - Code snippets

III. Teaching Process

A. Teaching Process

Learning activities (time)	Teaching content center	Main teaching methods	Evaluation plan
Activity 1: Identify ideas for creating a smart home (1 period)	- Overview of smart home. - Home control system using AI & IoT	- Conversation. - Create problem situations. - Working group.	- Study sheet - Evaluation form
Activity 2: Research background knowledge and propose solutions. (2 periods)	- Sensor technology, AI & IoT technology. - Central control circuit board. - Solutions for home security systems.	- Conversation. - Create problem situations. - Working group.	- Study sheet - Evaluation form - Study sheet - Evaluation form
Activity 3: Choose a smart home design option (3 periods)	- Blueprint. - Design 3D drawings using autocad software.	Conversation	- Study sheet - Evaluation form
Activity 4: Manufacturing, programming and testing smart home features controlled by AI & IoT (3 periods)	- Programming sensors - Manufacturing smart home models and assembling sensors. - Operate features for the house.	- Working group. - Use manufacturing methods and program features for the house.	- Evaluate smart home model products according to criteria.
Activity 5: Discuss AI & IoT control features and product improvements (3 periods)	- AI & IoT controlled features. - Introduce diagrams, designs and features of the house.	- Use presentation method. -Group discussion method.	-Evaluation sheets. - Study sheet.

B. Teaching Activities

Activity 1: Identify Ideas for Creating a Smart Home

- A. Target Mobilize students' knowledge about smart homes learned in previous topics and in practice.
- B. Organizing activities

The teacher transfers tasks study	Students perform learning tasks	Report perform
Instruct students to divide into 4 groups (each group has 7 to 8 students).	Make a list including group leader, secretary, and members.	Team list.
- The teacher sends videos to the house and distributes study sheets to groups. - After watching the video, each group completes the questions in the study sheet that the teacher designed for students.	Students watch the video and complete the exercise sheet.	Study sheets
The teacher corrects general questions in the worksheet and emphasizes the features that can control a smart home	Students answer the questions	The teacher randomly calls students into groups to answer. Teachers observe, comment and standardize knowledge.
The teacher introduces sensors and control options such as AI, IoT, wifi, and Bluetooth in more detail.	Observe, listen and take notes as necessary.	
The teacher sets up situations: Observe the child's house and point out devices that can be controlled by remote control panel, controlled by smartphone...	Students volunteered to answer and choose control ideas for their homes.	Teachers observe, comment and standardize knowledge

C. Learning Products

- Student's answer.
- Group list, with group leader and member notes.
- Come up with ideas for smart home control using AI & IoT

D. Evaluation Plan

- Teachers observe, listen and evaluate the results of students' work sheets.

Activity 2: Research background knowledge and propose solutions**A. Target**

- Give an overview of smart homes and sensors.
- Present the block diagram and operating principles of the smart home control system.

- Present the structure and operating principles of some types of sensors used in smart homes.
- Read instructions on how to properly and effectively use sensors used in smart homes.

B. Organize activities

The teacher transfers learning tasks	Students perform learning tasks	Report perform
Ask students in groups to answer questions while watching the teacher's video presentation. The teacher asks: What devices are used in control and monitoring.	Students observe, take notes and answer	Teacher listens, comments and emphasizes key knowledge
The teacher shows a slide introducing sensors: concepts, uses, and some common types of sensors.	Students write down the content	Content of students' notes.
The teacher asks students to bring the study sheet from the previous lesson to determine which sensors are needed for the smart features the group sets out to do. Explain.	Students discuss in groups and make choices and write them down on their study sheets.	Study sheet.
Teacher introduces Ohstem's programming software and control system (ESP32 microcontroller, AIoT or Yolo UNO - Aduino)	Students listen and take notes.	
The teacher asks each group to choose a realistic sensor for their group.	Each group sends 2 representatives to choose.	Sensor is selected
The teacher assigns tasks to groups to learn the structure and working principles of various types of sensors and programming software.	The group is assigned to perform, take notes and design report slides.	
Each group reports their research results	Each group reports in turn.	The remaining groups write their answers in their notebooks.
The teacher summarizes the key knowledge about sensors and asks students to write it down in their notebooks.	Students listen and take notes	Content of students' notes
Teacher introduces equipment: + Control chip: Yolo UNO – Aduino. + ESP32 wifi module + 1602 LCD display screen + Load the program to the control circuit + Control programming software.	Students listen and take notes	
Teachers guide students to practice: Designing a smart home control system using AI & IoT.	Each group performs product creation	Teachers support and comment when students practice.

C. Learning Products

- Study sheet
- Control system for smart home using AI & IoT

- Name the main tasks when designing a control system for a smart home.

D. Evaluation Plan

- Students evaluate peer-to-peer in evaluation groups with each other. Groups evaluate each other.
- The teacher observes, listens, comments and evaluates the groups' achievements according to the learning sheet

B. Organizing Activities

- Teacher asks students to choose a smart home design plan (Design 3D drawings using software of choice). With smart features: programming, sensor testing.
- Students choose a design plan to control a smart home using AI & IoT.
- The teacher asks the groups to complete the drawings and features for the house.

Activity 3: Choose a Smart Home Design Option**A. Target**

- Choose a smart home design plan.

C. Learning Products

- 3D technical drawings
- House model, smart home features.

D. Evaluation Plan

- The teacher observes and evaluates the groups' process of choosing control plans.

Activity 4: Manufacturing, Programming and testing Smart Home Features Controlled by AI & IoT**A. Target**

- Manufacturing, programming and testing smart home control features using AI & IoT.

B. Organizing Activities

- Teachers provide basic materials for students.
- The teacher asks students to manufacture and program the smart house according to the manufacturing process agreed upon in the group.
- Product Students can record the video and submit the product according to the group's correct position.
- Design posters to introduce group products.

C. Learning Products

- Smart home model complete with programmed control features, poster and video of the implementation process.

D. Evaluation Plan

- Teachers listen, observe and evaluate the groups' products according to the established criteria.

Activity 5: Discuss AI & Iot Control Features and Product Improvements**A. Target**

- Compare and comment on smart home products of different groups.
- Identify and evaluate products in terms of durability, aesthetics, efficiency and safety when using smart homes for groups.

B. Organizing Activities

- The teacher requires each group to display their products in the correct position prescribed by the teacher.
- The teacher asks students to introduce, present and demo the products that the groups have created and program the control system for smart homes using AI & IoT.
- The teacher reminds students to complete the evaluation form and self-assessment scale according to the initial criteria set by the group.

C. Learning Products

- Product display booth (smart home model, poster, video)

D. Evaluation Plan

- Teachers observe, evaluate using scoring sheets and share experiences.

5. CONCLUSION

Experimental results show that the process of teaching STEM topics is completely feasible, students are interested in learning and actively comprehend AI & IOT control technology to program "Smart Homes". In addition to ensuring content knowledge in teaching 10th grade Informatics and Technology, students also have access to current technology and STEM education. Initial results show that students can be more creative in applying AI & IoT in controlling and monitoring other devices to improve information technology, technology and creativity skills for high school students. High school in order to promote their abilities and strengths associated with future career orientation: choose a better industry and career.

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