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Original Research Article

Building Integral Stem (iSTEM) Teaching Topics Level 3 "Automatic Handwashing Machine to Prevent Covid 19"

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Abstract: STEM integrated education is a modern, global education model that aims to develop high-level human resources in the 21st century. STEM integrated education is in line with the current Vietnamese educational development. Today, the focus is on developing students' abilities and qualities, especially the problem solving and creativity - one of the common competencies that all subjects and educational activities must aim for in the 2018 educational program. Integrated STEM teaching topic (hereinafter referred to as iSTEM) is one of three forms of STEM integrated education organization [1], widely implemented for all types of students in Viet Nam. The iSTEM topic follows an integrated internal, multi-disciplinary or interdisciplinary approach, the content closely following the current general education curriculum. In this article, we apply the research results published in previous articles [2, 3], on criteria and process for building iSTEM topics, building level 3 iSTEM topics and teaching the subject in the framework of pedagogical experimentation. Research methods: document research, model proposal, model operation, pedagogical experiment. Achievements: Level 3 iSTEM teaching topic document "Automatic hand washing machine to prevent Covid 19."

Keywords: STEM integrated education, STEM integrated topic, iSTEM topic, STEM level, full STEM topic, automatic hand washing machine.

1. APPROACH

In Vietnam, STEM-integrated teaching topic is attracting the attention of all teacher communities while teaching the new program in 2018. The Ministry of Education has deployed the STEM education program to secondary school and high school to carry out teaching in the direction of integrating with the main program or outside of class time according to each topic integrating STEM for subjects. Design and build STEM-integrated topics according to what criteria? How is it done? These are the questions that many teachers wonder and are confused about when teaching STEM topics and are also our research goals.

We classify iSTEM topics based on the integration of subjects in the fields of Science (Physics, Chemistry, Biology), Technology, Engineering and Mathematics according to the content level of knowledge and skills of the topics to solve practical problems. The iSTEM topic has many levels in application; we classify iSTEM topics into the following three levels: Level 1. Internal STEM, integrating knowledge from grade 10,11,12 in the same subjects in the field of STEM; Level 2. Parts of STEM, integrating or embedding knowledge of one or more subjects in the core subject of the STEM field; Level 3. Full STEM, integrating knowledge of all subjects in the STEM field, in which Math is a tool for survey, research, and product design. This article publishes the results of applying the iSTEM topic development process proposed by us in [3] to build a level 3 iSTEM topic (full STEM), applied to teaching Physics at high school, topic "Automatic hand washing machine to prevent Covid 19".

2. RESEARCH CONTENT AND RESULTS

2.1. Building a theoretical framework for the iSTEM teaching topic

We build the theoretical framework published in [2] and [3], for convenience we state the main results:

Definition of iSTEM teaching topic: From research on integrated STEM education, we define the content of iSTEM teaching topic concept as follows: STEM integrated teaching topic (hereinafter referred to as iSTEM topic) includes the content and methods of organizing learning activities based on the technical design process for students:

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Self-reliance occupies the knowledge, skills, and requirements to be achieved in the educational program of the subjects of Physics, Chemistry, Biology, Technology, Engineering and Mathematics. Use that knowledge as a scientific basis to create meaningful, practical problem-solving products.

Provide a set of 6 criteria for identifying and evaluating iSTEM teaching topics:

(1) **Target criteria (criteria M):** The topic must be rooted in an interesting real-world problem and motivates learners to overcome (a) moderate engineering design challenge, to create a product to solve the problem.

(2) **Content Criteria (Criterion N):** The topic must cover the knowledge and skills of the educational program in subjects S, T, E, M.

(3) **Criteria for the relationship between objective and content (M&N Criteria)**: The scientific basis of the product (objective) is the knowledge of subjects S, T, E, M of the educational program (content). This relationship needs to be visualized with a concept diagram (Conceptual Flow Graphic for short CFG) [4].

(4) **Methodological Criterion (Criterion P):** Learning activities must be organized according to the engineering design process.

(5) **Criteria of organization (Criterion T):** Students work in groups inside and outside the classroom to solve problems.

(6) **Evaluation criteria (Criterion D):** The student's learning outcomes must be the physical product of several different versions that do not exclude the faulty version. Evaluation of student learning outcomes and development of competencies are based on the results of this product evaluation and the process of creating that product.

We have proposed the process of designing iSTEM teaching topics to ensure the iSTEM topic criteria (see Table 1).

Table 1: Criteria and process for designing iSTEM teaching topics

Steps	Content	Criteria
Step 1. Identify the problem	-Look for real-life scenarios to create a problem situation; - Proposing the problem	**Target Criteria (Criteria M)** -Fascinating, motivating context - Technical design challenge
Step 2. Identify the product/technology solution that can solve the problem	- Naming technology products/solutions - Find out similar products/technology solutions already on the market, evaluate advantages and disadvantages - Developing a system of standards and criteria for products/technology solutions -Design evaluation sheets of technology products/solutions	**Evaluation Criteria (Criteria D)** - Product review plan
Step 3. Identify background knowledge	- Gather knowledge of science and math subjects as a basis for designing, manufacturing and operating technology products/solutions (drawing diagrams of the relationship between background knowledge and products (CFG); - Identify the place of each knowledge in relevant science subjects (Physics, Chemistry, Biology), Technology, Informatics and Mathematics in the educational curriculum.	**Objectives and Content Criteria (M&N Criteria)** Draw diagrams linking products or technology solutions and knowledge in subjects S, T, E, M (CFG)
Step 4. Determine the teaching objectives of the topic	- Determine the target of knowledge and skills according to the curriculum of the subjects mentioned in step 3. - Identify other competency goals.	**Criteria M**
Step 5. Build a set of product-oriented questions	Build a set of product-oriented questions based on the learning process organized according to the technical design process.	**Method Criteria (Criteria P)**
Step 6. Design the process of organizing learning activities	Design activities of groups of students according to the technical design process: (1) Identify the problem - (2) Find out the background knowledge - (3) Propose designs - (4) Discuss and choose the design - (5) Manufacturing the product – (6) Product presentation, evaluation – (7) Design adjustment, product adjustment.	**Criteria of Organization (Criteria T)**
Step 7. Design a plan to evaluate learning outcomes according to the objectives in Step 4	-Design tools to evaluate subject capacity goals (Awareness, Understanding Science, Application); - Design a tool to evaluate common competency goals - Develop a plan to use evaluation tools	**Criteria D**

2.2. Building a level 3 iSTEM teaching topic "Automatic hand washing machine to prevent Covid 19"

Step 1: Identify the problem

The world is facing the Covid 19 pandemic, which has spread all over the world, sickening billions of people, causing millions of deaths, seriously affecting socio-economic activities in all countries. In Vietnam, the Prime Minister issued Directive 19/CT-TTg to implement measures to prevent and control the Covid-19 epidemic, the whole country detected and promptly handled the outbreaks, continued to control and limit the speed of infection in the community. People regularly wash their hands with soap or antiseptic solution; wear a mask when going out; keep a safe distance when in contact; do not gather in large numbers in public places, outside of offices, schools, hospitals... Equip staff with protective equipment, measure body temperature of incoming guests; arrange adequate facilities and supplies for hand washing and disinfecting at the facility and ensure distance when in contact.

Real product to solve the problem: Washing hand in the right way, right process, right dose of antiseptic and limiting direct contact with the user, we need to do it by an automatic hand washing machine. Thus, creating an automatic hand washing machine is really necessary and can effectively contribute to the prevention of Covid-19.

(The problem is posed in the context of motivating, engaging, stimulating students to overcome challenges in order to create a product, equipment, or machine according to the Technical Design process)

Step 2: Identify the product/technology solution that can solve the problem

Product name: Automatic hand washing machine to prevent Covid 19.

Survey of products on the market: Design based on delay generator circuit or on Arduino UR3 microcontroller, Current integrated circuits, evaluate the advantages and disadvantages of products on the market (see Table 2).

Table 2: Hand washing machines by type of microcontroller circuit on the market

Microcontrollers	Capacity	Durability	Longevity	Safety	Energy saving	Price
Arduino UNO R3	Low	Medium	Medium	High	Good	Low
Delay generation circuit DL-M610XY-JO2	Low	High	High	High	Good	Low

Standard system and product criteria "Automatic hand washing machine to prevent Covid 19" (see Table 3 and Table 4).

Table 3: Criteria of practical product "Automatic hand washing machine to prevent Covid 19"

Standards	Product Criteria	Score
1. Function	TC1. Automatically spray when detecting obstacles	10 point
	TC2. Spray the correct amount of solution	10 point
	TC3. Disinfectant solution in accordance with medical standards	10 point
	TC4. Green materials and technology (recycled materials)	10 point
2. Visual	TC5. Unique (not yet on the market)	10 point
	TC6. Easy to use	10 point
	TC7. Easy to transport and store	10 point
	TC8. Spectacular	10 point
3. Safe for users	TC9. Safe use of electricity	10 point
4. Price	TC10. Reasonable price	10 point

Table 4: Product presentation evaluation sheet "Automatic hand washing machine to prevent Covid 19"

Standard	Criterion of product	Score
Layout Powerpoint *(5 point)*	P1. Introduction	0,5 point
	P2. Learn about all the available products	0,5 point
	P3. Scientific basis of the product	1 point
	P4. Circuit diagram and product design	1 point
	P5. Product manufacturing	0,5 point
	P6. Product Operation	0,5 point
Content *(50 point)*	P2. Learn, investigate, research (structure, operating principle, function and cost) according to the number of products on the market.	5 point
	P3. Scientific basis -Physics: Ohm's law, power supplies, semiconductor components, Power receivers … -Chemistry: Ancol, preparation of antibacterial water -Biology: Virus, Covid 19 -Technology: Arduino microcontroller, pump, current rectifier, conditional	25 point

Standard	Criterion of product	Score
	programming, loop programming... P4. Circuit diagram and design drawing according to level of quantity, content and technique P5. Equipment selection, module manufacturing, assembly structure, product packaging	 10 point 10 point
Report *(45 point)*	P6. Product operation (product demonstration according to the requirements) - Visual (clear text) - Style (confident, agile, decisive) - Language (clear, concise, easy to understand) - Answer the question (sufficient, correct content) - Make questions (clear, to the point and content)	10 point 5 point 5 point 5 point 5 point 5 point

For Table 3 and Table 4 is the basis of two votes, product evaluation sheet and presentation evaluation sheet

Step 3: Identify background knowledge

Draw a diagram to show the relationship between the product "Automatic hand washing machine to prevent Covid 19" and the knowledge and skills of subjects S, T, E, M integrated in the STEM topic level 3 (see Figure 1 and Figure 2).

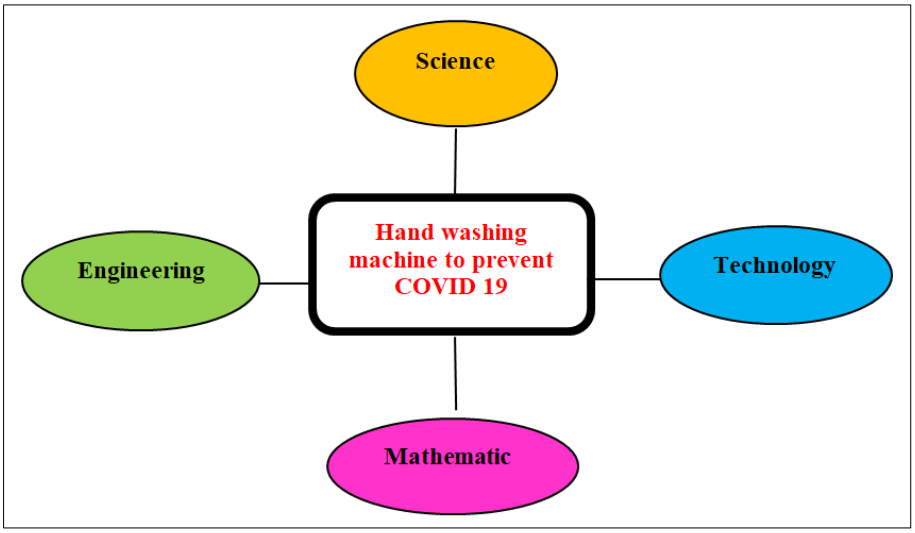


Figure 1: Map of integrated STEM fields under the topic "Automated hand washing machine to prevent Covid 19"

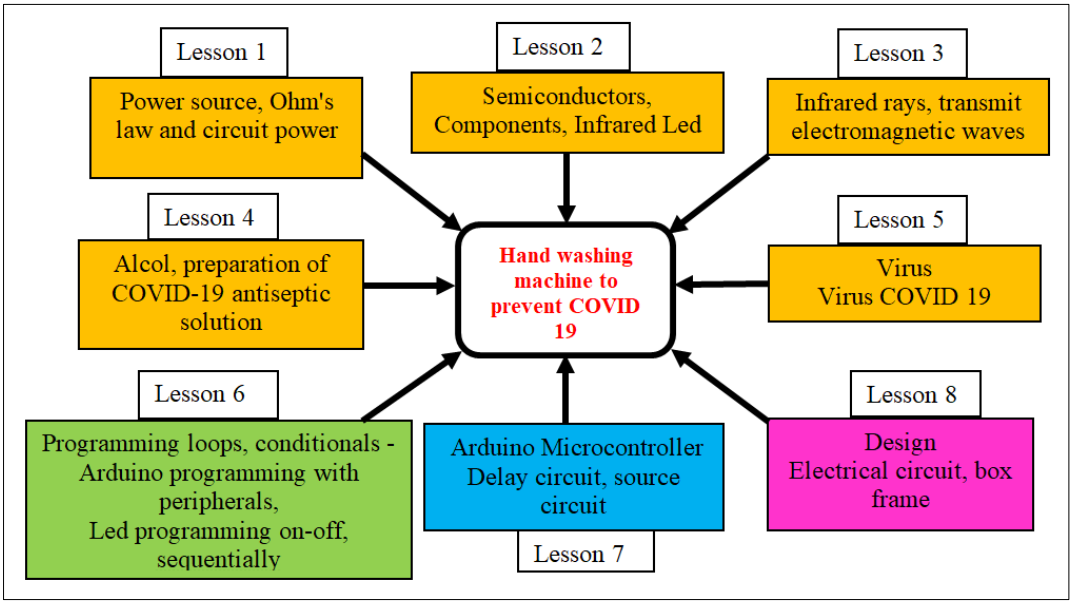


Figure 2: Knowledge linkage diagram integrating STEM fields under the topic "Hand washing machine to prevent Covid 19"

Level 3 iSTEM topics have a full range of fields including: Science with all 3 subjects (Physics, Chemistry, Biology), Technology, Engineering and Mathematics (in product design). Note that in the CFG (Conceptual Flow Graphic), we specify the representation of fields by color: Science (yellow), Engineering (green), Technology (blue), Math (pink).

Step 4: Determine the teaching objectives of the topic

Objectives of knowledge and skills of iSTEM level 3 topics with the aim of developing specific competencies for students in the process of teaching the topic.

Table 5: Objectives of iSTEM teaching topic at level 3

TEACHING OBJECTIVES	
Development: Physical competence, Problem solving and creativity, Self-study, Communication and cooperation	
Knowledge	Science (Physics, Chemistry, Biology) Apply knowledge of power sources, source coupling, Ohm's law for circuits, semiconductors, leds, infrared rays, electromagnetic wave receivers to create products - Applying Ancol knowledge, preparing Ancol to create Covid-19 antiseptic solution - Applying knowledge of viruses, structural features, and characteristics of Covid 19 to prevent Covid **Technology:** + Use voltmeter to check power, battery, measure voltage. + Apply the principle and structure of Arduino microcontroller, AC-DC converter circuit, trigger circuit, delay generator circuit, infrared transceiver circuit to create products + Electrical circuit design and simulation software **Engineering:** + Distinguish the output pins, input, port, polarity of the Arduino board, jack board, delay circuit board ... + Apply lead and lead soldering techniques for connecting wires. + Determine the value of the color ring on the resistor + Programming techniques on Arduino microcontrollers, loop instructions, conditionals. **Math:** Students apply math knowledge to design electrical circuits, determine the number of sources that need to be assembled to provide voltage and amperage corresponding to a given number of devices.
Skill	- Classify sources and perform power pairing according to usage requirements - Distinguishing component pins, Led, power poles - Distinguish the ports of the Arduino microcontroller pins, infrared transceiver pins, trigger and delay circuits - Design, assemble and connect components and devices in product circuits - Use tools proficiently such as Voltmeter, Ampere meter, soldering iron - Programming conditions, loops, effects for peripheral devices with Arduino microcontrollers
Quality	- Active in learning, designing and creating products - High spirit of cooperation, willing to listen to the opinions of team members - Be careful and meticulous in experience activities and strictly comply with occupational safety regulations in experiments, practice and research.

Step 5: Build a set of product-oriented questions

Introductory question:

How to prevent Covid 19 from spreading in the community? Why is it important to wash hands? How to wash hands effectively? What are the advantages of automatic hand washing machines in supporting Covid prevention?

To prevent Covid 19, please design and create an automatic hand washing machine to prevent Covid 19?

Lesson oriented questions:

- What components and equipment are needed to create an automatic hand washing machine?
- Why is it necessary to have such components and equipment? Is it designed to be used on what types of power supplies? What scientific principles does each type of device work on? Operating rules of automatic hand washing machine? Please draw the block diagram of the operation and the design table for the manufacture of a hand washing machine to prevent Covid 19?
- What is Covid-19 virus? Its structure, characteristics and transmission to the community?
- List the ingredients and how to prepare hand sanitizer to prevent Covid
- How to program obstacle identification on infrared sensor and solution pump done?

Step 6: Design the process of organizing learning activities.

We organized the iSTEM topic learning activity "Automatic hand washing machine to prevent

Covid 19" for a group of students according to a 7-step technical design process.:

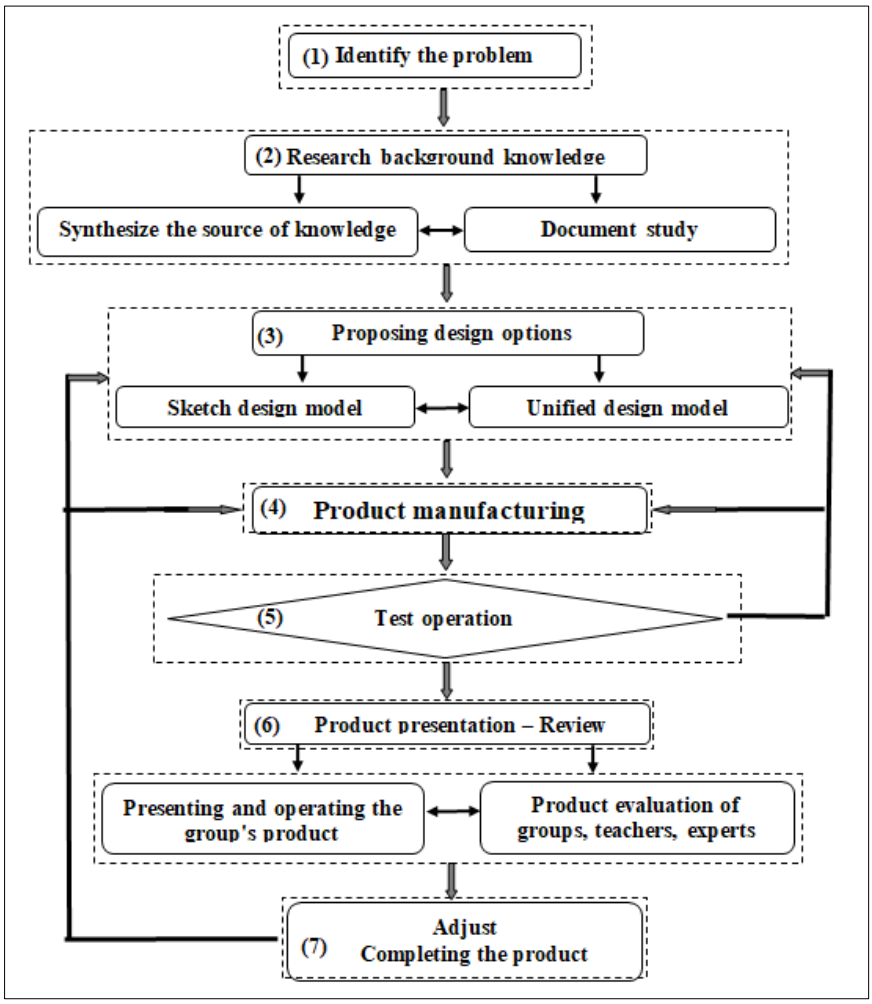


Figure 3: The process of technical design in teaching iSTEM topics proposed by us

Step 7: Design plans and tools to evaluate learning outcomes according to objectives.

In order to evaluate students' abilities in learning iSTEM topics, we implement an evaluation plan (see Table 6).

Table 6: Student evaluation plan in teaching iSTEM topic "Automatic hand washing machine to prevent Covid 19"

No.	Evaluation content	Evaluation tool	Max point		Quality Level			
					M1 (Not qualified)			
NL1	Problem solving and creativity	Product evaluation sheet	100		<40	41÷60	61÷80	81÷100
NL2	Ability to communicate & cooperate	- Evaluation sheet of product presentation about:		30	<15	15÷20	21÷25	26÷30
		+ Layout	5					
		+ Visual	5					
		+ Language	10					
		+ Answer and make questions	10					
NL3	Self-study ability	- Evaluation sheet of product presentation about	50		<21	21÷30	31÷40	41÷50
		+ Content						
NL4	Physical Abilities	- Evaluation sheet of product presentation	100	190	<91	91÷130	131÷160	161÷190
		- Evaluation sheet of product presentation about:						
		+ Physical basis	25x2					
		+ Language	10x2					
		+ Answer questions & make questions	10x2					

2. Pedagogical experiment

Level 3 iSTEM topic "Automatic hand washing machine to prevent Covid 19" was our Pedagogical Experiment at Le Hong Phong High School for the Gifted in Ho Chi Minh City, Vietnam, for students in grade 10 specialized in Informatics, period from 25/4/2022 to 15/5/2022 (the project lasts 3 weeks). Teachers of STEM subjects with content related to Level 3 iSTEM topics make teaching plan together, identify knowledge and skills goals to be integrated, plan teaching, scenarios and worksheets to assess students during the learning process.

Teacher study the scenario in 1 week before teaching and prepares teaching equipment. A group of teachers from Le Hong Phong High School for the Gifted experimented with level 3 STEM topics (full STEM) in subjects such as:

+ Science: Ms. Pham Thi Ngoc Phuong (Physics); Mr. Nguyen Phu Duc (Chemistry); Ms. Nguyen Thi Huong Giang (Biology)
+ Technology: Teacher Dao Thanh Tong
+ Engineering - Informatics: Mr. Nguyen Ngoc Vinh

Teachers can teach directly in class or indirectly through technological means such as Zoom or Google Meet (set up a zalo group to exchange and answer students' questions).

Some pictures of pedagogical experiments for the topic iSTEM level 3 below:

Figure 4: Grade 10 Informatics students are learning to program Arduino microchips

Figure 5: Grade 10 Informatics students are designing and assembling "Automatic hand washing machine"

Figure 6: Students presenting the product "Automatic hand washing machine"

Figure 7: Teachers participating in the evaluation of students' iSTEM products

Figure 8: Product of students after learning iSTEM topic "Automatic hand washing machine"

Hand washing machine products are successfully manufactured by students of Le Hong Phong High School for the Gifted at our school and put into use to participate in epidemic prevention and control in Vietnam in March 2020, the product is widely accepted by society and the community.

Học sinh Lê Hồng Phong làm máy rửa tay tự động tặng cho trường

07/04/2020 18:30 GMT+7

TTO - Ngày 7-4, em Lâm Hoàng Long - học sinh lớp 11CA1, Trường THPT chuyên Lê Hồng Phong, TP.HCM đã lắp đặt máy rửa tay tự động tặng cho ngôi trường mình đang theo học.

- Bệnh viện tự chế máy rửa tay có hệ thống cảm biến tự động
- Châu Bùi quay lại Bệnh viện dã chiến Củ Chi ủng hộ quạt máy, nước rửa tay
- Khách đi máy bay không mang quá 100ml dung dịch rửa tay

Lâm Hoàng Long đang lắp đặt máy rửa tay tự động tại Trường THPT chuyên Lê Hồng Phong - Ảnh: NHƯ HÙNG

MEDIA THỜI SỰ THẾ GIỚI PHÁP LUẬT KINH DOANH CÔNG NGHỆ XE DU LỊCH NHỊP SỐNG TRẺ VĂN HÓA GIẢI TRÍ THỂ

Long cho biết mất 2 tuần mày mò tìm các vật dụng và lắp ráp. "Máy của mình có kích thước nhỏ, gọn. Khi chúng ta đưa tay vào, hệ thống cảm biến hồng ngoại sẽ nhận biết được và tự động phun ra một lượng dung dịch nước sát khuẩn lên tay trong 3 giây.

Hiện mình đang để chế độ mỗi lần như vậy máy sẽ phun ra 1,5ml nước sát khuẩn ở chế độ phun sương. Nếu muốn lượng dung dịch sát khuẩn nhiều hơn hay ít hơn thì có thể điều chỉnh lại".

Lâm Hoàng Long - ngoài cùng bên trái - cùng bạn bè ở Trường THPT chuyên Lê Hồng Phong - Ảnh: NVCC

Cô Trương Thị Lệ Hà, phó hiệu trưởng Trường THPT chuyên Lê Hồng Phong, cho biết: "Lâm Hoàng Long là học sinh lớp chuyên Anh, đồng thời làm chủ nhiệm Câu lạc bộ sáng tạo của Trường Lê Hồng Phong.

Sản phẩm của em rất hữu ích và đã được nhà trường đặt ngay cổng ra vào, thuận tiện cho việc rửa tay khi học sinh quay trở lại trường.

Figure 9: Article of Youth online Vietnam publishes about the product "Automatic hand washing machine" by Lam Hoang Long, a student at Le Hong Phong High School for the Gifted, who supported the fight against Covid 19 in April 2020 [12]

We evaluated students' ability in teaching iSTEM level 3 topic "Automatic hand washing machine to prevent Covid 19" for 4 groups of subjects selected for survey research, each group had 3 students Excellent, Good, Average of pedagogical experiment class with evaluation process and evaluation criteria (See Table 7).

Table 7: Evaluation Process & Data Processing Specification

Step	**Evaluation activities**	**Teacher evaluate**	**Group evaluation** (Peer evaluation)	**Score**
1	Group score (ĐN)	ĐGV = Teacher evaluate score	ĐĐĐ= Average scores of groups that evaluate each other	ĐN= (ĐGVx2 + ĐĐĐ)/3
2	Personal score (ĐCN)	ĐKT= Test scores, questionnaires of each individual	ĐHĐ = Activity scores are evaluated by students in the group + ĐHĐ = 5 (very active and hardworking) + ĐHĐ = 0 (average) + ĐHĐ = -5 (Not so active)	ĐCN= ĐN + ĐHĐ + ĐKT
3	Analyzing data	- Make a list of students to research (randomly select 4 groups, each group select 3 students from 3 subjects in Step 2). - Score each student's ability according to table 6 - Scoring on Ability level		

Results of the evaluation of students' ability in the case study through the experimental teaching of the topic “Automatic hand washing machine to prevent Covid 19” (See table 8).

Table 8: Evaluation of students' ability in teaching the STEM topic “Automatic hand washing machine to prevent Covid 19”

Student group	**Student’s name (Encode)**	**NL1**	**NL2**	**NL3**	**NL4**	**Nn.m** (n) The first index is student group (m) The second index is student m=1 Excellent student (G) m=2 Good student (K) m=3 Average student (TB)
N1	N1.1 (G)	M3	M4	M3	M3	
	N1.2 (K)	M2	M3	M2	M3	
	N1.3 (TB)	M2	M3	M2	M2	
N2	N2.1	M4	M4	M3	M4	
	N2.2	M3	M4	M3	M3	
	N2.3	M3	M4	M3	M3	
N3	N3.1	M3	M4	M4	M3	
	N3.2	M3	M3	M4	M3	
	N3.3	M2	M2	M3	M2	
N4	N4.1	M3	M3	M4	M3	
	N4.2	M2	M2	M3	M3	
	N4.3	M2	M3	M2	M2	

Table 8 clearly shows the ability levels of each student in the group studied through the topic "Automatic hand washing machine to prevent Covid 19". We have determined the students' ability levels from the evaluation of knowledge and practical products presented and reported by students. From the teacher's score board combined with the group's evaluation of each subject's learning process, the group's score and personal evaluation, we evaluate the student's ability levels.

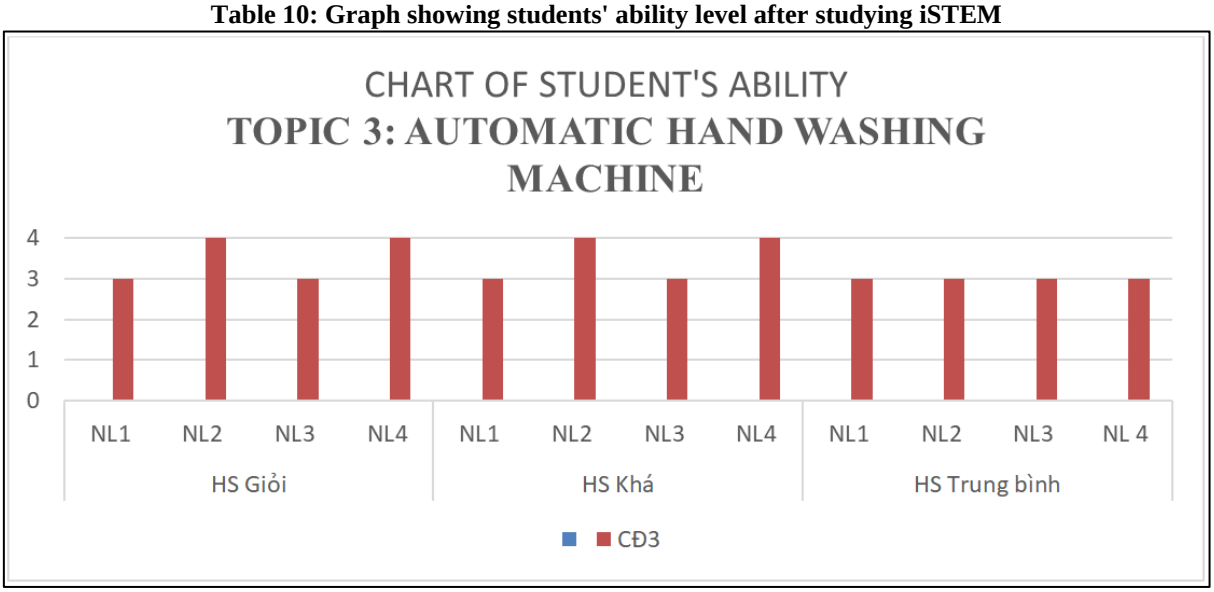
In order to have a general evaluation of the student's ability in the study area, we make Table 9 and a chart showing the students' ability levels (see Table 9).

Table 9: Results of evaluation of students' ability in the research area during and after teaching the topic “Automatic hand washing machine to prevent Covid 19“

Student ability type NL i.j	**Level of achievement**				**Note**
	M1 (none)	**M2 (Qualified)**	**M3 (Good)**	**M4 (Excellent)**	
NL1.1			x		**NL i.j** With **i** encode the ability type (i = 1,2,3,4) i = 1 Problem solving & creativity i = 2 Communication ability i = 3 Self-study ability
NL2.1				x	
NL3.1				x	
NL4.1				x	
NL1.2			x		

Student ability type NL i.j	Level of achievement				Note
	M1 (none)	M2 (Qualified)	M3 (Good)	M4 (Excellent)	
NL2.2				x	i = 4 Physic ability With **j** encode student (j = 1,2,3) j = 1 Excellent student j = 2 Good student j = 3 Average student
NL3.2			x		
NL4.2				x	
NL1.3			x		
NL2.3			x		
NL3.3			x		
NL4.3			x		

Table 10: Graph showing students' ability level after studying iSTEM



Based on Table 9 and the chart showing the student's ability in Table 10, we evaluate that the Excellent, Good, and Average students in the study area have positive development of problem solving skill, communication, cooperation, self-study and Physics ability compared to before implementing the topic.

In the topic of experimental teaching, we evaluated 4 students' abilities according to the criteria in the Rubic evaluation table at levels 1 to 4.

For problems solving ability and creativity, we evaluate through the scores students achieve in 6 standards of practical products to determine the level of competence achieved. The remaining competencies include Communication and Cooperation ability; Physics ability; Self-study ability, we evaluate the ability levels through a combination of product standards (presentation of PowerPoint), thereby drawing conclusions to evaluate students' progress after learning the topic.

Combined with the experimental results of two iSTEM level 1 and level 2 topics in Tables 8 and 9, we will have the development of students' abilities after learning 3 STEM topics by ascending level.

4. CONCLUSION

Level 3 iSTEM topic integrates knowledge and skills of natural sciences (Physics, Chemistry, Biology) in the field of Science with subjects of Technology, Engineering and Mathematics to solve practical problems, bring real value to life. The topic "Automatic hand washing machine to prevent Covid 19" applies the knowledge and skills of all STEM fields in the subjects included in the high school curriculum such as Science: Physics (Power, electrical circuits, Ohm laws, semiconductor components, electric motors, infrared rays, transmission and reception of electromagnetic waves...); Chemical (Ancol, preparation of antiseptic solution...); Student (Virus, Covid 19 ...) Technology (Types of Leds, rectifiers, Arduino microcontrollers, ...), Engineering (skills in using electrical tools, assembling electrical circuits, welding techniques, Arduino microcontroller programming techniques...), Maths (calculating circuit parameters, measuring, drawing pictures, ...).

Six criteria and seven-step process of designing and controlling iSTEM topic were applied to build the topic. In which the product specification sheet, the product evaluation sheet, the presentation evaluation sheet, the student ability evaluate plan are our creative proposals, which can be applied to the development of

plans and assessment tools in teaching other iSTEM topics – a very difficult problem now solved.

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