Building the Electronic Learning Materials to Support Teaching Topics "Materials" and "Energy" in Science 4 According to the 2018 General Education Curriculum

Le Thi Binh[1], Pham Thi Minh Thuy[2]

[1,2]Faculty of Primary Education, Thai Nguyen University of Education

ABSTRACT: The research paper focuses on the design of construction processes and the use of e-learning materials to support teaching and learning topics "Materials" and "Energy" in Science 4. Once we have built and uploaded online lectures to the Internet, teachers and students can utilize them in a flexible manner for classroom instruction or self-learning. In this article, we used the document research method to build a set of electronic learning materials on the topics "Materials" and "Energy" in Science 4. Additionally, it used expert methods to collect feedback from six lecturers at the Thai Nguyen University of Education and 32 primary school teachers. We experimented with a group of 30 students in the 4th grade, and the results showed that the e-learning material that we built helps students improve their autonomy and self-study, encouraging them to learn their prior knowledge at home by studying online lectures on the YouTube channel and questionnaires on the Azota app. Early research results showed that this electronic learning material has helped teachers and students teach and learn Science 4.

KEYWORDS: Science 4, e-learning, online lectures, Material, Energy.

1. INTRODUCTION

E-learning materials play a crucial role in enhancing teaching and learning behaviors by providing interactive resources that cater to learner-centered activities, maximize academic resources, and promote active learning styles. These materials offer flexibility in learning, allowing students to access content anytime and anywhere, reducing cognitive load, and reinforcing instruction through repetition without disrupting schedules [7] [9] [11]. Additionally, e-learning technologies facilitate the blurring of boundaries between traditional face-to-face instruction and online learning, promoting a methodology that combines the strengths of both approaches to enhance the quality of education [2] [8]. By incorporating simple and specific images, animations, audio, and video, e-materials make learning engaging and relaxed, catering to students' cognitive development and prior knowledge to improve attention and motivation, ultimately enabling effective problem-solving and concept formation.

In Vietnam, there are many authors who have researched the application of IT through building learning materials and digitizing documents to improve learners' cognitive abilities and meet the needs of society through digital conversion. Typical examples are: Do Thanh Trung - Nguyen Thi Hoa [1]; Pham Van Vinh [12]; Trinh Le Hong Phuong [6]; and Tran Cong Phong [5]. However, research projects on digital competencies and digital learning materials primarily target students and teachers. This capacity development is primarily applied at the undergraduate and postgraduate levels, with less focus on elementary school students.

In this article, we research and design the process of building and using electronic learning materials to support teaching Science 4 in elementary schools.

2. MATERIALS AND METHODS

2.1. Materials

Lecture system for teaching topics "Materials" and "Energy" in Science 4; electronic learning materials; principles for building electronic learning materials to support Science 4 teaching; We guide the process of creating electronic educational resources for Science 4.

2.2. Methods

2.2.1. Theoretical research methods

Synthesize documents, materials, and research projects relevant to the research topic; The research focuses on developing electronic learning materials to improve Science 4 instruction. We used the MOET's 2018 general education curriculum [10],

Building the Electronic Learning Materials to Support Teaching Topics "Materials" and "Energy" in Science 4 According to the 2018 General Education Curriculum

Science 4 textbooks [3], and the topics "Materials" and "Energy" to construct an electronic learning resource set that will aid in teaching Science subject 4.

2.3. Practical research methods

The practical research process includes two stages, specifically as shown in Table 1:

Table 1. presents the practical research process on the quality of e-learning materials for Science 4's teaching topics "Materials" and "Energy"

Phase	Objects	Total	Content
Phase 1	Education experts	6 education experts	- Use the method of asking for scientific comments and suggestions; multimedia in information transmission; usability (level of conciseness of knowledge, duration of lecture, form of experience, etc.); interactivity; Attractiveness and attractiveness to students;... and the remaining limitations by sending surveys, contacting, and discussing by phone with experts who are lecturers with deep expertise in the field of research and elementary school teachers. - Get feedback from teachers and experts. - Edit, continue to build, and perfect the electronic training system according to plan.
Phase 2	Primary school teachers and 4th grade students	32 primary school teachers); 30 4th grade students	- Upload the built e-learning system to the internet (youtube channel). - We are investigating the quality of the training materials for teaching "Materials" and "Energy" in Science 4 by creating a Google Form survey and distributing it to both teachers and students. Subjects of the questionnaire: 32 teachers from various primary schools in Phu Binh district and Thai Nguyen city, Thai Nguyen province, as well as 30 students from class 4A at Dao Xa primary school in Phu Binh district, Thai Nguyen province, participated in the survey. - Here are the steps to conduct phase 2 testing on the quality of the designed electronic data set: + Step 1: Choose survey subjects. 30 4th grade students; 32 elementary school teachers. + Step 2: Provide the pedagogical survey subjects with a link to the electronic learning materials that have been developed and posted online, along with a survey that gathers teachers' and students' opinions on the quality of these materials. + Step 3: Receive feedback forms from teachers and students. + Step 4: Process the results according to mathematical statistics methods; using Excel software. + Step 5: Evaluate and discuss the results.

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1 Principles for designing electronic learning materials for teaching the topics "Materials" and "Energy" in Science 4

Principle 1: Ensure direction in implementing lesson objectives.

The goal of the developed electronic learning materials is to closely follow the 2018 general education program in science subject. Each lesson's knowledge must be accurate, concise, and provide students with complete basic knowledge. The goals for both the topic and each lesson in the electronic learning materials set need to focus on teaching objectives to develop learners' capacity and qualities.

Principle 2: Ensure accuracy, science, completeness, and conciseness of content.

The system of new knowledge lectures, review lessons, and practice exercises has a clear and coherent structure; the sections are linked and unified, and the content closely follows the Science 4 curriculum, specifically the topics "Materials" and "Energy.".

The words used in the text and videos are easy to understand and scientifically accurate.

The lecture system is presented in detail, but the duration is not too long, focusing on the key knowledge of the topics "substance" and "energy" in Science 4.

A diverse and rich exercise system suitable for students' levels.

Building the Electronic Learning Materials to Support Teaching Topics "Materials" and "Energy" in Science 4 According to the 2018 General Education Curriculum

After each lecture, there is a summary, and after each chapter, there is a synthesis of knowledge to help students remember the knowledge they have learned.

Principle 3: Ensure pedagogy

Lectures, content, and presentation form attract students' attention.

Use specific colors for each chapter, helping students easily distinguish the content of the lesson.

Teaching aids must be suitable for the purpose of teaching and learning Science 4, topics "Materials" and "Energy.".

Principle 4: Ensure aesthetic and scientific presentation

Font, font size, and presentation color are suitable for elementary school students.

Sharp illustrations and videos attract students' attention.

An eye-catching and funny interface helps increase students' interest in learning, helping students easily access lessons and have a sense of self-study, self-exploration, and creativity.

Principle 5: Easy to use on computers or common reading devices

The documentation system and lessons are compatible with most computers, tablets, and smartphones with Internet connections.

Principle 6: Implement branching design

Learning materials are designed to divide students' learning activities into small parts; each part is completed to help students solve a learning problem, avoiding dilution or suffocation of knowledge.

Principle 7: Ensure interactivity

Electronic learning materials provide interactive activities to encourage student participation.

Learning materials need to provide feedback tools, facilitate direct interaction between teachers and students, and provide feedback assessment results to students.

Principle 8: Ensure effectiveness

Learning materials help students fulfill the requirements of each lesson on the topic.

After each lesson, students understand the lesson better and are interested in learning for the next lesson.

Through experiments and extended questions, stimulate students' curiosity and arouse their love and passion for scientific research.

3.1.2. The process of creating electronic learning materials to teach the topics "Materials" and "Energy" in Science 4

3.1.2.1. The process of developing electronic lessons to support the teaching of Science 4

On the basis of the 2018 general education program of Science 4, based on the principle of building electronic learning materials and combining knowledge content in Science 4 textbooks (Canh Dieu book series) , we have designed a set of electronic learning materials, including online lectures, to teach the topics "Materials" and "Energy" in Science 4 according to the 6-step process shown in the following chart:
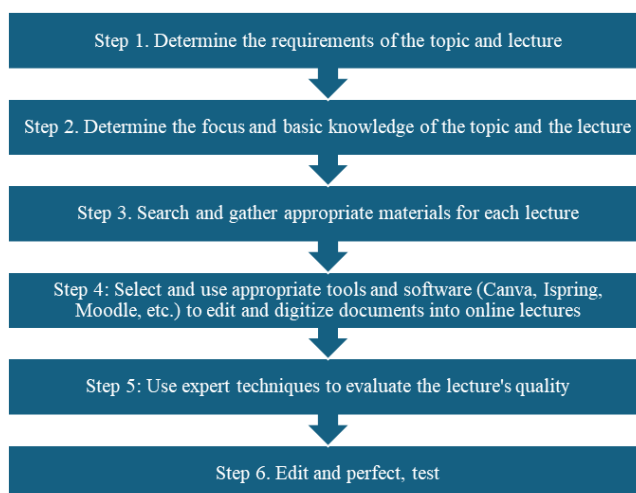
Step 1. Determine the requirements of the topic and lecture

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Step 2. Determine the focus and basic knowledge of the topic and the lecture

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Step 3. Search and gather appropriate materials for each lecture

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Step 4: Select and use appropriate tools and software (Canva, Ispring, Moodle, etc.) to edit and digitize documents into online lectures

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Step 5: Use expert techniques to evaluate the lecture's quality

↓

Step 6. Edit and perfect, test

Chart 1. illustrates the process of creating online lessons for teaching Science 4

3.1.2.2. The process of building digital learning materials for an online lecture system teaching the topics "Materials" and "Energy" in Science 4 on the Canva application platform

Step 1: Determine the requirements of the topic and lecture

Analyze the content flow and requirements to be met for both the topic and each lesson.

Identify scientific competencies, general competencies, and qualities needed after each lesson.

Identify elements suitable for students' cognitive abilities in the lesson.

Example: Designing an electronic lecture for lesson 1. Properties and roles of water

In step 1: Determine the requirements of the lesson, we base it on the 2018 general education Curriculum of Science and the content of Science Textbook 4 of Canh Dieu's book, the article "Properties and Roles of Water," to determine the requirements. The requirements of the lesson are as follows:

Observe and experiment with water to discover its properties.

Apply the properties of water in some simple cases.

Be able to state and make practical connections at home and locally about the application of some properties of water; the role of water in life, production, and daily activities.

Scientific capacity: ability to perceive the properties and roles of water; ability to apply learned knowledge and skills to explain some applications of water properties; The role of water in life, production, and daily activities, such as why roofs are often flat and inclined, materials for making umbrellas, raincoats, rain boots, etc., are made of waterproof materials,.

General capacity: ability to apply IT to learning.

Qualities: Study hard and do exercises to review and consolidate; Study and do homework voluntarily.

Step 2: Determine the focus and basic knowledge of the topic and the lecture

Based on the content of the 2018 general education Curriculum and the content of Science 4 textbooks and Canh Dieu books to determine the focus and basic knowledge of the topics "Material", "Energy" in Science 4 and each lesson.

For example: Key knowledge and basic knowledge of lesson 1. Properties and roles of water are shown in table 2.

Table 2. presents the key knowledge and basic knowledge from lesson 1, which includes the properties and roles of water

Key knowledge and basic knowledge	
Properties of water	*Roles of water*
Water is colorless, odorless, tasteless, and has no definite shape. Water flows from high to low, spreading in all directions. Water can penetrate some objects and dissolve some substances (sugar, salt, vinegar, etc.).	People, animals, and plants will die without water. Water is indispensable in human life, production, and activities.

Step 3: Search and gather appropriate materials for each lecture

Search for necessary videos, images, and documents with clear citations.

Choose a presentation template for each topic, and present each topic appropriately. Lessons within a topic need to be presented in a form that ensures consistency.

Example: Designing an electronic lecture for lesson 1. Properties and roles of water

Step 3: Present, in the form of an electronic lecture video, images and activities of the lesson taken from Canh Dieu Textbook Science 4 and from the website: https://hoc10.vn/doc-book/khoa- study-4/1/393/5. On the website, https://hoc10.vn/, I found the textbook content with necessary images and videos and downloaded images and videos suitable for the lecture.

Step 4: Select and use appropriate tools and software (Canva, Ispring, Moodle, etc.) to edit and digitize documents into online lectures

To build the e-learning kit, we used the main tools, which are Canva, Azota, Youtube, and the applications shown in Figures 1 and 2.
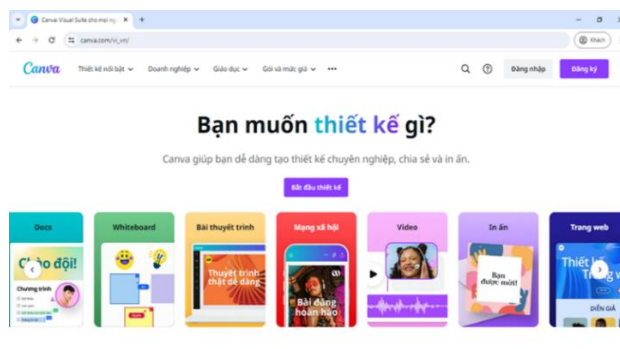

Figure 1. Canva application interface

Building the Electronic Learning Materials to Support Teaching Topics "Materials" and "Energy" in Science 4 According to the 2018 General Education Curriculum
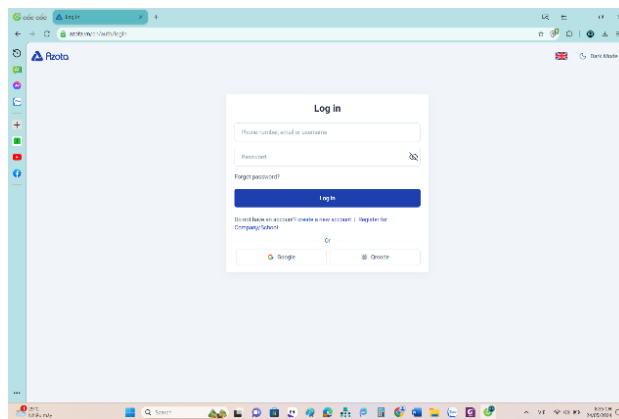

Figure 2. Azota application interface

Develop a scenario to design a video lecture. Synthesize the knowledge that needs to be conveyed in a video. Build a pedagogical script for each video, appropriate for the speed and duration of the video.

Access the Internet and enter the address in the search box: https://www.canva.com/vi_vn/

You can choose to log in via Gmail, Facebook, email, or register for a Canva account.

After logging in, you return to the home page and click "Create Design." The system displays options for you, such as: Docs, Whiteboard, Video, Presentation (16:9),... You choose the format for the type I want to design.

Build the web homepage interface by clicking on Video in the middle of the screen (according to the mouse cursor in the image). Next, in the Video section, you choose the first video type, which is the video format shared by all.

After clicking Video (the first item in the Easy Customizable Video section), you are transferred to a window with the name Untitled Design. You choose a name for the video by typing Untitled Design—Video. Next, in this step, you choose designs according to the suggested templates on the left-hand side of the screen. Additionally, you can also create your own templates using the sections "Element", "Text", "Branding", "Upload", "Draw"... To create the next pages of video, click on the plus sign to the right of the original slide and adjust the slide time to match the length of the narration.

Example: Designing an electronic lecture for lesson 1. Properties and roles of water.

Step 4. Use appropriate software (specifically in the topic of using Canva) to design teaching activities

Access Canva via the link: https://www.canva.com/vi_vn/, log in, and select the product type as video.

Name the video: Lesson 1: Properties and Roles of Water (Part 1).

Then, select the available template in Canva to make the first slide, and edit the lesson title and teacher's name accordingly.
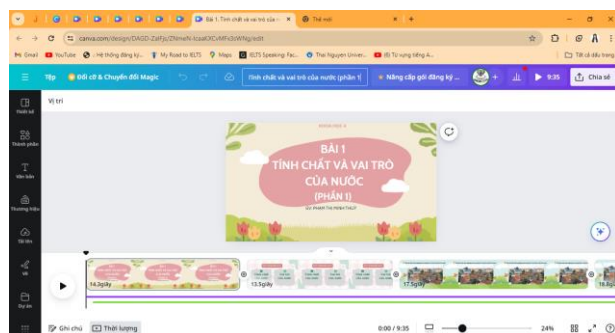

Figure 3. Design interface of the first page of video lesson 1. Properties and roles of water (part 1)
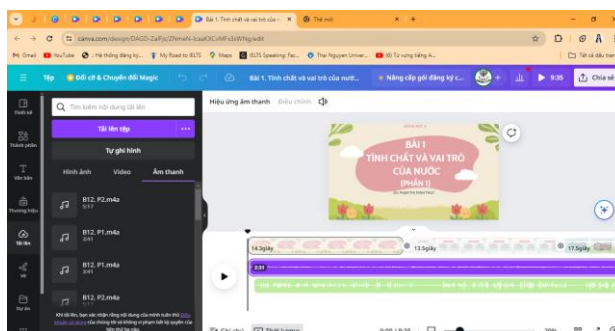

Figure 4. illustrates the integration of the file upload and audio editing interface into the slide pages

Building the Electronic Learning Materials to Support Teaching Topics "Materials" and "Energy" in Science 4 According to the 2018 General Education Curriculum

Next, upload pre-recorded files to introduce the lesson.

Here, use the mouse to move the sound to match the slide pages.

Adjust the file's volume, separate sounds, and insert additional sounds. Here, I use backgrounds music to accompany the lecture. I will represent different audio files with different colors to facilitate easy recognition and distinction.

Next, create more slides and edit the text box content. Move objects accordingly, select text boxes, change the text color, and so on.
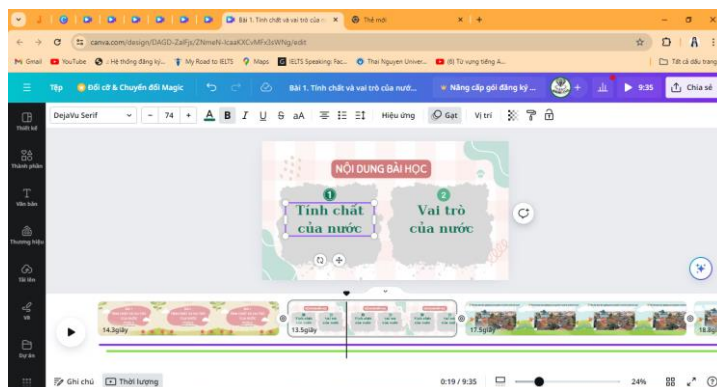
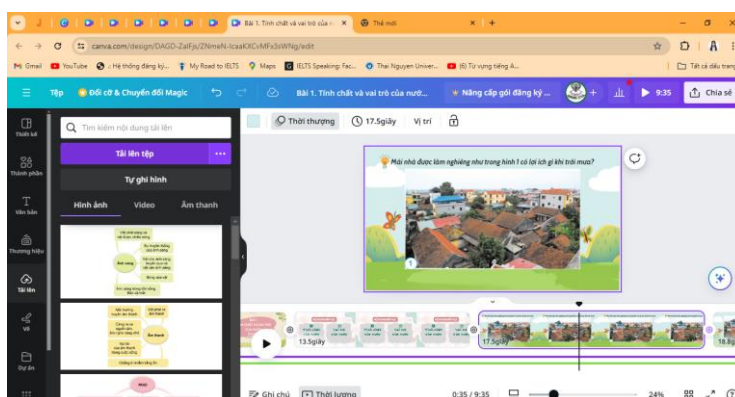**Figure 5. shows the text editing interface on the slide page**

Figure 6. Interface for uploading and selecting files to insert into the slide page

Upload images (from a computer) or copy images from websites (if available). Once the uploaded object is in the upload section, drag the image to the third slide and edit the size and position accordingly.

Complete the slides that correspond to the textbook's next activities. At the end of each article, there is a thank-you slide:
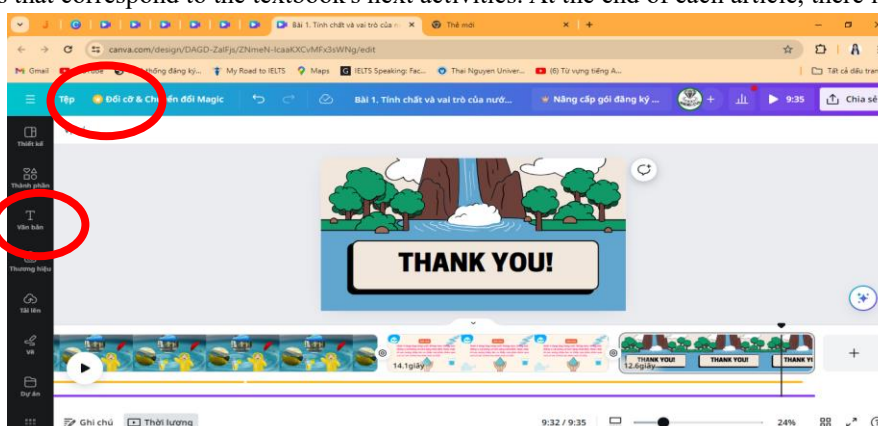

Figure 7. illustrates the interface of the selected slide page to be thanked at the conclusion of the video

Step 5: Use expert techniques to evaluate the lecture's quality

After completing the electronic lecture system, we conducted a survey to ask for expert opinions. Table 3 displays the results of our survey on expert opinions on lesson plans.

Table 3. Displays the survey results from architects' experts regarding the training materials used to teach the topics "Materials" and "Energy" in Science 4

No	Evaluation criteria	Advantage	Weakness
1	Systematic	Basically, the content ensures a logical lesson structure.	Some indexes are inconsistent in font style, font size, and font color.
2	Relevance to teaching goals	Lesson objectives are clear and consistent with the program's requirements.	
3	Scientific	The content ensures scientificity, succinctness, and conciseness.	
4	Interactivity	The level of interaction in lectures is not high, and the review exercises respond well.	You need to increase interaction levels in online lectures.
5	Flexibility (ease of use)	Easy to access and use on a computer or smartphone.	
6	Attractiveness and attractiveness to students	The lecture has high aesthetics, a presentation format, and an engaging voice that attracts students.	It is necessary to reduce the background noise and increase the lecturer's voiceover volume.

Step 6. Edit and perfect, test

Conduct experiments, monitor, and evaluate the effectiveness of video lectures.

Completing the product: After finishing the videos, you download a separate file to your computer for offline documentation or upload it to the social networking site Youtube to watch online.

Example: Designing an electronic lecture for lesson 1. Properties and roles of water

Step 6: Edit and perfect the product.

Before downloading the video, preview the newly designed product to check and review if there are errors during the design process.
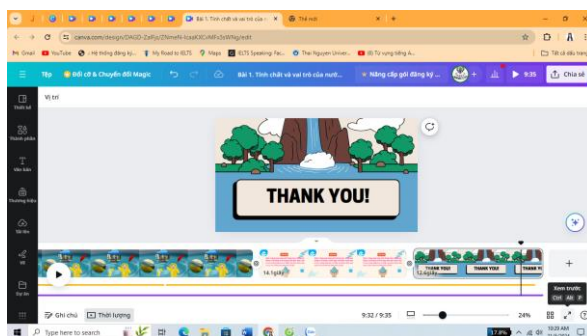

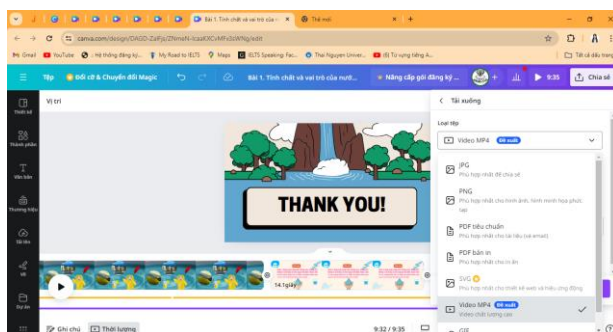**Figure 8. Video preview location after design completion**

Figure 9. The "Share" section interface includes functions related to the newly designed product

Once you've reviewed the product, proceed to download the video. Go to "Share" and select "Download."

In the "Download" section, select the download file type as "MP4 Video" and select all the slides to download.

Building the Electronic Learning Materials to Support Teaching Topics "Materials" and "Energy" in Science 4 According to the 2018 General Education Curriculum

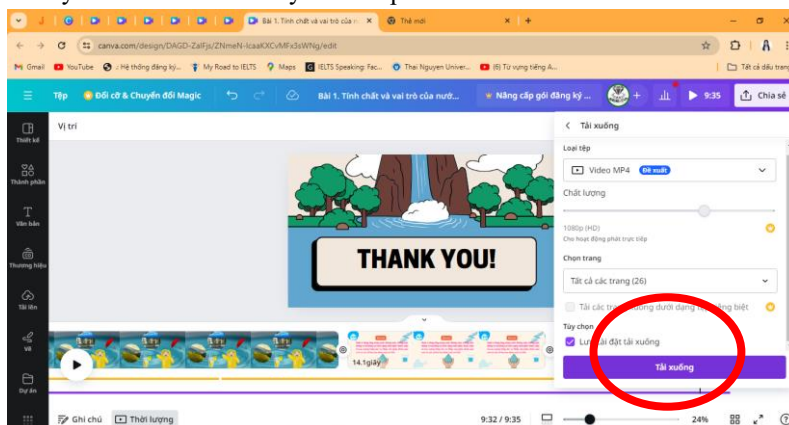Download and save to an easy-to-find location on your computer.

Figure 10. Instructions for downloading the newly designed product

Figure 11. Location to save the downloaded product

Finally, we have the video on my computer. And after having all the video lessons, I uploaded them to YouTube and copied the access link for students to follow.
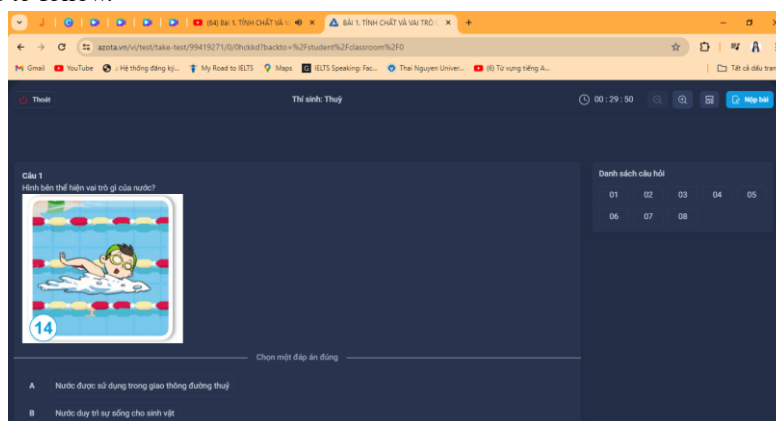

Figure 12 shows the interface of the knowledge consolidation lesson in the Azota software after accessing the link and entering the student's information.

3.1.3 The e-learning materials for teaching "Materials" and "Energy" in Science Subject 4.

The e-learning materials we developed comprise a logical system of lessons covering two topics, "Materials" and "Energy," in Science 4, which align with the distribution of the Canh Dieu textbook program. In each lesson, we separate the content into two corresponding sections to ensure time efficiency and prevent students' health from being negatively impacted by prolonged computer or smartphone screen use. with two videos. Each video lesson is no longer than 15 minutes. At the end of each lesson, to help students remember, review, and apply the lesson's knowledge, we design a system of review and practice lessons, including 11 units of review and practice lessons. Each review and practice unit includes a number of exercises in the form of multiple-choice questions and learning games. After students complete these exercises, there will always be feedback from students and teachers about the results of that assignment.

Building the Electronic Learning Materials to Support Teaching Topics "Materials" and "Energy" in Science 4 According to the 2018 General Education Curriculum

Table 4 illustrates the logical structure of the training materials for teaching the topics "Materials" and "Energy" in Science 4.

Table 4. Structure of electronic learning materials for teaching topics "Materials" and "Energy" in Science 4

Topic "Materials" - The link: https://www.youtube.com/watch?v=6_Qf8vod-hw&list=PL33BRSKenRcXX-ndHOYIrIE7TFHhC3cyl	Topic "Energy" - The link: https://www.youtube.com/watch?v=SltSCd5VwnU&list=PL33BRSKenRcXM44ui80IPYCoTAz1XiABG
Lesson 1: Properties and Roles of Water	Lesson 7. Light transmission
Lesson 2: Water Transformation	Lesson 8: Light in Life
Lesson 3. Protecting water sources and some ways to clean water	Lesson 9: Sound propagation
Lesson 4: The air surrounding us	Lesson 10: Sound in life
Lesson 5: Air movement	Lesson 11: Heat transfer
Lesson 6: The role of air and protecting the air environment	Lesson 12 covers the differences between good and poor thermal conductors
Review topic: Materia	Review topic: Energy

3.2. Discussion

The set of electronic learning materials we built only includes electronic video lectures, review exercises, and practice exercises. To enhance the attractiveness and applicability of our electronic learning materials for teaching the topics "Materials" and "Energy" in Science 4, we need to incorporate a variety of electronic learning materials, including learning games, study sheets...

4. CONCLUSIONS

In order to meet one of the issues of digital transformation in the field of education pointed out in Decision No. 749/QD-TTg of the Prime Minister, "National Digital Transformation Program to 2025, oriented to 2030," [4] it is necessary to transform the content and teaching methods, develop digital competencies for teachers and learners at the same time, and build a set of quality and useful e-learning materials to support teachers and students in teaching and learning the topics "Materials" and "Energy." We carried out the project "Designing electronic learning materials for teaching the topics "Materials" and "Energy" in Science 4."

We have cultivated knowledge about IT applications to design electronic lectures, clearly defining the educational program's goals and content on the topics "Materials" and "Energy" in Science 4, while adhering to the principles involved. Following the 6-step process for designing electronic lectures, we have created a set of electronic lesson plans that include 14 electronic lecture units and 12 review lessons to reinforce the topics "Materials" and "Energy." We have posted this training manual on Youtube with the link https://www.youtube.com/@vuihockhoahoc so that teachers and students can easily access and use it in teaching and learning.

To assess the feasibility of scientific hypotheses or the usability and quality of training materials, we conduct pedagogical tests. Initial pedagogical testing results show that the training materials meet the set criteria and are of good quality. The electronic learning materials set is an effective support tool for teachers and students in teaching and learning the topics "Materials" and "Energy" in Science 4.

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