

Developing a School's Education Plan Based on the Competence-Competence-Oriented Education: A Study on teaching Chemistry for Grade-11 Students at a Vietnamese High School

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Abstract Designing education plans towards the development of students' competences has been considered an important task for high school teachers in Vietnam as for the requirements of the national educational reforms. This paper is aimed to present principles and procedure of designing a school's education plan, particularly some theme-based teaching modules, in teaching Chemistry for grade-11 students in a Vietnamese high school, using competence-based education approach.

Keywords: *grade-11 chemistry, school's education plan, competence-based education, theme-based, integrated, STEM*

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1. Introduction

General Education Program (GEP) plays a very significant role in improving the quality of general education in almost all countries over the world and in Vietnam. GEP is designed based on the economic, political and social context of each country and of the whole world in a particular period of time. Hence, GEP may be fixed in a particular period of time, but frequently renewed and updated for the improvement of the national general education system, meeting new requirements of labor market in the modern society [1,2].

Vietnam's Ministry of Education and Training has issued many official documents on designing school's education plans such as Letter 791, Letter 4612, Letter 3414, or Letter 3089,... [3,4,5,6]. According to these letters, academic departments in each school conduct a review of the teaching contents in the currently used textbooks, from which they make such changes as omitting what is beyond the required knowledge and skills, replacing what is outdated by the newly updated, selecting appropriate teaching contents to design theme-based teaching modules for each subject or for different subjects in combination. Eventually, they make education plans for each subject according to competence-based teaching approach and the school's teaching context [7].

Globally, developing school's education programs has long been discussed. In the late 20th century, the concept of "competencies needed for a healthy life" was used in "Model of Japanese Education in the 21st century". At the beginning of the 21st century, many countries in OECD and in the world put an emphasis on designing their GEPs towards the competence-based teaching approach. There may be differences among these GEPs, but they are all aimed to build up and develop students' essential knowledge and skills for their lifelong learning, their daily life and their future work [2].

Competence-based education has been studied by a number of researchers in the world, who have been working in the field of psychology, philosophy and educational studies. The term "competence", or so-called "competency", has been used for a long time. According to Mulder, Weigel & Collins, the term "competence" was first used in Plato's (Lysis 215 A., 380 BC), and then became popular and interested for research in the 1970s [8]. So far, there have been different perspectives and approaches into this concept. It is differently defined by such individuals or organizations as: OECD (2002) [9], Québec - Ministry of Education (2004) [10], F.E. Weinert [11], Howard Gardner [12], or Tremblay [13], However, they all agreed that competence refers to the ability in synthesizing and applying knowledge, skills and attitudes to perform a certain task in a particular context.

In Vietnam, the GEP released in 2018 is aimed for students' full development with a series of qualities and competences. Hence, competence-based teaching has become a matter of great concern in recent years. In a study conducted by Associate Professor Phuong Thi Lan Nguyen et al, published in the book "*Competence-based teaching program*" [14], the researchers present some aspects of competence-based education; theoretical background and procedures for designing competence-based standards, testing and assessment methods, and examples for competence-based standards as well as testing and assessment used in some high school subjects. Associate Professor Oanh Thi Dang et al [15] also give discuss competence-based teaching with its theories, teaching methods, testing and assessment methods, especially when it is applied to teaching Chemistry for secondary school students.

To sum up, building up a school's education plan, for all educational levels and all subjects in general, and for the subject of Chemistry in particular, is now such an indispensable duty for each teacher in the context of numerous educational reforms towards the trend of developing qualities and competences for high school students in Vietnam.

2. Content

2.1. School's Educational Plan

A *school's education plan* can be defined as plans for educational activities proposed and conducted by educational institutions and organizations based on the local context and their teaching and learning situations. A school's education plan should be based on the education plan designed for each subject or each educational activity.

A *school's education plan* should be associated with educational objectives and the local context. It also needs to have basic elements as listed below:

- a) Educational objectives should be consistent with the school's conditions for quality assurance;
- b) Plans for educational activities in each subject or in the educational program (including educational activities described as integrated, interdisciplinary or localized) should satisfy the requirements of the national general education program and be implemented properly and flexibly based on the institutional and local contexts;
- c) Plans for educational activities in the institution and for teachers and students to take part in social activities, contributing to the community development;
- d) Plans for mobilizing, arranging and utilizing resources for the implementation and quality assurance of the school's education plan;
- e) Special educational activities for special educational institutions [1,16].

2.2. Developing a School's Education Plan for Teaching Grade-11 Chemistry towards the Competence-based Education Approach

2.2.1. Principles

In order to a successful school's education plan for the subject of grade-11 Chemistry towards the competence-

based teaching, it is essential to follow the principles below:

Principle 1: Ensuring the legality

When developing a school's education program, it is inevitable to strictly follow related legal documents. Accordingly, any plan which is officially approved by the competent authority will act as a legal document.

Principle 2: Ensuring the consistency in educational objectives

Developing a school's education plan should be based on educational objectives for the subject of Chemistry as specified in the National General Education Program; designing and conducting teaching and educational activities should be consistent with unique characteristics of the subject - as a subject of natural science - in order to fulfil the objectives stated in the course outline, from which fulfil the objectives of the GEP and ensure the educational quality. It also should meet the objectives of both the national education program and of the school education, as well as be in accordance with the school's conditions for ensuring the quality of the program.

Principle 3: Ensuring the logic of knowledge, the consistency in the contents and the total time duration for each subject, in accordance with the national general education

A school's education plan needs to have a logic of the knowledge so that it helps achieve the objectives of all educational levels. Besides, the total time duration for each subject should be follow the requirements of the GEP. As for the subject of Chemistry, its education plan designed for each educational level can have some changes in the teaching contents, teaching methods, teaching materials, and class time duration, but has to ensure the consistency of the teaching contents and educational activities and the total time duration as prescribed in the GEP. This principle is believed to give flexibility for the implementation of the school's education plan.

Principle 4: Ensuring the teaching quality

Teaching quality is seen as the most important part throughout the education process in each school. Improving the educational quality and teaching quality is always prioritized by each school and by the national education system. Thus, developing a school's education plan for teaching the subject of Chemistry should be aimed for the improvement of teaching quality.

Principle 5: Ensuring the scientificity, updatedness and feasibility

The school's education plan for teaching the subject of Chemistry should be scientific, updated, and practical enough to meet students' learning demands and serve the requirements of the socio-economic development within the country and in the world.

Principle 6: Ensuring pedagogical functions

The school's education plan for teaching the subject of Chemistry must be highly feasible to give teaching contents and teaching time in accordance with students' learning needs and school facilities. It should be focused on the important knowledge and skills as well as the connection with the real-life situations.

2.2.2. Procedure for Developing a School's Education Plan

To develop a school's education plan for grade-11 Chemistry, teachers need to follow the steps below:

Step 1: Analyzing the school's current situation

It is necessary for teachers to conduct a survey and analysis on the school's current situation in order to have a deeper understanding about it before determining the objectives, the structure, the contents and the implementation of the school's education plan.

Step 2: Determining the objectives for the school's education plan in teaching the subject of Chemistry

Based on the objectives stated in the national curriculum of Chemistry and the school's current situation, academic departments identify and specify the objectives of the subject.

Step 3: Developing the contents for the school's education plan in teaching the subject of Chemistry

Academic departments conduct a review on the current syllabus of the subject. Then, in accordance with the school's characteristics, they decide to omit unnecessary items; replace the outdated and inappropriate contents by the most updated ones; select the contents for designing theme-based modules in each subject or in a combination of different subjects; and rearrange the teaching time, or testing and assessment methods to meet the changes in the new school's education plan.

Step 4: Consulting experts about the school's education plan

It is essential to consult experts about the newly-designed school education program, and then make some changes if any before submitting it to the school authority for approval and practical implementation.

Step 5: Implementing the school's education plan after its approval

Implementing the school's education plan as approved by the school authority. During the implementation, it is necessary to strictly follow the teaching objectives, to promote students' active learning, flexibility and creativity and to ensure the teaching quality.

Step 6: Making self-evaluation and adjustments

After the implementation of the school's education plan for the subject, academic departments will make self-evaluation. Based on the strengths and weaknesses of the plan, there should be some adjustments for the better implementation in the next time.

2.2.3. Some Recommendations on Developing a School's Education Plan in Teaching the Subject of Grade-11 Chemistry

2.2.3.1. Applying the theme-based learning

Theme-based learning refers to the ways to explore associated and related concepts, ideas, knowledge, learning contents and themes, and based on the connection of the theories and practice in each subject or among different subjects to make more meaningful and more practical theme-based learning contents. It is for students to work more on their own to find out new knowledge and then apply it into real-life situations [3,17].

In the syllabi of all subjects and that of Chemistry [18], learning contents are established and divided into comparatively complete, specific and independent units of

knowledge, and they are then arranged in a logical order so that it helps to maintain the consistency of each syllabus. This gives help to the "class-lesson" teaching model as well as the unification in the syllabus management and allocation according to the current ordinances. However, this classification can make the learning contents separate from one another, making the knowledge provided to students become patchy and discrete. This can cause difficulties for students to achieve it, and their learning process becomes impractical. Theme-based learning will allow teachers to deal with these problems and improve their teaching quality. Based on results collected from a review on the current syllabus of grade-11 Chemistry in Yen Lac High School located in Vinh Phuc, Vietnam and an analysis of the school's current situation, the group of Chemistry teachers develop a set of learning themes for their classes. The themes can be listed in Table 1.

Table 1. Learning themes for grade-11 Chemistry

No	Learning themes	Time duration
1	Phosphorus and its compounds	2 periods
2	An overview of organic chemistry	4 periods
3	Unsaturated hydrocarbon and life	7 periods

2.2.3.2. Applying the STEM education model

STEM education is an educational model of an interdisciplinary approach, which allows students to use their knowledge of science, technology, engineering and Maths to deal with a real-life situation in a particular social context. STEM education has been applied in many related subjects in the GEP 2018 [19,20,21]. Based on the current situation of Yen Lac High School, we suggest some STEM-based learning themes to be used in teaching grade-11 Chemistry. These themes are listed in Table 2.

Table 2. STEM-based learning themes for grade-11 Chemistry

No	STEM-based learning themes	Time duration
1	Alkane and handmade scented candles	3 periods
2	Soybean yogurt production	2 periods
3	Acid-base reagents made from apple lotus flowers	3 periods
4	Making a dry hand sanitizer	2 periods

2.2.3.3. Applying the integrated and interdisciplinary teaching model

Integrated teaching aims to develop students' ability to select and combine knowledge and skills of different fields to successfully solve the problems arisen in their study and their real lives. This can be found in their learning and practice. Integrated teaching also helps to develop students' essential skills, especially their problem-solving skills. The integration in teaching is shown through the ability to select, combine and relate knowledge and skills of different fields to successfully deal with a problem and achieve different objectives at the same time [3,13]. Based on the current situation of Yen Lac High School, we propose some integrated interdisciplinary learning themes to be used in teaching grade-11 Chemistry. These themes are presented in Table 3.

Table 3. Integrated and interdisciplinary learning themes for grade-11 Chemistry

No	Integrated and interdisciplinary learning themes	Time duration
1	Carbon and some practical problems	3 periods
2	Nitrogen, its compounds and life	4 periods
3	Chemical fertilizers with plants and environmental problems	3 periods

2.2.4. School's Education Plan for Grade-11 Chemistry

Analyzing the current situation of teaching grade-11 Chemistry for high school students:

We conducted a study on developing a school's education plan for teaching grade-11 Chemistry in Yen Lac High School located in Vinh Phuc, Vietnam. The current situation of the school can be illustrated as follows:

Teaching staff of Chemistry: There are 8 teachers in which two hold a master degree and six hold a bachelor degree. They are about 34 years old on average, and have attended training courses of new teaching methods. This gives the school's advantages for its educational reforms.

Students: Yen Lac High School has 320 grade-11 students in total, 85% of whom come from middle-income family and their parents are working as farmers. The

majority of students survey stated that they are not really interested in Chemistry as it has some difficult learning contents.

The school's facilities and resources for teaching Chemistry: Currently, Yen Lac High School has equipped modern equipment needed for teaching and learning in general. However, there are still inadequate facilities for Chemistry teaching, especially a lack of chemicals and experimental equipment.

Educational management staff: Basically, the school's educational management staff have good management skills and teaching skills. They also have relevant experience in educational management, and they give priority to the teaching innovations.

With regard to the currently-used syllabus and textbook of grade-11 Chemistry, directions in the implementation of education plan by Vinh Phuc's Ministry of Education and Training, and the current situation of Yen Lac High School, we, in association with their teaching staff of Chemistry and the school authority, developed a school's education plan for teaching grade-11 Chemistry in the school year of 2019-2020. The contents of the plan can be seen in Table 4.

Table 4. Yen Lac High School's education plan for teaching grade-11 Chemistry

School's education plan for grade-11 Chemistry According to the province's general education plan		School's education plan for grade-11 Chemistry (Particularly used in Yen Lac High School, Vinh Phuc)	
Contents	Total number of periods	Contents	Total number of periods
Introduction	02	Introduction	02
Chapter 1: Electrolysis - Electrolysis - Acid, base and salt - Electrolysis of water. pH. Acid-base indicator - Ion-exchange reactions in an electrolyte solution - Practice: Acid, base and salt - <i>Practice Exercise 1:</i> Acidity and basicity. Ion-exchange reactions in an electrolyte solution - <i>45-minute Test</i>	08	Chapter 1: Electrolysis - Electrolysis - STEM theme: Acid-base reagents made from apple lotus flowers - Ion-exchange reactions in an electrolyte solution - Practice: Acid, base and salt - <i>Practice Exercise 1:</i> Acidity and basicity. Ion-exchange reactions in an electrolyte solution - <i>45-minute Test</i>	01 03 01 01 01
Chapter 2: Nitrogen - Phosphorus Nitrogen - Phosphorus - Nitrogen - Ammonia and ammonium salts - Acidic acid and nitrate salt - Phosphorus - Phosphoric acid and phosphate salts - Chemical fertilizers - Practice: Properties of nitrogen, phosphorus and their compounds - <i>Practice Exercise 2:</i> Properties of nitrogen and phosphorus and their compounds - <i>45-minute Test</i>	12	Chapter 2: Nitrogen - Phosphorus - Integrated theme: Nitrogen - Phosphorus and life - Theme: Phosphorus and its compounds - Theme: Chemical fertilizers with plants and environmental problems - Practice: Properties of nitrogen, phosphorus and their compounds - <i>Practice Exercise 2:</i> Properties of nitrogen and phosphorus and their compounds - <i>45-minute Test</i>	04 02 03 01 01
Chapter 3: Carbon and Silicon - Carbon - Compounds of carbon - Silicon and its compounds - <i>Exercise:</i> Properties of carbon, silicon and their compounds	05	Chapter 3: Carbon and Silicon - Integrated theme: Carbon and some practical problems - Silicon and its compounds - <i>Exercise:</i> Properties of carbon, silicon and their compounds	03 01 01
Chapter 4: An introduction into Organic Chemistry - An introduction into Organic Chemistry - Molecular formula of organic compounds - Molecular structure of organic compounds - <i>Practice:</i> Molecular structure of organic compound - <i>Practice:</i> Organic compounds, their molecular formulas and structural formulas - <i>Revision for Semester 1</i> - <i>End-term Test 1</i>	09	Chapter 4: An introduction into Organic Chemistry - Theme: An overview of Organic Chemistry - <i>Practice:</i> Molecular structure of organic compound - <i>Practice:</i> Organic compounds, their molecular formulas and structural formulas - <i>Revision for Semester 1</i> - <i>End-term Test 1</i>	04 01 01 02 01
Chapter 5: Saturated hydrocarbons - Alkane - <i>Practice:</i> Alkane - <i>Practice Exercise 3:</i> Qualitative elemental analysis. Preparation of Methane and its properties	04	Chapter 5: Saturated hydrocarbons - STEM theme: Alkane and handmade scented candles - <i>Practice Exercise 3:</i> Qualitative elemental analysis. Preparation of Methane and its properties	03 01

School's education plan for grade-11 Chemistry According to the province's general education plan		School's education plan for grade-11 Chemistry (Particularly used in Yen Lac High School, Vinh Phuc)	
Chapter 6: Unsaturated hydrocarbons - Alkene - Alkenedien - <i>Practice:</i> Alkene và Alkanedien - Alkyne - <i>Practice:</i> Alkyne - <i>Practice Exercise 4:</i> Preparation of ethylene and acetylene and their properties - <i>Mini Test</i>	09	Chapter 6: Unsaturated hydrocarbons - Theme: Unsaturated hydrocarbon and life - <i>Practice Exercise 4:</i> Preparation of ethylene and acetylene and their properties - <i>Mini Test</i>	07 01 01
Chapter 7: Aromatic Hydrocarbons - Natural Hydrocarbon Sources - Benzene and its homologues. Some other aromatic hydrocarbons - <i>Practice:</i> Aromatic hydrocarbons	03	Chapter 7: Aromatic Hydrocarbons - Natural Hydrocarbon Sources - Benzene and its homologues. Some other aromatic hydrocarbons - <i>Practice:</i> Aromatic hydrocarbons	02 01
Chapter 8: Derivatives of halogen, alcohol and phenol - Alcohol - Phenol - <i>Practice:</i> Alcohol and phenol - <i>Practice Exercise 5:</i> Properties of ethanol, glycerol and phenol - <i>45-minute Test</i>	07	Chapter 8: Derivatives of halogen, alcohol and phenol - STEM theme: Making dry hand sanitizers - Phenol - <i>Practice:</i> Alcohol and phenol - <i>Practice Exercise 5:</i> Properties of ethanol, glycerol and phenol - <i>45-minute Test</i>	02 01 02 01 01
Chapter 9: Aldehydes - Ketones - Carboxylic acids - Aldehydes - Ketones - Carboxylic acids - <i>Practice:</i> Aldehydes -Ketones - Carboxylic acids - <i>Practice Exercise 6:</i> Properties of aldehydes and carboxylic acids - <i>Revision for Semester 2</i> - <i>End-term Test 2</i>	10	Chapter 9: Aldehydes -Ketones - Carboxylic acids - Aldehydes - Ketones - STEM theme: Production of soybean yogurt - <i>Practice:</i> Aldehydes -Ketones - Carboxylic acids - <i>Practice Exercise 6:</i> Properties of aldehydes and carboxylic acids - <i>Revision for Semester 2</i> - <i>End-term Test 2</i>	02 02 02 01 02 01

2.3. Applying Theme-based Learning in Teaching Grade-11 Chemistry towards the Development of Students' Competences in the School Year 2019-2020

We conducted 9 theme-based lessons (*Acid and base reagents made from apple lotus flowers; Nitrogen, its compounds and life; Phosphorus and its compounds, Chemical fertilizers with plants and soil environment; Carbon and some practical problems; Alkane and handmade scented candles; Unsaturated hydrocarbons and life; Making dry hand sanitizers; and Production of soybean yogurt*) in the school year 2019-2020 at Yen Lac High School, located in Vinh Phuc, Vietnam. Below we present one of theme-based lesson plans, which is "Chemical fertilizers with plants and soil environment".

I. Objectives

* *Students are able to present* the roles of chemical elements for plants; some common chemical fertilizers and their composition, their chemical formulas; principles for evaluating the content of nutritional elements in each fertilizer, including the content of nitrogen, phosphorus, and potassium; the role of each fertilizer with plants; harmful effects of their residues on soil and water environment; solutions to deal with soil environment related problems caused by fertilizer residues.

* *Students are able to explain* factors for proper fertilization; ways of storing each fertilizer; symbols commonly used on the fertilizer packages; causes of soil and water pollution related to the improper use of some chemical fertilizers.

* *Students are able to identify* common types of chemical fertilizers; the content of each nutrient element in each fertilizer; proper use of some types of chemical fertilizers. *They also can develop* their data collection and processing skills; public speaking skills; computer skills and teamwork skills.

* *Students can develop their positive attitudes, specifically:*

- Raising their awareness on environmental protection, propagating to their families and people in their community about environmental protection

- Having a good use of fertilizers in agriculture, understanding their responsibilities for maintaining their personal health and other people's health, for protecting soil environment and water environment.

- Raising their interests in their study in general and in the subject of Chemistry in particular

II. Contents and procedure of applying theme-based learning

1. Contents

The main contents of the theme is presented in Figure 1.

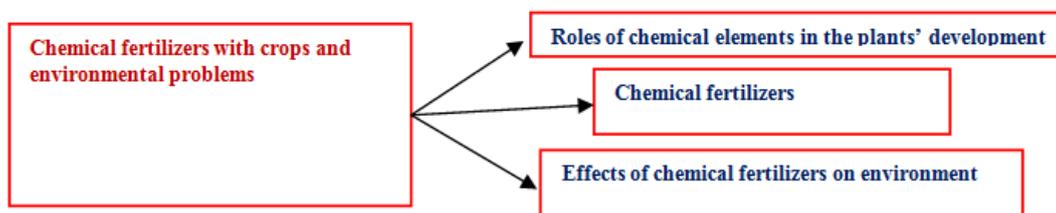


Figure 1. Main contents of the theme: Chemical fertilizers with plants and environmental problems

2. Some questions to be dealt with the theme

No	Contents	Questions to be dealt with	Learning Outcomes
1.	Roles of chemical fertilizers in the plants' development	<ul style="list-style-type: none"> - What are micronutrients and macronutrients in chemical fertilizers? - What are the roles of micronutrients and macronutrients to the development of the plants? - How can plants assimilate nutrients? 	Complete the tasks in the worksheet 1
2.	Chemical fertilizers	<ul style="list-style-type: none"> - What are some common chemical fertilizers? - What are the roles of chemical fertilizers in the development of plants? - What are proper uses of chemical fertilizers for environmental protection? - How can chemical fertilizers be identified and stored? + What are observable properties (color, shape,) of each fertilizer? + What is the solubility of each fertilizer? Based on the features of solubility, how can each fertilizer be stored? + What chemical methods can be used to identify types of fertilizer? 	<ul style="list-style-type: none"> - A report on the group's assignment - Script for the contest "Miss Fertilizer"
3.	Effects of chemical fertilizers on soil and water environments	<ul style="list-style-type: none"> - What is acidic soil, and how can the acidity of the soil be determined? - What are effects of fertilizer residues on water environment? (current situation, problems and solutions) - What are effects of fertilizer residues on the soil environment? (current situation, problems and solutions) 	<ul style="list-style-type: none"> - Pictures, videos about the current use of chemical fertilizers in the local area - Posters about the proper use of chemical fertilizers for increasing the crop productivity and quality but maintaining environmental protection - Reports on project results from 2 groups: Group 1 - Effects of chemical fertilizers on water environment, Group 2 - Effects of chemical fertilizers on soil environment (presented on A₄ paper, or A₀ paper).

3. Time duration for the theme-based learning

The theme-based learning can be conducted in 03 periods in class and 01 period for students' at-home study.

III. Theme-based lesson plans

Period 1

A. Teacher's and students' preparations

1. Teacher's preparations

- Lesson plan, personal laptop, and projector
- Teaching aids: pictures, worksheets, markers, A0 papers and other related teaching aids.
- Read the contents of the lesson "Chemical fertilizers".

B. Learning activities

Activity 1: Warm-up (5 minutes)

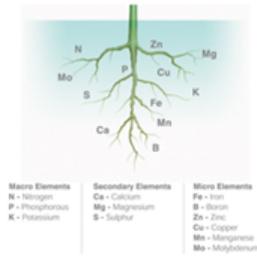
Teacher's activities	Students' activities
<ul style="list-style-type: none"> - Teacher (T) plays a video on what elements a plant needs to grow. - T: <i>Based on what can you see on the video and your previous knowledge, can you name nutrients a plant needs to grow and chemical elements included in these nutrients? If the soil is poor of nutrients, how can it be improved?</i> - T gives comments and feedback. - T: Chemical fertilizers can help improve the crop productivity, from which it can help increase the economic growth for farmers. What are some types of chemical fertilizers? What are their components and effects? How can they be produced and used? 	<ul style="list-style-type: none"> - Students (Ss) watch a video on the screen. - Ss give answers to the questions raised by the T: <ul style="list-style-type: none"> + Nutrients in chemical fertilizers mainly include N, P, K and some trace elements in the form of compounds. + If the soil is poor in nutrients, it needs fertilizers.

Activity 2. Roles of chemical elements in the development of plants (10 minutes)

T's activities	Ss' activities
<ul style="list-style-type: none"> - T divides the class into 4 groups to find out the roles of chemical elements in the development of the crops. T asks each group to recommend a leader and a secretary. - T explains the tasks in Worksheet 1, and asks each group to read the textbook and other sources to complete the tasks in 6 minutes. - T asks each group's representative to report their collected results and other groups to listen, compare and give feedback. - T organizes group discussions and then calls for comments and corrections. - T: <i>Is it true that the more chemical fertilizers are used, the more productive the crops are and the better the soil quality is?</i> - T asks Ss to watch a video about a farmer's improper use of chemical fertilizers, which leads to a decrease in the crop productivity. - T asks Ss to present what they can see. - T instructs Ss to state the problem. 	<ul style="list-style-type: none"> - Ss are divided into groups as instructed by the T. Each group vote for a group leader and a secretary. - Ss work in groups under the control of the group leader, read the textbook and other sources to complete the assigned tasks. - Each group's representative reports the group's collected results - Ss give answer the question (Ss may find the contradiction between what they can see on the video and the roles of chemical fertilizers as previously concluded. This arises a problem on the use of chemical fertilizers for increased crop productivity.) - Ss state the problem: <i>What is the proper use of chemical fertilizers to increase the crop productivity and preserve soil environment?</i>

WORKSHEET 1

Read the textbook. Look at the pictures. Answer the questions below.



The plant is nutritious enough



Plants lack nutrients

Deficiency Chart of Micronutrients

- Boron:** Discoloration of leaf buds. Breaking and dropping of buds
- Calcium:** Plant dark green. Tender leaves pale. Drying starts from the tips. Eventually leaf buds die.
- Sulphur:** Leaves light green. Veins pale green. No spots.
- Iron:** Leaves pale. No spots. Major veins green.
- Manganese:** Leaves pale in color. Veins and venules dark green and reticulated.
- Copper:** Pale pink between the veins. Wilt and drop.
- Zinc:** Leaves pale, narrow and short. Veins dark green. Dark spots on leaves and edges.
- Molybdenum:** Leaves light green/ lemon yellow/orange. Spots on whole leaf except veins. Sticky secretions from under the leaf.
- Magnesium:** Paleness from leaf edges. No spots. Edges have cup shaped folds. Leaves die and drop in extreme deficiency.
- Potassium:** Small spots on the tips, edges of pale leaves. Spots turn rusty. Folds at tips.
- Phosphorus:** Plant short and dark green. In extreme deficiencies turn brown or black. Bronze colour under the leaf.
- Nitrogen:** Stunted growth. Extremely pale color. Upright leaves with light green/yellowish. Appear burnt in extreme deficiency.

THE COLOUR REPRESENTED ARE INDICATIVE. THEY MAY VARY FROM PLANT TO PLANT

1. Name some nutrients needed for the plants (including macronutrients and micronutrients).
2. Present the roles of macronutrients and micronutrients in the development of the plants.
3. Present some indicators to identify a plant that lacks of nutrients.
4. Present ways that a plant can assimilate nutrients and ways to provide needed nutrients when a plant lacks of nutrients
5. It is said that "The more chemical fertilizers are used, the stronger and more productive the plants are". Present your opinion on the statement and give your reasons.

Activity 3. Study different types of chemical fertilizers (30 minutes)

T's activities	Ss' activities
<ul style="list-style-type: none"> - T asks Ss to work in groups to find out solutions to the problem raised in Activity 2. - T asks each group to report and discuss their collected results about the solutions they choose. - T asks Ss to identify the strengths and weaknesses for each solution and choose the best one. - T uses the teaching technique "Jigsaw". T asks Ss to study different types of chemical fertilizers with the steps as listed below: 	<ul style="list-style-type: none"> - Ss discuss in groups and find out solutions. - Each group's representative reports the group's solutions. - Ss select the best solution: Read the learning materials to find out about different types of chemical fertilizers, their uses and their effects on the plants' development. - Ss discuss and propose their implementation of the suggested solution.

Step 1: Class work

- T divides the class into smaller groups and instructs Ss to use the technique "Jigsaw".
- Ss are put in groups as instructed.
- T assigns learning tasks for each group, including Specialized groups and Jigsaw groups.

Round 1: For Specialized group

- Group 1 : Discuss nitrogenous fertilizers;
- Group 2 : Discuss phosphate fertilizers;
- Group 3 : Discuss potassium fertilizers;
- Group 4 : Discuss other types of fertilizers.
- T asks each Specialized group to complete the learning task in 10 minutes, using the questions below:

Learning task for Specialized groups
 Discover different types of chemical fertilizers
 For each type of fertilizer: nitrogenous fertilizers (Group 1), phosphate fertilizers (Group 2), potassium fertilizers (Group 3) and other types of fertilizers (Group 4). Ss answer the following questions:

1. What chemical elements does each type of fertilizer provide for the plants? By what element is the content of the fertilizer calculated?
2. What are the effects of each type of fertilizer? How can it be stored?
3. What are the sub-classification of each fertilizer type and their uses?
4. How can each type of fertilizer be produced?
5. What should be noted when using each type of fertilizer?

Round 2: Jigsaw group

Jigsaw groups discuss and complete the learning task as follow:

White worksheet: Jigsaw learning tasks

Identify the effects that each type of fertilizer has on the development of the plants and on the soil environment

1. What are effects each type of fertilizer has on the development of the plants? List chemical elements of each type of fertilizer.
2. On the package of an NPK fertilizer, there are numbers such as 20. 10. 10, etc. What do these numbers show? Calculate the content of the elements N, P, K in this fertilizer.
3. What are some places in your country that produce fertilizers?

Each Jigsaw group discuss and complete the learning task. Prepare their presentations on A⁰ papers or their slides. Present their results in 10 minutes.

Step 2: Group work (20 minutes)

- T organizes group discussions (to complete the learning task as instructed in Step 1). T observes and gives help if necessary. T controls the time and instructs Ss when they move to another group.

- Ss work in group

Step 3: Discussions (10 minutes)

- T asks each group to show their results for the

learning task in White worksheet on the board, and calls each group's representative to present. Other groups listen and give comments if any. T wraps up and elicits feedback.

- T gives overall comments and feedback to each group.

T plays the slides about the effects each fertilizer has on the development of the plants and on the soil environment as a consolidation.

- If all groups cannot finish their presentations in the allowed time, T can flexibly move their presentations to the next period.

PERIOD 2**Activity 4. The contest "Miss Fertilizer" (15 minutes)**

T's activities	Ss' activities
<ul style="list-style-type: none"> - T introduces about the contest "Miss Fertilizer" and invites Ss to join it. - T explains the rules of the contest, assigns each group to play the role of a Miss Fertilizer and then introduce the fertilizer, its uses and its effects in agriculture to the farmers. - T asks each group to prepare their scripts, assign the role, and rehearse at home. - T selects one S to be the MC of the contest. MC leads the contest by calling each group to play their role. - T asks class members to vote for group's performances by raising their hands. 	<ul style="list-style-type: none"> - Ss take the assigned learning tasks. - Ss listen to the rules of the contest and get ready for the game. - Ss discuss in groups at home, write the scripts and assign the roles. - Some Ss perform. Other Ss see and cheer up. - Ss vote for the best performance by raising their hands.

SCRIPTS FOR THE CONTEST "MISS FERTILIZER"

- **Objectives:** Ss can be able to consolidate their knowledge on different types of fertilizer (nitrogenous, phosphate and potassium) and their uses.

- **Tasks:** Each group discuss and write scripts, consult the teacher, and prepare for their performance.

- **Contents:**

1. Group of Nitrogenous Fertilizer

Preparation: - 01 student plays the role of "Miss Nitrogenous Fertilizer" (Selecting a student with a fair complexion).

- 01 paper hat with the name of the Miss Nitrogenous Fertilizer

- Chemical formulas of ammonium nitrogenous fertilizer (NH₄Cl, (NH₄)₂SO₄, NH₄NO₃, ... nitrate nitrogenous fertilizer (NaNO₃,

Ca (NO₃)₂ ..., Urea (NH₄)₂CO written on A₄ papers.

Script:

- Hi everyone. Let me introduce myself. I'm Nitrogenous Fertilizerrrrrr....My family consists of many siblings, such as NH₄Cl; NaNO₃; or (NH₂)₂CO. It is often said that "**Form is the most important, skin color is the second most important**" when talking about the woman's beauty. All members in my family are tall and have fair complexion Look at me! My skin is **as white as snow**. Everyone loves it.

- In addition to having a good appearance, I am very helpful to the farmers as I help them in increasing their crop productivity (with more seeds, tubers and fruits). I love purple color, I love sweets and I really hate sour food.

- If you intend to become a successful farmer, please **work well** with me.

Thank you all. Please vote for me on the website: NH₄_NO₃.com!

I love You!

2. Group of Phosphate Fertilizer

Preparation: - A student plays the role of Miss Phosphate Fertilizer (Selecting a student with a dark skin color)

- 01 paper hat with the name of the Miss Phosphate Fertilizer

- Chemical formulas of phosphate fertilizers Ca₃(PO₄)₂, (Ca(H₂PO₄)₂ written on A4 papers. (or pictures).

Script:

- Hello guys. I'm a member in the family of chemical fertilizers. My name is Phosphate Fertilizerrrrrr.... Look at me! My skin is quite dark, but it doesn't matter. You know. I am confident with my dark skin. It may look better than the white skin (pointing to Miss Nitrogenous Fertilizer)

- My parents named me after Ca(H₂PO₄)₂. Although I don't look so beautiful, I am extremely helpful to everyone else. It is often said that "**Goodness is better than beauty**". If the farmers want their plants with strong branches, green leaves (raising arms to show the muscles), good seeds and big fruits, just call me.

- Thank you all. Please vote for me on the website: P₂O₅@.com.

3. Group of Potassium Fertilizer

Preparation: - 01 student plays the role of Miss Potassium Fertilizer (Selecting a student with a good form)

- 01 paper had with the name of "Potassium Fertilizer".

Script: Hi everyone. My name is Potassium Fertilizer. People often call me with my Vietnamese nickname "LiliKaka". You know? Humans have to face problems of food security or diseases, and plants do, too. Due to the weather changes, plants become susceptible to different pests and diseases and have slow growth. It matters nothing to me! (showing happy face) I'm here to give plants strength and resistance to survive in the cold or the drought. Believe in me and vote for me at the website Potassium@.com, please!

Activity 5: Conducting learning project (15 - 20 minutes)

Effects of chemical fertilizers on soil environment and human health

General question: What can be done to develop a sustainable agriculture?

T states the problems and raises the question: Agriculture serves as a key economic sector in Vietnam. Our agricultural output is relatively large, but the export market of our agricultural products is still limited due to

the inappropriateness in taking care of crops and lack of modern production methods, especially the abuse of chemical fertilizers. How will the improper use of chemical fertilizers affect human health and the soil environment?

Ss discuss and conduct an analysis on the subject matter: **“Effects of chemical fertilizers on human health and the environment”**.

Learning Task: Suppose that you are an agricultural engineer. Find answers to the following questions:

- | |
|---|
| <ol style="list-style-type: none"> 1. What is the current situation in using chemical fertilizers in your family and in your neighborhood? 2. What is acid soil? How can you determine soil acidity? How can the soil acidity be reduced? 3. What are effect of chemical fertilizer residues on the water environment? 4. What are effect of chemical fertilizer residues on the soil environment? 5. Draw a propaganda poster on the proper use of chemical fertilizers to protect the environment. |
|---|

T's activities	Ss' activities
<ul style="list-style-type: none"> - T instructs Ss to combine their learning projects with real-life situations related to the use of chemical fertilizers, and then brainstorm different learning projects. - Based on Ss' initial ideas, T instructs Ss to projects with highly practical meanings and then choose the project <i>“Effects of chemical fertilizers on human health and the environment.”</i> - T divides the class into 4 groups and asks each group to conduct a learning project. - T asks each group to identify the objectives and contents of their project and make a mind map for the project implementation. - T observes, supervises and gives help to each group in generating the research question, using teaching techniques, searching for data, finding the form and methods of presenting project results. - T asks Ss to discuss and share their project plans. - T wraps up and finalizes criteria for project evaluation. 	<ul style="list-style-type: none"> - Ss discuss, brainstorm and propose some learning projects. (using mindmaps). - Ss discuss again and choose the topic for their learning projects: <i>Effects of chemical fertilizers on human health and the environment”</i> - Ss are put in groups. Each group's leader starts group discussions and leads the group to finish the following learning tasks: <ul style="list-style-type: none"> + Identifying the objectives and contents of the project + Proposing the research question + Completing the mindmap for the project plan. + Consulting the teacher on the project plan. + Assigning work to each group member, clarifying learning tasks and expected project results. - All groups discuss and suggest the criteria for project evaluation. - Each group secretary notes down key points in the discussions.

Activity 6. Conducting the project and completing the products (in a week)

T's activities	Ss' activities
<ul style="list-style-type: none"> - T observes and supervises the process of conducting the group's projects. - T gives advice and help when necessary. T may guide students by giving some questions. - T asks each group's leader to report the progress of the project. T gives feedback and suggestions if any. 	<ul style="list-style-type: none"> - Each group's members follow steps in the project plan and in work assignment. They can contact the teacher when they need advice and consultations. - Each group members collaborate to work on the project by sharing the information and sending their research results to the group leader. - Each group's leader sets up group discussions for collecting, selecting, and analyzing the data collected. They then present the data in figures and tables. - All group members prepare the structure, contents, and illustrations for the group's project report.

Period 3

Activity 7. Reporting the project results (25' -30')

T's activities	Ss' activities
<ul style="list-style-type: none"> - T asks each group to report their project results and discuss. (7-10 minutes for each group) - T gives Ss questions for each group to help them to find the answers to difficult problem or the meaning of their project results. - T acts as the facilitator in groups' discussions and give the final comments. 	<ul style="list-style-type: none"> - Each group's representative reports their project results. Other groups listen and discuss. - Group members helps the presenter by giving illustrations and clarifications. - Other groups raise the questions or give comments if any. - Each group answer questions from the other groups and raise questions for the other groups' presentations. - The secretary notes down the questions and answers.

Activity 8. Evaluating Ss' project results (15 minutes - 20 minutes)

T's activities	Ss' activities
<ul style="list-style-type: none"> - T asks each group to revise, edit and complete their project reports. - T delivers self-evaluation sheet to Ss. - T asks Ss to draw their own conclusions for their learning process with the integrated theme-based learning of <i>“Chemical fertilizers with plants and environment”</i> - T consolidates the lesson and asks Ss to prepare for the next lesson. 	<ul style="list-style-type: none"> - Ss revise, edit and complete their project reports. - Ss conduct peer evaluation and self-evaluation on their products and problem-solving skills. - Ss complete their learning process by selecting needed knowledge and making their own mind map.

3. References Formats

Developing a school's education plan for all subjects in the curriculum in general and for the subject of grade-11 Chemistry in particular towards the development of students' competences is an indispensable task for each Vietnamese teacher. From our own teaching experiences, we developed a school's education plan for teaching Chemistry to grade-11 students in Yen Lac High School. In the school year 2019-2020, we also conducted 09 theme-based teaching modules according to competence-based teaching approach. This is hoped to improve the quality of Chemistry teaching and learning in high schools in Vietnam.

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