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Compilation the Type of Exercise: "Using the Information from the Text" to Improve Reading Comprehension Skill in Teaching Chemistry in English at High School

Cao Cu Giac[1,*], Pham Ngoc Tuan[2]

[1]School of Natural Science Education, Vinh University, Vietnam
[2]Nguyen Thi Minh Khai High School, Ho Chi Minh City, Vietnam
*Corresponding author: giaccc@vinhuni.edu.vn

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Abstract Reading comprehensions skill is one of the basic skills that is cared about the process of teaching and learning foreign languages, especially scientific subjects. Chemistry is one of them. That determines whether the learner understands the content of the text or not, at what level. Improving reading comprehension skills is one of the most important purposes of the study, which helping students to be able to reach suitable content for their level and age by reading books, newspapers, and documents written in English. That helps them to have the opportunity to improve their English skills, especially the English academy. Thereby, students can have habits of learning actively, lifelong learning; practice English academic skills; have confidence in English academic communication and international integration in the future. The paper researches to design the type of exercise: "Using the information from the text" to practice reading comprehension skills in teaching chemistry in English in high school. The paper also focuses on analyzing students' expressions and assessing the level of using chemical reading comprehension skills in English through specific examples of this type, to develop students' skills more effectively.

Keywords: *skill, reading comprehension skill, chemical reading comprehension skill in English, chemical exercise, using the information from the text*

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1. Introduction

Globally, there are now approximately 60 countries and territories that use English as an official language, many of which apply English to teaching natural science in high school such as India, China, Hong Kong, Philippines, Singapore, Ireland, The UK, Wales, Scotland, Canada, Jamaica, The US, Peurto Rico, Liberia, South Africa, Zimbabwe, New Zealand, Australia, Israel, Malaysia, Brunei, Costa Rica, Sri Lanka,...

In the United States, Ms. Cara Hanes, a chemistry teacher at Long Beach Polytechnic Highschool, has designed a teaching method for students to easily approach the chemistry subject, especially students using a second language (English). Her goal is not to create a class full of students with high ability in this field of study but to help students have more experiences in researching natural science successfully, fostering the confidence in students and their general natural science knowledge. This method combines critical thinking, learning process and specially designed academic instruction in English (or SDAIE). This includes several steps: learning the language, writing the chemical formulas and understanding the most important unit of measurement: "mol" [1].

In the Czech Republic, Ostrava university has used a general program mainly for special preparation for Chemistry teacher including teaching this subject in English. This program consists of many academic subjects, psychology, and others to enhance teacher's performance in teaching natural sciences. Moreover, the program focuses on developing student's qualifications as well as the ability to convey chemical knowledge at the high school level and to work efficiently with a suitable method and teaching technique. When graduates, students will be capable of working in environments with a high level of danger; can work with databases and be equipped with good communication skills; can handle practical data; apply technology effectively, and can present work results or teach the subject by the English language [2].

In Austria, in some exams, there are written parts and an oral part. In terms of Chemistry subject, students may have one oral test. They can take the test in several ways (relating to the oral test about chemistry):

- A normal oral test with chemical content (two questions).
- A midterm test (called vertiefende Schwerpunktprüfung), if the chemistry is compulsory (called Wahlpflichtfach).
- An interdisciplinary test (called fächerübergreifende Schwerpunktprüfung) meaning chemistry with another subject such as biology, Physics, Maths,…
- A brand new form of a special test called ergänzende Schwerpunktprüfung (extra test), for example, Chemistry test in English [3].

The Biological Chemistry Department of the Master's Program in Biology, organized by the Faculty of Engineering and Natural Sciences at Johannes Kepler University and the Faculty of Natural Sciences (PRF) at the University of Southern Bohemia in Budweis is an interdisciplinary combination of studies in chemistry, biochemistry, biology, and physiology. This bilingual program is offered in English, trains students to gain skills and expertise in a multidisciplinary field, as well as to learn more about international academic communication and international academic research [4].

Researches on the current situation of teaching chemistry in English in high schools in Vietnam show that teaching chemistry in English plays an important role in seeking new knowledge and training the ability to use English, in which exercises to practice reading comprehension skills in English play a key role. Many studies of some authors in the document [5,6,7] have mentioned the problem of teaching chemistry in English, but have not considered using specialized exercises to practice chemistry English reading comprehension skills as well as not yet given the set of criteria to assess the level of using English reading comprehension skills of students. Therefore, we refer to the content of the article: "Designing Chemistry exercises in English, using the information from the text to improve English reading comprehension skills in teaching chemistry in high school"

2. Research Content

2.1. Overview of English Reading Comprehension Skills

When learning any language, reading skill always plays a vital role besides improving communication skills because it helps vocabulary become richer and more vivid. According to author Langer, a lecturer working at the College of Education at Columbia University (USA), readers with different personal knowledge foundation backgrounds will bring different thoughts, images, imagination about the same text. Therefore, the more a person's background knowledge is connected to the text being read, the more likely the reader is aware of what is being read [8]. The reader may not need to use the dictionary and guess the meaning of the new word in the context of the whole article. In this way, not only will we learn vocabulary but also how to use them in specific contexts. Besides, the article is a rich source of material for forging necessary language skills such as listening, speaking and writing.

2.2. English Reading Comprehension Skills in Teaching Chemistry

When reading scholarly documents, understanding the content will be very restricted and difficult for the following reasons: (1) new words or technical terms; (2) Complicated grammatical structure; (3) Paragraphs with hard-to-decipher information (4) Confusing ways of writing; ... The challenge posed by chemical lexicon with both scientific and everyday meanings is the subject of many authors' studies, such as the works of the Author in the document [9,10,11]. The author Youngjin Song, lecturer of Northern Colorado University (USA) and Shannon Carheden, a teacher at Coal Ridge High School (USA) have conducted qualitative research, investigating how college students understand dual meaning vocabulary (Dual Meaning Vocabulary (DMV) selected before and after teaching Chemistry [12]. They learned that: (i) before teaching, most students defined a term DMV with its daily meaning; (ii) after teaching, the retention of the scientific meanings of the words DMV was very poor and (iii) the lack of scientific meaning was attributed to infrequent use, study habits and unknown terminology [13]. Developing the Chemistry comprehension skills in English will help students to correctly understand the lessons/subjects written in the English language with the contents suitable to the level and age of the students, thereby improving specialized English proficiency [14].

2.3. Chemistry Exercises in English, Using the Information from the Text

Exercises taking information from exam data is a form of high-level practice exercises, in which students must answer questions in many different forms (essay questions, multiple-choice questions) relating to a paragraph with chemical content. This form of exercises is designed to test and evaluate the basic skills needed in effective reading comprehension: the ability to understand the meaning of words; to apply vocabulary in specific contexts; general ability to understand the meaning, main content of a reading; ability to deduce other facts from reading content based on existing knowledge,…

2.4. The Principles of Designing Chemistry Exercises in English, Using the Information from the Text

Based on researching the purpose and necessary skills when understanding Chemistry by English, we propose some principles of building exercises getting information from the given data in English as follows:

- Assure the science, accuracy of the chemical content.
- Reinforce, enhance and test the technical skills and knowledge according to the standard of knowledge and skills.
- Enrich student’s chemical vocabulary and terms in English.
- Practice analyzing the grammatical structure of sentences, deducting and predicting to understand the meaning of the English content in the right way.
- Develop the skills to read and understand the contents of Chemistry in English.

2.5. The Method to do Chemistry Exercises in English, Using the Information from the Text

For students to do chemistry exercises in English, using the information from the text, we propose the following steps:

- Skim the whole paragraph. Pay attention to the headings, topic sentences, or summary sentences to identify or deduce the main ideas and important information of the text.
- Carefully re-read the paragraph to find out the data relating to the questions.
- Transform the headings, topic sentences into questions and find ways to answer them.
- Predict the meaning of new words based on known knowledge or from clues and data contained in the text.
- Clarify vague information.
- Take a brief, careful note of the text with keywords, diagrams, reactions, phenomena in your way.
- Answer the easiest questions, within your ability that you are confident that the right answer.
- Check carefully before deciding the final answer.

2.6. A Set of Tools to Assess the Level of Chemistry Reading Comprehension Skills in English

In the article, we propose an evaluating level scale of proficiency in reading comprehension skills of students in learning chemistry in English in high school, by completing the chemistry exercises in English, using the information from the text. The rating levels of criteria in each skill are arranged in ascending order from 1 to 6 (1 is the lowest level; 6 is the highest level) according to the improved Bloom classification scale, proposed by Anderson and colleagues [15]. The rating levels in each criterion of skill are arranged in ascending order from 1 to 5 (1 is the lowest level; 5 is the highest level): (1) not performed; (2) partially performed but incorrectly; (3) performed completely but incorrect; (4) performed correctly but incompletely; (5) performed correctly and completely.

Skill	Criteria of skill	Level of skill				
		1	2	3	4	5
1. Summarizing and Synthesizing	1.1. Remember the primary keywords in the chemical text.					
	1.2. Identify the main content in the chemical text.					
	1.3. Illustrate each of the main contents in the chemical text with diagrams, images, pictures,...					
	1.4. Outline the text by basing on the main content (according to the section or chapter or...).					
	1.5. Determine persuasive and easy to remember chemical concepts, reactions, phenomena,... to illustrate the main content in the chemical text.					
	1.6. Compose, illustrate and present the main content of the chemical readings with evidence, examples, phenomena, reactions,... in your way.					
2. Goal Setting and Planning	2.1. List the purposes after reading a chemical text.					
	2.2. Research specific goals to be able to achieve the goal specified for a chemical test.					
	2.3. Sort goals in order of precedence according to the chemical content of the text.					
	2.4. Outline the plan after reading a chemical text.					
	2.5. Prioritize the tasks in the plan in order of precedence based on the chemical content of the text.					
	2.6. Evaluate the results achieved after doing the plan related to the chemical content of the text.					
3. Determining What's Important and Evaluating	3.1. List the main contents of the chemical test.					
	3.2. Explain the main chemical contents which are available in the text.					
	3.3. Demonstrate the main chemical content that is available in the text with reactions, phenomena,...					
	3.4. Relate information, chemical contents which are available in the text to known knowledge, phenomena in life,...					
	3.5. Evaluate chemical information, facts, equations, phenomena,... that are important and to make the reader think of the message to convey.					
	3.6. Inferring messages that relate to the chemical content of the text need to send to the readers.					
4. Monitoring and Clarifying	4.1. Define the unknown chemical information, phenomena, reactions,...					
	4.2. Describe the unknown chemical information, phenomena, reactions,...in your way (pictures, diagrams,...).					
	4.3. Pause reading to find out, explain the unknown information, concepts, reactions, phenomena,...					
	4.4. Interpret unknown information, chemical problems in the text by other information in the text.					
	4.5. Decide to read slowly or quickly or reread the unknown chemical information in the text.					
	4.6. Create questions relating to chemical content, new concepts, new reactions, strange phenomena,... of the text to make sure that you controlled the information of the text and clarify the unknown information.					
5. Skimming	5.1. Underline important keywords, chemical terminology, chemical content in each paragraph, in the text.					
	5.2. Give examples, chemical phenomena, reactions,... to illustrate important keywords, content to understand the keywords, that content surely.					
	5.3. Self-Practice of using important keywords, chemical terminology, chemical content.					
	5.4. Classify of keywords, chemical terminology, sentences, snippets that have similar chemical content or relate to each other.					
	5.5. The debate on the chemical content can be obtained as the main content of the text.					
	5.6. Give the main content of the text in a concise manner involving a chemical problem.					

2.7. Chemistry Exercises in English, Using the Information from the Text to Improve Reading Comprehension Skills

This type of exercise is designed to test and evaluate the basic skills needed for effective reading to understand the meaning of words; ability to understand the meaning and apply vocabulary in specific contexts; general ability to understand the meaning, main content of a reading; ability to deduce other facts from content readings based on existing knowledge.

Example 1. Read the passage and answer the questions below:

An electron-dot structure is a type of diagram used to keep track of valence electrons. Electrons in the highest principal energy level of an atom are called valence electrons. Electron-dot structures are especially helpful when used to illustrate the formation of chemical bonds. Unreactive noble gases have electron configurations that have a full outermost energy level. This level is filled with two electrons for helium ($1s^2$) and eight electrons for the other noble gases (ns^2np^6). Elements tend to react to acquire the stable electron structure of a noble gas.

A positive ion forms when an atom loses one or more valence electrons to attain a noble gas configuration. A positively charged ion is called a cation. Metals atoms are reactive because they lose valence electrons easily. Nonmetals, which are located on the right side of the periodic table, easily gain electrons to attain a stable outer electron configuration. An anion is a negatively charged ion. To designate an anion, the ending *-ide* is added to the root name of the element.

Oppositely charged ions attract each other, forming electrically neutral ionic compounds. During the reaction, a sodium atom transfers its valence electron to a chlorine atom and becomes a positive ion. The chlorine atom accepts the electron into its outer energy level and becomes a negative ion. The oppositely charged ions attract each other, forming the compound sodium chloride. The electrostatic force that holds oppositely charged particles together in an ionic compound is referred to as an ionic bond. Compounds that contain ionic bonds are ionic. The charge of a monatomic ion is known as its oxidation number or oxidation state. The oxidation number of an element in an ionic compound equals the number of electrons transferred from the atom to form the ion. The ionic compounds have high melting points and high boiling points.

Questions

1. A characteristic of a cation is that:

A. The number of neutrons is related to the number of electrons

B. It has fewer electrons than protons

C. It has equal numbers of electrons and protons

D. It has fewer protons than electrons

2. Which statement is NOT correct?

A. Cations and anions combine in the simplest ratio which results in electrical neutrality

B. The number of electrons lost by the cation equals the number of electrons gained by the anion in an ionic compound

C. Ionic compounds may contain one metal and one halogen

D. Formulas of ionic compounds are written with the anion first, followed by the cation

3. Explain with the help of (i) atomic or orbital structural diagram (ii) electron dot diagram, for the formation of the following: Sodium chloride.

4. Answer the questions below:

a) Why do elements form ions in certain chemical reactions?

b) What kind of elements form positively charged ions? Support your answer with two examples.

c) What kind of elements form negatively charged ions? Support your answer with two examples.

5. Fill in the blank spaces with appropriate words.

a) Sodium chloride is an ionic compound formed as a result of a transfer of …… valence electron from metallic sodium to a non-metallic chlorine atom.

b) Calcium oxide is an ionic compound formed as a result of a transfer of …… valence electrons from metallic calcium to non-metallic oxygen atom.

c) Magnesium chloride is an ionic compound formed as a result of the transfer of …… valence electrons from metallic magnesium to …… atoms of non-metallic chlorine.

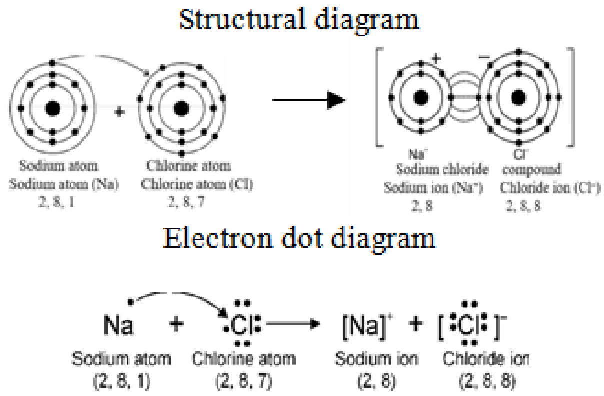
6. Sodium oxide [Na_2O] contains ionic bonding. Write down the formulae of ions in sodium oxide. What changes in electron arrangement occur when these ions are formed from sodium and oxygen atoms? What type of force hold these ions together?

Assessing the level of chemistry reading comprehension skills in English regarding skill 1 "***Summarizing and synthesizing***":

Criterion 1: Students need to remember the main keywords in the reading: A positive ion forms, lose, one or more valence electrons, positively charged ion, a cation, ... From there, students can deduce that the number of electrons in the ion will be less than that of protons and choose the answer B for question 1.

Criterion 2: Students can identify the main contents in the reading namely: electron formula, ion formation, ion bond formation then select the content that is not in the text, so the correct answer is D for question 2.

Criterion 3: Students can illustrate the ion formation in the NaCl compound by given diagrams.



Criterion 4: Students can outline, grasp the main content of the text to answer question 4:

(a) Except for noble gases that have eight electrons in their valence shells (He has 2 electrons) and are in the minimum state of energy, all other elements have one to seven electrons in their valence shells. Thus, to attain a state in which they have minimum energy, they either lose or gain electrons, so that their valence shell has eight electrons. However, in doing so their positive and negative charges get unbalanced and hence they form charged ions.

(b) Metals form positively charged ions.

$Na \rightarrow Na^{+} + 1e$

$Mg \rightarrow Mg^{2+} + 2e$

(c) Non-metals form negatively charged ions.

$Cl + e- \rightarrow Cl^{-}$

$S + 2e- \rightarrow S^{2-}$

Criterion 5: Students can identify the concepts, mechanisms… to illustrate the main content in the reading text such as the definition of ion, the mechanism of the formation of ion bonds, octet rule… from which students can decide the question: (a) one, (b) two, (c) two, two.

Criterion 6: Students can draft, illustrate and present the main contents of the reading, that is, the explanation of the formation of ion bonds by diagrams or drawings of illustration reactions, ... to answer question 6:

The sodium oxide contains the following ions:

(1) Two sodium ions, each having a unit positive charge, i.e., $2Na^{+}$.

(2) One oxide ion, having 2-units negative charge, i.e., O^{2-}.

The sodium atom has an electronic configuration (2, 8, 1). It loses one electron from its valence shell to have a stable electronic configuration (2, 8) like that of the neon gas.

$Na \rightarrow Na^{+} + e^{-}$

(2, 8, 1) (2, 8) [Neon-like configuration]

Sodium atom sodium ion

The oxygen atom has an electronic configuration (2, 6). It accepts two electrons in its valence shell to have a stable electronic configuration (2, 8) like that of the neon gas.

$O + 2e^{-} \rightarrow O^{2-}$

(2, 6) (2, 8)[Neon-like configuration]

Oxygen atom oxide ion

Example 2. Read the passage and answer the questions below:

Certain compounds called indicators to show a definite color change when they are mixed with an acid. Litmus paper, a commonly used indicator, changes from blue to red in an acid solution. Another indicator is phenolphthalein. This liquid is colorless in an acid solution.

Cabbage Indicator

Purpose

In this activity, you will remove an indicator from red cabbage. An indicator belongs to a special group of compounds that changes color when added to acidic or basic solutions. You will use the cabbage indicator to measure the acidity of various substances.

Materials *(per group)*

Red cabbage leaves	Distilled water
Flat-bottomed dish	Clear soft drink
Small beaker	9 test tubes
Bunsen burner	Litmus paper
Vinegar	Tripod
Grapefruit juice	Wire gauze
Milk	Stirring rod
Shampoo	Oven mitten
Drain cleaner	Safety goggles
10-mL graduated cylinder	
Ammonia cleaning solution	

Procedure

1. Tear four leaves of red cabbage into small pieces and place them in a flat-bottomed dish. Using the bottom of the beaker, gently squash the leaves. Then put the leaves and any juice into the small beaker. Add water to the beaker so that the leaves are covered.
2. Place the wire gauze and then the beaker on the tripod. Position the Bunsen burner beneath the beaker and light it. **CAUTION:** *Be careful when lighting and using a Bunsen burner. Wear your safety goggles for the remainder of this activity*.
3. Boil the cabbage-water mixture until the liquid portion gets very dark. Wearing an oven mitten, carefully pour the liquid into a test tube. **CAUTION:** *Be extremely careful. The liquid being poured is hot*.
4. Place 3 mL of each of the following in separate, labeled test tubes: vinegar, grapefruit juice, ammonia cleaning solution, milk, shampoo, drain cleaner, clear soft drink. Be sure to rinse the graduated cylinder every time you pour out a different solution. **CAUTION:** *Do not drink any of these liquids. Some are poisonous*.

To each test tube's contents add 2 ml of the liquid from the cabbage solution. Stir with a stirring rod and note the color changes. The cabbage liquid will turn bright red in most acids and blue-purple in the presence of most basic solutions. Record the results of each experiment in a table that has the headings Solution, Color, and Acid/Base.

Questions

1. What is the purpose of the laboratory activity?
2. What does an acid/base indicator do?
3. Why is it important to wear an oven mitten?
4. Why is it important to wear safety goggles?
5. Why should you not taste or drink any of the liquids?
6. What color change takes place when:
   a) Sulfuric acid is added to litmus paper?
   b) Sodium hydroxide is added to the phenolphthalein solution?
   c) Sodium carbonate is added to the phenolphthalein solution?
   d) Zinc chloride is added to litmus paper?
   e) Sodium chloride is added to litmus paper?
   f) Potassium hydroxide is added to litmus paper?
7. What color change takes place when:
   a. Lemon juice is added to the water spinach solution?
   b. Lemon juice is added to tea?
8. What did you find out about the red cabbage solution?
9. What color change takes place when an acid is added to the red cabbage mixture?
10. What color change takes place when a base is added to the red cabbage mixture?
11. Why did you use other indicators?
12. Can you use the red cabbage mixture as an indicator to test for acids and bases?
13. Why did they use cabbage the red cabbage mixture as an indicator instead of another chemical?
14. What are your purposes after reading the text?
15. What are your specific goals to achieve the purposes after reading the text?
16. Sort goals in order of precedence according to the chemical content of the text.

17. Outline the plan after reading a chemical text.
18. Prioritize the tasks in the plan in order of precedence based on the chemical content of the text.
19. You evaluate yourself of results achieved after doing the plan related to the chemical content of the text.

Assessing the level of chemistry reading comprehension skills in English regarding skill 2 "Determining What's Important and Evaluating":

Criterion 1: Students need to identify the main contents of the text to answer questions 1 and 2:

+ Answer to question 1: To use red cabbage as an indicator to test for acids and bases.

+ Answer to question 2: In the presence of an acid or a base, the indicator changes from one color to another.

Criterion 2: Students need to explain some important chemical contents in the test, specifically in question 3, 4, 5 relating to safety in the labs, then answering those questions:

+ Answer to question 3: To protect the hand from the hot liquid.

+ Answer to question 4: To protect the eyes from any hot liquids, acids, and bases that may splatter.

+ Answer to question 5: Some may be poisonous.

Criterion 3: Students demonstrate the main Chemistry content in the reading by reaction equations, phenomena, etc., specifically here is the color shift of color indicator, through answering the question 6(a) red; (b) pink; (c) pink; (d) red; (e) no change; (f) blue.

Criterion 4: Students relate the chemistry-related information in the reading to known knowledge, phenomena in life, ... Specifically in this question, students have to observe and remember the common phenomenon of color change in real life: when squeezing lemon juice into morning glory or tea to answer question 7: (a) it changed to red; (b) it changed to golden

Criterion 5: Students evaluate important information, data, reaction equations, phenomena, ... that reminds readers of the message they want to convey, specifically in this exercise, the color change of a purple cabbage juice in the presence of acid or base solutions. Thereby, students will answer questions 8, 9, 10 and 11 as follows:

+ Answer to question 8: Red cabbage solution is an indicator of acids and bases.

+ Answer to question 9: It changed from purple to bright red.

+ Answer to question 10: No change.

+ Answer to question 11: To confirm the results of the red cabbage indicator.

Criterion 6: Students can deduce the message relating to the content of the text sent to the readers to answer questions 12 and 13, which is related to the use of purple cabbage solution as an indicator of acid, base color:

+ Answer to question 12: Yes, we do.

+ Answer to question 13: Safe, unpolluted, economical, a material found in life easily.

Assessing the level of chemistry reading comprehension skills in English regarding skill 3 "Goals setting and Planning":

Criterion 1: Students list the goals after reading a text with chemical content, answering question 14: Prepare other natural indicator solution.

Criterion 2: Students study-specific goals to achieve the set goals to answer question 15, which may be: Find out the natural materials in life, economical, safe, unpolluted, compound making the color change, procedure.

Criterion 3: Students arrange the goas in order according to the content of the text, then answer question 16.

1. Research compound making the color change.
2. Research to find out the natural, unpolluted, safe, economical materials in life.
3. Research procedure.

Criterion 4: Students map out the plan to solve the question 17 after reading the text. Answer example:

1. Choose natural material containing compounds making the color change.
2. Research document writing about compounds making the color change, physical and chemical properties of them, influencing factors.
3. Research the color change takes place when adding an acid or base.
4. Design the procedure to extract those compounds with a suitable solvent

Criterion 5: Students map out the plan to solve the question 18 after reading the text:

1. Research document writing about compounds making the color change, physical and chemical properties of them, influencing factors
2. Choose natural material containing compounds making the color change
3. Design the procedure to extract those compounds with a suitable solvent
4. Research the color change takes place when adding an acid or base

Criterion 6: Students self-classify and evaluate the achieved results after performing the tasks relating to the content of the readings in the proposed plan:

1. Research document writing about: compounds making the color change, physical and chemical properties of them, influencing factors:
   + Compounds making a color change: anthocyanin.
   + Physical and chemical properties of anthocyanin.
   + Influencing factors: temperature, light, oxygen, pH.
2. Choose natural material containing compounds making the color change: tea or rose, …
3. Design the procedure to extract those compounds with suitable solvent: water, ethanol, water-ethanol (1:1)
4. Research the color change takes place when adding an acid or base: have changes

Evaluate: Successful or unsuccessful

Example 3. Read the passage and answer the questions below

Ionization energy, as its name suggests, is the energy needed to remove an electron from an atom and form an ion. It takes a lot of energy to remove electrons from the very stable octets of the noble gases. First ionization energies generally increase as you move from left to right across a period. First ionization energies generally decrease as you move down a group. Which is expected to have greater ionization energy, Ca or Br? But we can see in nitrogen which has a first ionization of 1402 kJ/mol, and oxygen, which has a first ionization of 1314 kJ/mol.

The atomic radius of an atom can be defined as the distance from its nucleus to the outermost electron of that atom. Atomic size is a periodic trend influenced by electron configuration. As you go down a group, the radius of the atoms will increase as the atoms fill more principle energy levels with electrons. The proof for this trend can be seen in lithium, which has an atomic radius of 155 picometers (10-12 meters), and cesium, which has an atomic radius of 267 picometers. You might expect the same to happen as you examine the elements from left to right across a period. If lithium has fewer electrons than fluorine, then lithium should have a smaller radius than fluorine, right? Wrong! Fluorine has an atomic radius of 57 picometers and lithium a radius of 155 picometers.

Questions

1. What is the information that you did not understand clearly?

2. Describe the unclear information in question 1 by yourself.

3. Explain the unclear information by yourself.

4. What is the information that you can skim, read slowly and read once more time?

5. Explain the unclear information according to other information in the text.

6. Ask some questions that describe the content of the text and the unclear information in the text.

Assessing the level of chemistry reading skills in English regarding skill 4 "Monitoring and Clarifying":

Criterion 1: Students make clear of vague chemical information, reactions, phenomenon,… to answer question 1:

Which is expected to have greater ionization energy, Ca or Br?

Why does nitrogen have a greater first ionization than oxygen?

Why does fluorine have a smaller atomic radius than lithium?

Criterion 2: Students describe chemical information, reactions, phenomenon,… in their way (by diagrams, graphs…) to answering question 2 with following example answer:

According to the text, first ionization energies generally increase as you move from left to right across a period. But nitrogen has a greater first ionization than oxygen while both of them are in the same period.

According to the text, atomic size is a periodic trend influenced by electron configuration and the radius of the atoms will increase as the atoms fill more principle energy levels with electrons. Why does fluorine have a smaller atomic radius than lithium while fluorine has more electrons than lithium?

Criterion 3: Students temporarily stop reading to answer, explain unknown information in question 2 then answer question 3:

+ Br is located closer to F and will have higher ionization energy.

+ We can think that nitrogen and oxygen can be compared in electron configuration: N ($1s^22s^22p^3$) and O ($1s^22s^22p^4$). The $2p$ sublevel of N is half-filled with 3 electrons. Thus, the electron configuration is unexpectedly stable (low energy).

+ Both fluorine and lithium are in the same period. That means both of them have the same number of layers. But fluorine has a greater nuclear charge than lithium, so it has a smaller atomic radius.

Criterion 4: Students consider skimming or carefully reading or re-reading unclear information in the text. Under this circumstance, students can:

+ Skim: The atomic radius of an atom can be defined as the distance from its nucleus to the outermost electron of that atom

+ Read slowly: The proof for this trend can be seen in lithium, which has an atomic radius of 155 picometers (10-12 meters), and cesium, which has an atomic radius of 267 picometers. You might expect the same to happen as you examine the elements from left to right across a period. If lithium has fewer electrons than fluorine, then lithium should have a smaller radius than fluorine, right? Wrong! Fluorine has an atomic radius of 57 picometers and lithium a radius 155 picometers

+ Reread: It takes a lot of energy to remove electrons from the very stable octets of the noble gases. Atomic size is a periodic trend influenced by electron configuration

Criterion 5: Students need to illuminate unclear information in the text by other understood information:

+ First ionization energies generally increase as you move from left to right across a period. Ca and Br are in the same period. Br has a greater charge than Ca. Thus, Br will have higher ionization energy.

+ Atomic size is a periodic trend influenced by electron configuration. Nitrogen has a more stable electron configuration than oxygen. Thus, nitrogen has a greater first ionization than oxygen to remove an electron from its atom.

+ Fluorine has more protons and positive charge in its nucleus than does lithium. It turns out that when looking at atomic radius across a period, it is the nuclear charge (and not the number of electrons) that determines the radius of the atom. Atomic radius generally decreases as you move from left to right across a period when the nuclear charge increase.

Criterion 6: Students ask questions relating to the content of the text and answer them to make sure that they fully understood all the information. Students can answer question 6 as follows:

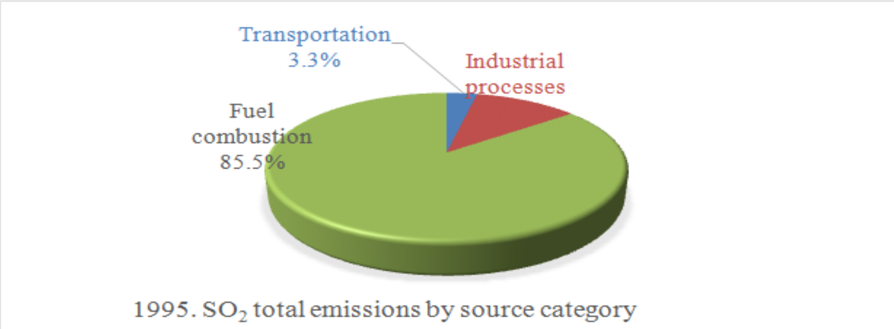
+ How are the elements organized in the periodic table? Answer: The periodic table organizes the elements into periods (rows) and groups (columns).

+ Describe the period and group trends in first ionization, atomic radii. Answer: Ionization energies generally increase from left to right across a period, and decrease as you move down a group. Atomic and ionic radii decrease from left to right across a period and increase as you move down a group.

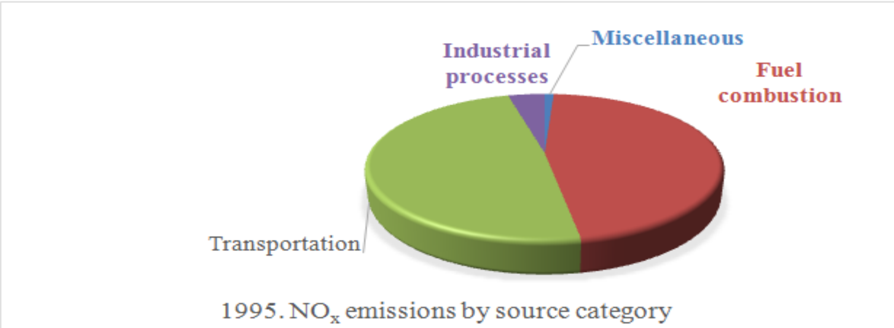
+ Why does nitrogen have a greater first ionization than oxygen? Answer: Nitrogen has a more stable electron configuration than oxygen.

Example 4. Read the passage and answer the questions below

Now that we have identified the two major contributors to acid precipitation, it is reasonable to ask whether the oxides of sulfur or the oxides of nitrogen pose a greater problem. The annual U.S. anthropogenic emissions of SO_2 and NO_x are of roughly equal magnitude. Most (86%) of the sulfur dioxide emissions can be traced to coal-burning electric utilities (Figure 1). That same source accounts for 46% of the nitrogen oxides released, but transportation, powered by internal combustion engines generates about 49% of the NO_x that enters the atmosphere from human sources.



(a)



(b)

Figure 1. U.S emission sources of (a) sulfur dioxide and (b) nitrogen oxides. Data from EPA National Air Quality Trends report, 1995 (issued in 1997). (Source: Data from EPA, National Air Quality and Emission Trends Report, 1995, [issued in 1997])

Table 1. Estimated Global Emissions of Sulfur and Nitrogen Oxides (in millions of metric tons per year)

Source	SO_2	NO_x
Natural:		
Oceans	22	1
Soil and plants	2	43
Volcanoes	19	
Lightning		15
Subtotals	43	59
Anthropogenic:		
Fossil fuels combustion	142	55
Industry (mainly ore smelting)	13	
Biomass burning	5	30
Subtotals	160	85
Totals	**203**	**144**

Source: * Data from Spiro, *et al*., "Global inventory of sulfur emissions with 1o x 1o resolution" in Journal of Geophysical Research, 97, No. D5, 6023, 1992.
** The United States Environmental Protection Agency. Air Quality Criteria for Oxides of Nitrogen, EPA/600/891/049aA.

Table 1 presents a global view of SO_2 and NO_x emissions from both natural and human sources. On this worldwide scale, human activities release almost twice as much SO_2 as NO_x. Furthermore, if only fossil fuel combustion is considered, the mass of nitrogen oxides emitted per year is less than the mass of sulfur dioxide. Unfortunately, reliable emissions information is difficult to obtain. and the data of Table 1 are somewhat out of date. According to *Vital Signs* 94, between 1980 and 1990, global SO_2, emissions from the burning of fossil fuels increased by approximately 10% and NO_x emissions increased by 20%.

It is probably a significant indicator of things to come that during this period there was a major decrease in the mass of SO_2, generated by the industrialized nations. But this decrease has been more than offset by a massive increase in SO_2 emissions by the rapidly developing countries. For example, in 1970 the United States emitted about 30 million tons of sulfur dioxide and China emitted 10 million tons. In 1990, both countries released about 22 million tons of SO_2. Thus far, the developing nations have been unable to afford the pollution-reduction technologies or low sulfur fuels that have been adopted by their more affluent neighbors. Nitrogen oxide emissions may pose an even more serious long-range problem. They are more difficult to control and appear to be increasing in most countries. Industrial development has had and will continue to have, a major impact on both the global economy and the global environment.

It is also important to be aware that humans are not the only generators of sulfur and nitrogen oxides. As Table 1 indicates, oceans and volcanoes release large quantities of SO_2: soil, plants, and lightning are major sources of NO_x. In a typical year, natural emissions account for about 21% of the sulfur dioxide and 41% of the nitrogen oxides released into the atmosphere.

Occasionally, major geological events alter this pattern. The June 1991 eruption of Mount Pinatubo in the Philippines is a case in point. This eruption, the largest in a century, injected between 15 and 30 million tons of sulfur dioxide into the stratosphere. There the SO_2 reacted to form small droplets of sulfuric acid. For more than two years, much of this H_2SO_4 aerosol remained suspended in the atmosphere, reflecting and absorbing sunlight. The temporary drop in average global temperature that was observed in late 1991 and continued through 1992 has been abused to the effects of the Mount Pinatubo eruption. Indeed, when the cooling effects of the Mount Pinatubo eruption are included in the computer programs used to model global temperature changes, the predictions agree well with the observations, thus validating the models. There is also evidence that droplets and frozen crystals of H_2SO_4 formed as a result of the eruption provided many new microsites for chemical reactions leading to the destruction of ozone. Quite obviously, the topics of this text are tightly interwoven.

Questions:

1. Fill in the blanks:

- A global view of SO_2 and NO_x emissions from both (1)___and (2)___ sources.

- In a typical year, natural emissions account for about 21 % of the (3)___ and 41 % of the (4)___ released into the atmosphere.

- Most (86 %) of the (5)___ emissions can be traced to coal-burning electric utilities. That same source accounts for 46 % of the (6)___ released, but transportation, powered by internal combustion engines generates about 49 % of the NO_x that enters the atmosphere from human sources. It is also important to be aware that humans are not the only generators of sulfur and nitrogen oxides

2. You can list some reactions forming SO_2 or NO_x.

3. Fill in the blanks:

Much of the acid rain can be able due to (1)___ or (2)___ produced by (3)___electric utilities or (4)___ or (5)___ sources.

4. Put the words in the text into suitable groups:

Chemical	Nation	Words relating to producing SO_2 and NO_x	Source of emission

5. List some information that is the main idea of the text.

6. Identify the most important information in the text.

Assessing the level of chemistry reading comprehension skills in English regarding skill 5 "Skimming"

Criterion 1: Students need to underline the keywords, terminology, important content in each paragraph, in the reading, namely: two major contributors, acid precipitation, oxides of sulfur, oxide of nitrogen, sulfur dioxide, transportation, internal combustion engines, human and natural sources, … from which we can answer question 1: (1) human; (2) natural; (3), (5) sulfur dioxide; (4), (6) nitrogen oxides.

Criterion 2: Students give chemical examples, phenomenon, reactions,…for each keyword, important content. To be specific, there are SO2 and oxides of nitrogen. Therefore, students can answer question 2:

$S + O_2 \rightarrow SO_2$

$4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$

$N_2 + O_2 \rightarrow 2NO$

$2NO + O_2 \rightarrow 2NO_2$

$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$

Criterion 3: Students themselves need to practice using underlined keynotes to make sure they understand them, then students can answer question 3: 1) sulfur dioxide; (2) the oxides of nitrogen; (3) coal-burning; (4) transportation; (5) natural.

Criterion 4: Students can classify keywords, terminologies or relating chemical content. Then students can answer question 4:

Chemical	**Nation**	**Words relating to producing SO_2 and NO_x**	**Source of emission**
SO_2 NO_x H_2SO_4	United States China Philippines	emissions released generates emitted	coal-burning electric utilities transportation internal combustion engines natural and human sources fossil fuel combustion oceans and volcanoes soil, plants, lightning

Criterion 5: students consider which information to be the main content of the text. Then, students can answer question 5:

+ Two major contributors to acid precipitation.

+ Whether the oxides of sulfur or the oxides of nitrogen pose a greater problem.

+ Human activities are the main reason to release almost twice as much SO_2 as NO_x.

Criterion 6: Students must briefly give the main content of the text relating to a chemical problem. Then students can answer question 6: There is also evidence that droplets and frozen crystals of H_2SO_4 formed as a result of the eruption provided many new microsites for chemical reactions leading to the destruction of ozone.

2.8. Pedagogical Experiment

We conducted pedagogical experiments to evaluate the feasibility and effectiveness of Chemistry exercises in English, using the information from the text to improve reading comprehension skills. That experiment was done on 1425 students of the control group (Co) and 1425 students of the experimental group (Ex). Those students were in grades 10, 11 and 12 of 11 high schools in Vietnam. The results are below.

Table 2. Summary of test scores

Group		Score X_i									
Amount of students		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ex	Amount	0	15	34	133	169	288	267	193	174	152
1425	%	0.00	1.05	2.39	9.33	11.86	20.21	18.74	13.54	12.21	10.67
Co	Amount	6	213	255	223	183	213	142	116	74	0
1425	%	0.42	14.95	17.89	15.65	12.84	14.95	9.96	8.14	5.19	0.00

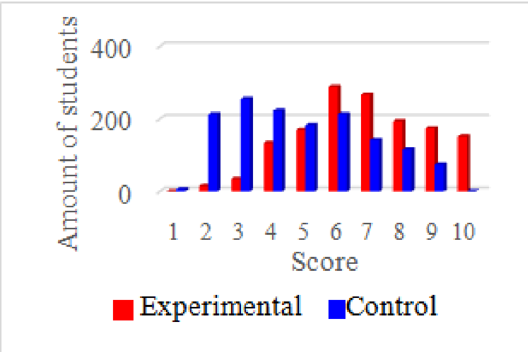
Table 3. Cumulative frequencies table

Group	% Students get a X_i score or below									
	1	2	3	4	5	6	7	8	9	10
Ex	0.00	1.05	3.44	12.77	24.63	44.84	63.58	77.12	89.33	100.00
Co	0.00	15.37	33.26	48.91	61.75	76.70	86.67	94.81	100.00	100.00

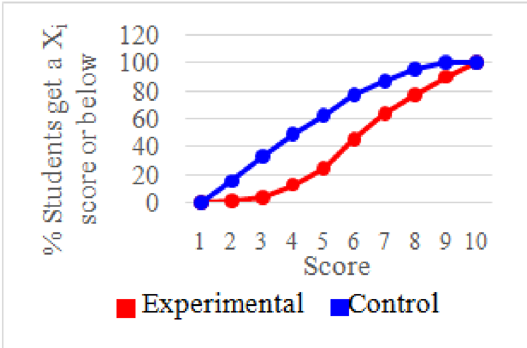
Table 4. Summary of specific data

Group	Amount of students	$\overline{X}$	S^2	S	m	CV	k	t	$t_{\alpha,k}$	ES	Influence
Ex	1425	6.83	3.72	1.93	0.05	28.23	2848	26.70	1.96	0.96	Large
Co	1425	4.82	4.37	2.09	0.06	43.35					

Variances	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig (p)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Lower
Equal variances assumed	23.83	0.00	26.70	2848	2.48×10^{-14}	2.01	0.08	1.86	2.16
Equal variances not assumed			26.70	2830	3.06×10^{-14}	2.01	0.08	1.86	2.16



(1)



(2)

Figure 2. Diagram of test scores (1); Graph of cumulative frequencies (2)

According to the diagram of test scores and the average test score values (Figure 2, Table 4), we found that the average test scores of the control group are lower than the experimental group. The graph of cumulative frequencies showed the line of the experimental group is on the right and below the line of the control group. That confirms the studying outcomes of students of the experimental group is higher than the control group.

According to the data of Table 4, we found that:

- The Criterion deviation (S) value and the coefficient of variation (CV) are relatively small ($S_{Ex} < S_{Co}$ and $CV_{Ex} < CV_{Co}$), so the data are less dispersed. The average test score values ($\overline{X}$) have high reliability. We hypothesize: H_0 – the difference between the values of $\overline{X}_{Ex}$ and $\overline{X}_{Co}$ is not statistically significant; H_1 – the difference between the values of $\overline{X}_{Ex}$ and $\overline{X}_{Co}$ is statistically significant. The value of t (Student's t-distribution) is greater than $t_{\alpha,k}$ ($\alpha = 0.05$). Therefore, we can conclude: reject the hypothesis H_0, accept hypothesis H_1. That means students of the experimental group have advancement in English better than students of the control group [16]. The value of ES is large [17].

By using a t-test, we found that the (p) Sig. values were less than the value of α (= 0.05). That means the difference in the distribution of test scores between the control and experimental group is due to the impact of reading comprehension exercises on English language skills in English, but not by accident [18].

Table 5. Results of evaluating the level of chemical reading comprehension skill in English

CRITERIA	Level of skill										Max of %		Evaluate level of skill	
	1		2		3		4		5					
	Co	Ex	Co	Ex	Co	Ex	Co	Ex	Co	Ex	Co	Ex	Co	Ex
1	283	340	758	738	10277	1153	1769	1744	1163	10275	72.12	72.11	3	5
2	278	303	736	737	10376	1140	1675	1751	1185	10319	72.81	72.41	3	5
3	342	323	735	747	10344	1148	1702	1738	1127	10294	72.59	72.24	3	5
4	342	293	737	693	10334	1138	1732	1700	1105	10426	72.52	73.16	3	5
5	328	372	757	765	10354	1150	1686	1745	1125	10218	72.66	71.71	3	5
6	372	355	761	731	10261	1125	1721	1736	1135	10303	72.01	72.30	3	5
Total	1945	1986	4484	4411	61946	6854	10285	10414	6840	61835	72.45	72.32	3	5
CRITERIA	Percentage of students										Max of %		Evaluate level of skill	
	%1						%4		%5					
	Co	Ex	Co	Ex	Co	Ex	Co	Ex	Co	Ex	Co	Ex	Co	Ex
1	1.99	2.39	5.32	5.18	72.12	8.09	12.41	12.24	8.16	72.11	72.12	72.11	3	5
2	1.95	2.13	5.16	5.17	72.81	8.00	11.75	12.29	8.32	72.41	72.81	72.41	3	5
3	2.40	2.27	5.16	5.24	72.59	8.06	11.94	12.20	7.91	72.24	72.59	72.24	3	5
4	2.40	2.06	5.17	4.86	72.52	7.99	12.15	11.93	7.75	73.16	72.52	73.16	3	5
5	2.30	2.61	5.31	5.37	72.66	8.07	11.83	12.25	7.89	71.71	72.66	71.71	3	5
6	2.61	2.49	5.34	5.13	72.01	7.89	12.08	12.18	7.96	72.30	72.01	72.30	3	5
Total	2.27	2.32	5.24	5.16	72.45	8.02	12.03	12.18	8.00	72.32	72.45	72.32	3	5

Table 6. Spearman – Brown reliability coefficient table

Spearman-Brown Coefficient (**r_{SB}**) Guttman Split-Half Coefficient (**r_{hh}**)	**Group**	**Reading comprehension skills**					**General evaluation**
		9	1	10	8	2	
r_{SB}	Co	0.946	0.965	0.969	0.974	0.975	0.995
	Ex	0.994	0.995	0.994	0.992	0.994	0.999
r_{hh}	Co	0.946	0.965	0.968	0.974	0.975	0.994
	Ex	0.994	0.995	0.994	0.992	0.994	0.999

Through observing the developments in class, we found that: (1) In the control group, the learning spirit of the students has not been positive, quite quiet, less proactive in participating in the lesson. Doing exercises is not voluntary. It depends on the score. So students are bad in chemical reading comprehension in English; (2) In the experimental group, students have a positive learning attitude. They are also very interested in doing exercises. The amount of homework is plentiful and suitable for the high school program. It is important that the exercises were designed to help students improve chemical reading comprehension in English, which helps them think better and be more confident when solving problems.

Besides, by surveying the assessment of chemical reading comprehension in English, we obtained the following results.

Observing the Table 5, we found that the results of the assessment of chemical reading comprehension skills in English of the experimental group are level 5, higher than the results of the control group (being level 3). It also shows that reading chemistry in the English of students is improved. Besides, according to Table 6, we found that the values of rSB are greater than 0.7. Thus the data obtained is reliable [19].

3. Conclusion

With the purpose of training and developing chemistry reading comprehension skills in English for high school students, the research paper designs a toolkit to evaluate the level of chemistry reading comprehension in English with 5 component skills and 6 skills criteria from low to high corresponding to 5 skill levels in each criterion. The paper proposed and designed the exercises to get information from the problem data, and analyzed the skill level corresponding to each criterion of each reading comprehension skill in English of students through a specific type of these exercises. Through the Experimental results, we found that students in Experimental classes have had positive signs of improvement in the proposed criteria. They have shown a proactive, positive attitude in doing homework, thereby gradually mastering the use of reading comprehension skills in English and using chemical knowledge to do the English-fill-in chemistry exercises. The above results show that the chemical exercises that get information from the given English data to improve reading comprehension skills in English for high school students that we propose are feasible and effective.

References

[1] National Science Teachers Association, Online. Available: http://www.nsta.org/publications/news/story.aspx?id=48976.

[2] Roman Maršálek, Ph.D., "Department of Chemistry," [Online. Available: http://kch.osu.cz/?branch=teaching-of-chemistry-for-secondary-school-single-major.

[3] Björn Risch (Ed.), *Teaching Chemistry around the World*, Waxmann Publishers, 2010.

[4] "Studyportals," Online. Available: https://www.mastersportal.com/studies/108940/biological-chemistry.html.

[5] Giac, C.C., Thao, T.T., Nga, L.T. and Da, N.T.L., "Some measures to improve the efficiency of teaching chemistry in English at high schools", *Vietnam Journal of Education*, special volume. 171-173. Mar.2014.

[6] Giac, C.C., 2016. "Design chemistry lectures in English for teaching at high schools". *Journal of Educational Science*, 124. 18-20. Jan.2016.

[7] Giac, C.C., My, C.T., and Han, N.N.H. "Methods of teaching Organic Chemistry in English to 11th students". *Journal of Science - HNUE*, 61 (6A). 116-123. 2016.

[8] Langer, J.A., *Envisioning Literature, Literary Understanding and Literature Instruction*, New York, London, Teachers College, Columbia University, 1995.

[9] Snow, C. E., "Academic language and the challenge of reading for learning about science", *Science*, 328 (23). 450-452. 2010.

[10] Jasien P. G., "You said "neutral", but what do you mean?", *Journal of Chemical Education*, 87 (1). 33-34. 2011.

[11] Jasien P. G., "What do you mean that "strong" doesn't mean "powerful"?", *Journal of Chemical Education*, 88. 1247-1249. 2011.

[12] Song, Y. and Carheden, S., "Citation: Dual meaning vocabulary (DMV) words in learning chemistry", *Chemistry Education Research and Practice*, 15 (2). 128-141. 2014.

[13] Roko Vladušić, Robert Bucat and Mia Ožić, "Citation: Understanding of words and symbols by chemistry university students in Croatia", *Chemistry Education Research and Practice*, 17 (3), 475-476. 2016.

[14] Giac, C.C. and Ninh, T.T., *Methods of teaching chemistry in English in High School*. Vinh University Publishers, 2018, 12-13.

[15] Anderson, L.W. and Krathwohl, D.R. (Eds.), *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy of cognitive objectives (Complete edition)*, Longman Publishers, New York, 2001.

[16] Ministry of Education and Training, Belgian and Vietnamese project, *Applied pedagogical science research*, University of Education Publishing House. 2010

[17] Cohen, J., Statistical power analysis for the behavioral sciences (2nd ed.), NJ: Lawrence Earlbaum Associates, Hillsdale. 1988.

[18] Levene and Howard, *Robust tests for equality of variances*, In Ingram Olkin; Harold Hotelling; et al. (eds.), *Contributions to Probability and Statistics: Essays in Honor of Harold Hotelling*, Stanford University Press, 1960.

[19] Spearman, C., 1904. "General intelligence" objectively determined and measured", *American Journal of Psychology*, 15. 201-293. 1904.