

## CRITICAL THINKING COMPETENCY FOR STUDENT THROUGH CHEMICAL TEACHING IN HIGH SCHOOL

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### ABSTRACT

Critical thinking is an important element of all professional careers. It is part of the educational process and is of increasing importance for the progress of students through higher education. Critical thinking competency is one of the essential competencies of students. Overview of thinking and critical thinking capacity in teaching, this article clarifies the role of critical thinking in the intellectual development of students and propose some solutions to develop this capacity for students through chemical teaching in universities.

**Key Words:** Develop, Competency, Critical thinking competency, Students.

### 1. INTRODUCTION

To adapt and develop in the world of multi-dimensional information requires people to have an accurate and objective assessment of things and phenomena and to have the capacity to think critically. Critical thinking is one of the manifestations of dialectical thinking, helping people to analyze and evaluate problems and phenomena from many different points of view, making the search for truth and truth effective. better (Alec Fisher, 2001). Training people who are fully developed, have the capacity to think critically, and are able to meet the increasing demands of society towards the formation of a global citizen is an urgent requirement of the education sector. our country. In fact, not everyone has the capacity to think well. Human thinking can be influenced by many factors: conservatism, prejudice, narrow-mindedness, lazy thinking, personal feelings... Developing critical thinking capacity for learners has been studied by many scientists around the world. In the study of Critical Thinking, many researchers are interested (Duong Thi Hoang Oanh, 2005): Robert Ennis, Richard Paul, Mathew Lipman. J. Dewey (1859-1952; USA) called critical thinking "reflective thinking": The essence of critical thinking is the active, comprehensive consideration of information before giving it out. reviews; The key element in critical thinking is the capacity to reason. Robert J. Stembert believes that: critical thinking has many components and skills, in which the characteristic skills of critical thinking are information processing, and problem solving. In the article "Teaching and training critical thinking skills for students", the author has identified the benefits of critical thinking for learners, the cognitive levels of students towards thinking. Critical thinking, propose some steps in teaching to practice critical thinking for students (Bui Loan Thuy, 2012).

In education in general and in high school education in particular, we are aiming to form and develop students' capacity, including the capacity to think critically. According to the World

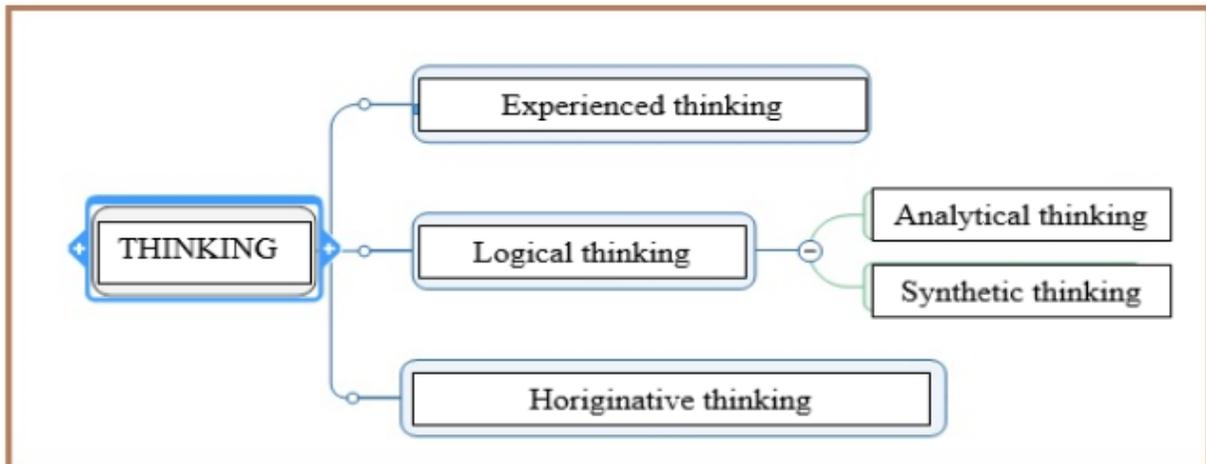
Economic Forum (thesaigontimes, 2015) on “New Vision for Education: Developing the Potentials of Industry”, to meet the human resource requirements in the global era, learners must have 16 essential energy; in which, the capacity to think critically plays a key role, the core factor connecting the remaining competencies to reach the final competence, which is lifelong learning capacity (Mathew Lipman, 2003). This article delves into the study of critical thinking and the development of students' critical thinking capacity in the teaching process at high school. In particular, the study of the role together with a number of solutions to develop critical thinking competence for students has a lot of theoretical and practical significance in realizing the goal of education and development of human resources in our country in the current period. now on.

## 2. CONTENTS

### 2.1. Overview of thinking and critical thinking capacity in the classroom

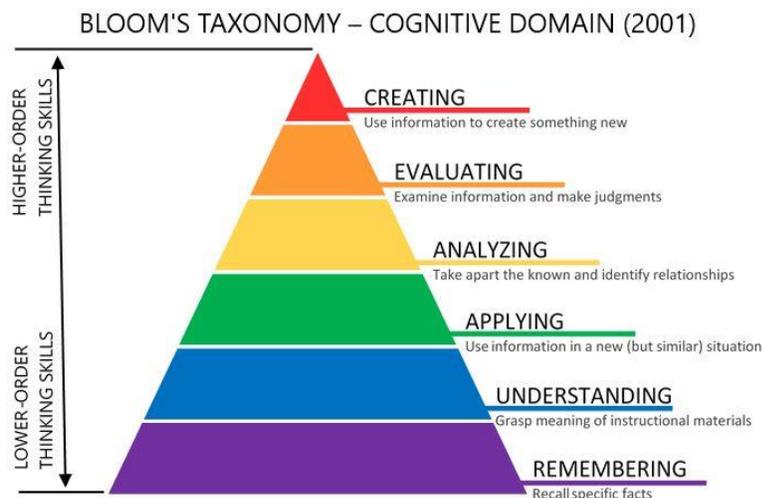
#### 2.1.1. Thinking

In practice, there are many things we do not know, do not understand. But in order to master the reality, people need to thoroughly understand those unknowns, to outline their nature and regular relationships. That process is called TD. TD is divided into the following types: TDLG (the law of post-centre and syllogism), critical thinking, critical thinking, etc. (Le Tan Huynh Cam Giang, 2011)



**Figure 1.** Taxonomy of thinking

According to Benjamin S. Bloom, human mind consists of 6 levels: Remember; Understand; Applying; Analyze; Evaluate); Create



**Figure 2.** Bloom's cognitive taxonomy

## 2.1.2. Critical thinking and students' critical thinking capacity

### 2.1.2.1. Critical thinking

Critical thinking comes from the term “Critical Thinking”. Socrates recognized the importance of asking deep questions to deeply investigate thoughts before we accept opinions. He attaches great importance to finding evidences, carefully studying information and assumptions, analyzing the nature of problems and drawing directions for problem solving (Le Tan Huynh Cam Giang, 2011). J. Dewey calls critical thinking “reflective thinking” and defines it as: The active, continuous, careful consideration of a belief, a scientific assumption that takes into account valid reasons, argument defends it and further conclusions are aimed at. Thus, critical thinking comes from the capacity to reason and evaluate inferences actively (questioning themselves, searching for relevant information, etc.), continuously and needing to consider carefully the problems. information before drawing conclusions. On that basis, belief and awareness of knowledge are formed.

Author Nguyen Gia Cau said: "Critical thinking is an important value of personality, a thinking process that includes analysis, selection, "screening" and evaluation of an existing information or problem. in a different way to clarify and re-affirm the accuracy of the problem" (Nguyen Gia Cau, 2015). Critical thinking is divided into two types: self-critical thinking and external critical thinking.

Thus, critical thinking not only helps students have a multi-dimensional view when exploiting the lesson content, but also forms the capacity to solve life's problems. In education at the high school level, teachers need to take measures to influence the teaching process to help students develop necessary competencies, including critical thinking capacity.

### 2.1.2.2. Critical thinking capacity in teaching

- According to (Nguyen Phuong Thao, 2010), "Critical thinking capacity is the capacity of people to make judgments, demonstrating the positive interaction of people about the world around them". Inheriting the researches on critical thinking, we believe that: Critical thinking capacity is the capacity to apply independent thinking and reflective thinking in analysis and evaluation. , relate every aspect of an existing information with a positive skepticism for the problem posed, thereby

clarifying and re-affirming the accuracy of the problem with convincing arguments". According to (Bui Loan Thuy, 2012), core skills of critical thinking capacity in teaching include: Interpretation (Interpretation), analysis (Analysis), evaluation (Evaluation), inference (Inference), solution Exploration and self-regulation.

- The typical manifestations of students with critical thinking capacity:
  - + No prejudice: Knows how to listen and accept opinions that are contrary to his/her own, knows how to consider different points of view and will change his/her opinion when deductive reasoning shows that change must be made;
  - + Capacity to argue with supporting evidence, identify, evaluate and construct arguments;
  - + Capacity to infer, draw conclusions from one or more details (see logical relationships between data)
  - + Look at the problem from many different angles
  - + Make persuasive judgments and judgments
- Framework of critical thinking capacity of high school students:

We have conducted a test of the Critical Thinking Competency framework for students of grade 4 and 11 of schools: Cho Gao High School, Go Cong High School to check the feasibility, objectivity and complete the framework. We propose a framework of critical thinking skills for students through teaching and learning chemistry, including 2 component competencies and 8 criteria (expression).

**Table 2.1. Structure of critical thinking capacity of high school students**

TT	Component capacity	Expression of critical thinking capacity
1	Independent thinking	1. Listen and observe 2. Collect information 3. Asking questions 4. Analyze, evaluate, compare opinions
2	Reflective thinking	5. Problem solving 6. Concluded 7. Test results 8. Self-regulating

**2.2. The role of critical thinking in the intellectual development of students**

- Critical thinking plays a great role in students' learning and scientific research (Robert H. Ennis, 2003):
- + Students actively approach new things, advances in thinking and acting.

- + Students will get rid of old-fashioned thinking, follow patterns, follow habits, easily recognize and eliminate old-fashioned and outdated ones; create a ready attitude to accept the new, the social progress.
- + Encourage students to search and discover new ideas and values of the problem; consciously see all problems from a new perspective, bring new results, stimulate creativity.
- + Students look at the problem comprehensively, objectively, overcome the situation of one-sided, one-sided, subjective, will-only perception.
- Critical thinking plays an important role in promoting students' comprehensive development of abilities (Nguyen Thanh Thi, 2013):
- + Observational capacity: Not only stopping at the criteria of seeing but also having to understand
- + Research capacity: Students constantly ask questions such as what is criticism, what is the role of criticism, how to practice critical thinking skills... Since then, they try to find answers and make decisions. right decision for yourself.
- + Logical thinking capacity: Connecting problems from there to have a more comprehensive view from many different angles.
- + Decision-making capacity: Only when practicing critical thinking will the decision-making be accurate, minimizing risks.
- CRITICAL THINKING stimulates confidence: Students with knowledge and confidence will dare to stand up and express their own views.

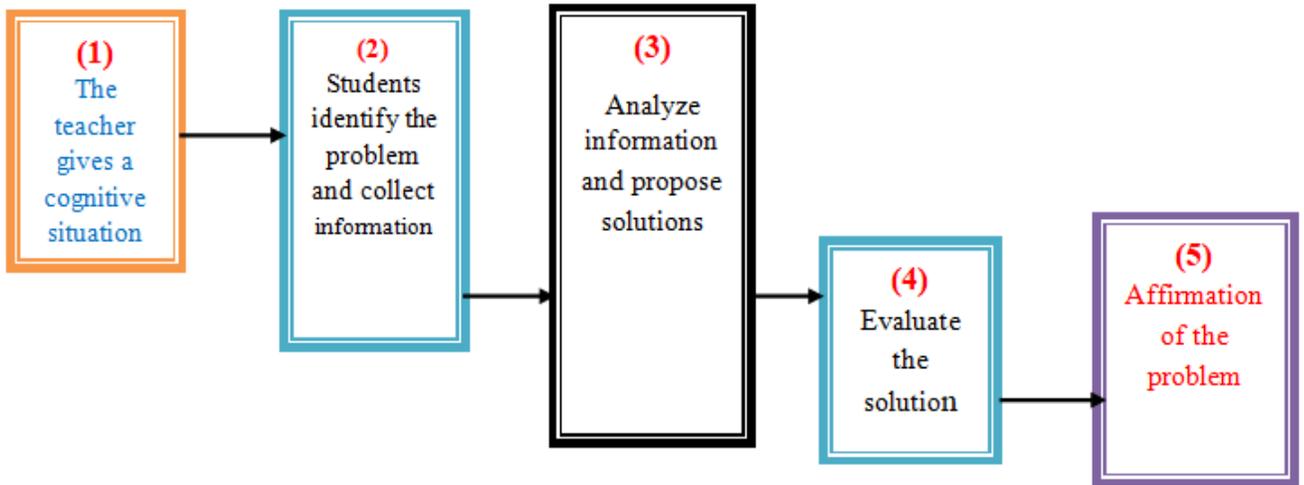
### **2.3. Developing critical thinking capacity for high school students**

#### ***2.3.1. Teaching process to develop critical thinking capacity for students***

According to research documents (Robert H. Ennis, 2003) the critical thinking process includes the following steps:

- (1) Identify opinions related to the issue raised
- (2) Analysis: Each opinion gives a few arguments for and against. With each argument, there are many different arguments from many angles
- (3) Evaluation: Survey of contradictions between opinions; Assess the persuasiveness of opinions; Give your own opinion (which opinion is correct)
- (4) Presenting results: Point out the persuasive points of an opinion and back it up with factual evidence; Disprove opposing opinions with arguments

On the basis of research on the critical thinking process, we propose the teaching process to develop critical thinking capacity for students as follows:



**Figure 3.** Teaching process to develop critical thinking capacity

### 2.3.2. Some measures to develop critical thinking for students

(1) Encourage students to search and select relevant information by themselves

- Purpose of the measure: To form in students a characteristic sign of critical thinking capacity is to analyze opinions, approach problems from many sides, and listen carefully to the opinions of others.

- How to take action:

+ Step 1: Organize for students to search for information

+ Step 2: Organize for students to listen, observe and discuss (during class time)

For example: In the chemistry class (theory as well as practice) on Oxygen - Ozone, the teacher let the students learn about physics, chemistry, their preparation and applications through the textbook, youtube channel.... In practice hours, teachers show students experimental techniques. Students observe, analyze, discuss with each other and ask questions with the teacher to answer questions and mistakes in theoretical research as well as practice.

(2) Create problematic situations in teaching so that students can dialogue, debate, and present- Purpose of the measure: Problematic situations in teaching are conditions for students to discuss, debate, and construct arguments with persuasive judgments. At the same time, it helps students become bold and confident when expressing their opinions, practice respect for evidence, arguments, and moderation when arguing.

- How to take action:

+ Step 1: Teacher gives a situation, students discover a problem that needs to be solved.

Step 2: Handle the situation. Teachers organize for students to discuss in groups and propose solutions. The way to handle situations is not fixed but needs to be rich, depending on the construction of each student under the guidance of the teacher.

+ Step 3: Evaluate the results (confirm or refute the stated hypothesis, students observe, listen, can ask questions related to the problem, judge, take notes), give opinions and conclusions .

Example: Situation: Why do calcium tablets dissolve quickly and effervescent in water? (Carboxylic Acid lesson)

Calcium is an important component of bones, adolescents at puberty need calcium supplements to promote normal bone growth. If the elderly lack calcium, the bones become brittle and break easily. People with hypocalcaemia often use French calcinol tablets that include calcium carbonate and citric acid  $C_3H_4OH(COOH)_3$ . When dropping the tablet into water, the tablet dissolves quickly and becomes effervescent.

Why is that? How to store tablets?

Procedure to use scenario:

Step 1: The teacher gives the situation (with video illustrations). Students discover a problem that needs to be solved.

Step 2: The teacher organizes for students to discuss in groups, and the teacher suggests for students to answer with questions

Is citric acid a carboxylic acid? What are the physical and chemical properties of carboxylic acids? When the tablet is dropped into water, the tablet dissolving quickly and effervescent is the property of the carboxyl functional group or of the hydrocarbon radical in citric acid? What is the cause of bubbling? What role does water play in this case? How to store medicine?

+ Step 3: The problems students need to grasp after solving the situation: Know that citric acid belongs to carboxylic acids. Understand the physical and chemical properties of carboxylic acids.

Understand that citric acid exhibits properties of the  $-COOH$  group when it encounters calcium carbonate. The effervescence is caused by  $CaCO_3$  reacting with  $H^+$  of citric acid to produce  $CO_2$



Know that water acts as a solvent. Understand the need to store medicine in a dry, sealed place, to avoid moisture.

(3) Encourage students to ask themselves questions to activate CRITICAL THINKING

- Purpose of the measure: Encourage students to always have a positive attitude of skepticism before all problems of life and study, thereby trying to find answers to develop themselves - the manifestation of CRITICAL THINKING force, training students to be proactive, bold, confident, dare to question and have frank dialogue.

- How to take action:

Teachers encourage students to ask questions in the following cases:

+ Students ask questions to the teacher when they do not understand a part of the lesson, or are facing obstacles that they cannot solve.

+ Students ask students when they want to clarify a content of the lesson, or to check your perception of the literary issue in question, to refute in the argument process...

+ Students ask themselves questions to find ways to solve the problems that the lesson poses.

- To encourage students to ask questions, teachers can do the following things:

+ Ask students to write questions on paper about the problem being studied

+ Encourage students to ask questions to the teacher, or other students while discussing a situation, a problem

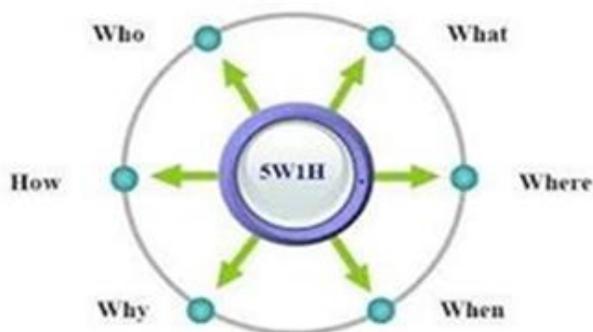
+ Using students' questions as the basis for lectures, discussions, and tests in the teaching process.

+ Provide specific instructions for students to ask questions about other materials they can read.

+ Show genuine interest and attention to students' questions: listen attentively, add points or praise for good questions.

+ Design situations, use teaching methods and active teaching techniques so that students are forced to ask questions.

In fact, the “5W – 1H” thinking questioning technique is the most widely used and easiest technique. To understand the nature of a problem/phenomenon, people often start with question words such as: What?, Why?, Where?, When?, Who? and How



**Figure 4:** Thinking questioning technique 5W1H

In general, depending on the problem or research area, 5W1H can be applied flexibly differently. In the process of implementing problem clarification, learners need to be encouraged to think independently, ask different types of questions before a problem, ask the right focus, at the right place, at the right time; are encouraged to make personal comments, judgments or assessments; proactively explain reasons, arguments, and prove their point of view; multi-dimensional view of the problem, and the capacity to give convincing evidence about the problem.

Example: Chemistry Question 5W1H

+ Who was the first person to imagine the existence of atoms?

What was the name of the first man-made chemical element?

+ Where in the world was the first atomic power plant built?

+ In the 19th century, people used oxygen as a unit of measurement for atomic mass, but then people chose Carbon. Why that change?

+ Why is the air usually fresher after thunderstorms?

+ A Vietnamese proverb has a sentence: "Water flows and rocks wear away", what does this sentence mean by chemical science?

### 3. CONCLUSION

With the above analysis, it can be seen that critical thinking plays a great role in the learning process of students and scientific research. Especially in the current era of technology 4.0, modern high school education requires students to have active, independent thinking, actively grasp and master scientific knowledge. From there, students will boldly present their thoughts and views based on scientifically grounded inferences, actively create new knowledge, keep pace with modern education in the world, meet requirements of global citizens.

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