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ASSESSMENT OF COMPETENCE OF GAINING KNOWLEDGE AND COMMUNICATION USING VISUAL TEACHING METHOD WITH THE TOPIC OF "MATTER AND ITS CHANGES" IN NATURAL SCIENCES GRADE 7

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Abstract. The competence of gaining knowledge and communication is one of the three components of natural science competence – the specific competence in Natural Sciences. Assessment is oriented towards developing students' qualities and abilities, emphasizing process assessment. Process assessment is a form of assessment for the improvement of learners and is one of the measures to develop the learning nature competency. In this article, we have investigated the current situation of applying formative assessment to develop the competence of gaining knowledge and communication in teaching Natural Sciences, thereby proposing measures to apply formative assessment in project-based learning with the topic of "Matter and its changes" of Natural Sciences for grade 7 to develop the competence of gaining knowledge and communication of students.

Keywords: formative assessment, competency assessment, visual teaching, the competence of gaining knowledge and communication, Natural Sciences for grade 7, the topic of "Matter and its changes".

1. Introduction

Competency assessment is an activity to measure the ability to perform missions, and learning activities, the potentiality of students and the application of knowledge and skills, and the attitude to solve the learning tasks to a certain standard. From a modern viewpoint, assessment is oriented toward developing students' qualities and competencies with an emphasis on process assessment. Process assessment is a form of assessment that is regularly performed in the learning process to provide feedback to improve teaching and learning [1]. In Vietnam, research on process assessment delves into the perspective, philosophical influences, and meanings of process assessment. Some studies have pointed out the difficulties and measures to implement process assessment in teaching [2]. Suggested solutions include using PISA exercises [3], using rubrics for peer assessment [4], and developing a lesson plan approach to process assessment according to appropriate processes [5]. Currently, a process assessment is underway, but the use of assessment tools and methods is not effective. The competence of gaining knowledge and communication is one of the three components of natural science competence. When developing the ability to learn about nature, students can combine knowledge and basic skills to understand and explain things and phenomena in life and prove those phenomena with scientific evidence [6].

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Regarding the structure of nature research competency, Cao Cu Giac [7] built the Natural Science Competence framework according to the assessment of PISA with 6 component competencies, 10 criteria, and 3 levels of students' competency development in natural sciences. Nguyen Thinh Hoa [8] gives a structure of 4 component competencies and 10 criteria for Natural Science Competence. Measures to develop the competence of gaining knowledge and communication include using the hand method of kneading dough [8], building a toolkit for assessing Natural Science Competence, and developing PISA exercises [3]. The visual teaching method is a teaching activity where visual aids such as pictures, diagrams, natural specimens, experiments, models, and videos are used by teachers to provide information. Information helps students discover new knowledge, review, reinforce, or test [9]. There have been studies on the use of chemical experiments as a means of visual teaching methods such as Nguyen Duc Dung [10], and Vu Tien Tinh [11]. In the 2018 general education program, the visual teaching method is an active teaching method with similar steps to develop students' competencies and qualities. Although there are many studies on visual teaching methods, there have not been many studies focusing on assessing the ability to learn about nature in natural science in grade 7 through the visual teaching method.

In the world, there are a number of studies on process assessment. Chu, Cauley, and McMillan have shown that the combination of interactive learning and process assessment helps students improve their learning outcomes and motivation [12,13]. According to the OECD, there are six basic elements of process assessment [14]. Leahy mentioned 5 strategies in process assessment [15].

On that basis, we realized that the topic "Assessment of competence of gaining knowledge and communication using visual teaching method with the topic of "Matter and its changes" in Natural Sciences grade 7" is necessary in the current context.

2. Content

2.1. Methods, timeframe, means, and content of study

** Methods of study*

This study has used theoretical research methods; practical research methods (including investigation and pedagogical experiment); and statistical methods.

** Timeline and means of study*

This study was conducted from 09/2022 to 04/2023, including theoretical research (09/2022-01/2023); reality investigation (09/2022); pedagogical experiment (10/2022-11/2022); data processing and conclusion (02/2023-04/2023).

The means of study are the following: References, questionnaires, SPSS software.

** Content of research*

This study focuses on the following contents: theoretical research about competence, the competence of gaining knowledge and communication, formative assessment, visual teaching method, and the relationship among them in teaching the topic of "Matter and its changes" for 7^{th} - grade natural science subject; Investigation of the application of formative assessment for the development of the competence of gaining knowledge and communication; Construction of formative assessment tools and lesson plan of the topic of "Matter and its changes" in teaching 7^{th} - grade natural science subject; pedagogic experiment, data processing, and conclusion.

2.2. Research results

2.2.1. Some theoretical issues about the competency and competence of gaining knowledge and communication

Competency is an individual attribute that is formed and developed through inherent qualities and training, being able to successfully perform a certain type of action in specific conditions through the synthesis of technical knowledge, ability, interest, belief, will, etc. [16].

The competence of gaining knowledge and communication (CGKC) is an individual attribute that manifests the performance of basic skills to understand and explain phenomena in natural life or to prove problems in practice using scientific evidence [6].

To develop CGKC through process assessment, it is necessary to clearly define the structure and nature of CGKC. Based on the 2018 general education program on Natural Sciences, the proposed CGKC structure consists of 6 component competencies with 12 expressions.

Table 1. Structure and description of the expression of the competence of gaining knowledge and communication

(Level 1: not reached; Level 2: reached; Level 3: good)

Component of competence	**Expressions**	**Competence in gaining knowledge and communication evaluation level**		
		Level 1 *(Not reached)*	**Level 2** *(Reached)*	**Level 3** *(Good)*
CGKC1. Propose problems and make questions	CGKC 1.1 Realize and ask questions about things, phenomena, and processes.	Realize but don't know how to ask questions about things, phenomena, and processes.	Realize but make questions about things, phenomena, and processes, superficially	Realize and make questions about things, phenomena, and processes specifically and clearly
	CGKC 1.2. Describe things, phenomena, and processes.	Unable to describe things, phenomena, and processes.	Able to describe things, phenomena, and processes quite clearly and in detail	Ability to describe things, phenomena, and processes clearly and in detail
CGKC 2. Make judgments and build up hypotheses	CGKC 2.1. Make judgments based on analysis of things, phenomena, and processes	Haven't made a judgment even though analyzing things, phenomena, and processes	Able to make judgments based on analysis of things, phenomena, and processes	Able to make specific judgments based on analysis of things, phenomena, and processes
	CGKC 2.2. Build up hypotheses and formulate things, phenomena, and processes that	have built hypotheses but have not been able to state things, phenomena, and processes that need to be learned.	Formulate hypotheses and state things, phenomena, and processes that need to be studied	Build hypotheses and state things, phenomena, and processes that need to be understood clearly and with the right focus

	need to understand		but not with the right focus.	
CGKC3. Plan and implement	NEC 3.1 Build a framework for learning content	Build a framework for learning content, but there are many mistakes	Build a relatively complete and correct framework for learning content.	Build the correct and sufficient framework for learning content
	CGKC 3.2. Select the appropriate research method.	The method can be selected, but it is not suitable for the content to be studied.	Select a method that is suitable for the content to be studied.	Select a method that is appropriate and creative with the content to be learned.
	CGKC 3.3. Make a plan to learn about things, phenomena, processes...	Plan to learn about things, phenomena, and processes but still sketchily, unclearly	Make a plan to learn about things, phenomena, and processes quite fully.	Make a plan to learn about things, phenomena, and processes in detail and clearly.
CGKC 4. Effectuate the plan	NEC 4.1 Collect and store data from experiments and investigation results.	Collect but do not know how to store data from experiments and investigation results.	Collect and store data from experiments, and survey results but still insufficiently.	Collect and store data from experiments, investigation results completely, and abundantly
	CGKC 4.2 Analyze, process, evaluate, contrast with hypotheses and draw conclusions.	The analysis can process the data, but it has not been evaluated, controlled, and drawn to conclusions.	Analyze, process, evaluate, and control the hypothesis, but the conclusion is not clear.	Analyze, process, evaluate, contrast with hypotheses, and draw specific and clear conclusions.
CGKC 5. Write presentations and discussions	CGKC 5.1. Describe the learning process and results using language, images, diagrams, videos, etc.	The learning process and results have not been clearly expressed by using one of the forms of language, images, diagrams, videos,	Express the learning process and results using one of the forms of language, images, diagrams, videos, etc.	Express the learning processes and results using a combination of linguistic forms, images, diagrams, videos, etc.
	CGKC 5.2. Listen, share, and protect the findings	Listen, and share but do not protect the results.	Listening and sharing are quite active, but defending the research results is	Listen and share actively, and defend findings convincingly.

			not very convincing.	
CGKC 6. Make decisions and suggest ideas.	CGKC 6.1. Conclude and propose ideas for processing things, phenomena, and processes. that have been studied.	Draw conclusions but have not proposed ideas for processing things, phenomena, or processes that have been studied.	Conclusions can be made, but suggestions for handling things, phenomena, and processes that have been studied are not clear and in detail.	Draw conclusions and propose ideas for processing things, phenomena, and processes that have been studied clearly and in detail.

Based on the above structure, to ensure the assessment throughout the process of performing learning tasks, suitable tests, rubrics, checklists, and rating scales are built for each activity.

2.2.2. The theoretical basis of competency assessment to develop competence in gaining knowledge and communication through process assessment

- *The notion of process assessment:* Process assessment takes place throughout the teaching and learning process, providing feedback to teachers and students to improve the quality of education, for the sake of students' progress, unlimited number of times of assessment, and diversification of participants in the assessment [1].

- *The process of process assessment to develop competence in gaining knowledge and communication [17]:* Step 1: Find out the purpose and context for process assessment; Step 2: Select a toolkit for process assessment; Step 3: Teach using process assessment tools; Step 4: Analyze and process the assessment results; Step 5: Use the assessment results to adjust the teaching and learning process; Step 6: Announce the results of the assessment to stakeholders.

- *Visual teaching process [9]:* Step 1: Identify the content to be implemented and the goal of using visual media; Step 2: Prepare visual media; Step 3: Design learning assignments; Step 4: Use visual media in the teaching process; Step 5: Learn from experience and reform the teaching plan.

- *The relationship between the process of visual teaching and the manifestations of the competence of gaining knowledge and communication and the tools of process assessment:* To build lesson plans using the tools of process assessment to develop the competence of gaining knowledge and communication, we have built a relationship between three factors: the process of visual teaching, components of competence of gaining knowledge and communication, and the tools of process assessment. The results are described in Table 2.

Table 2. The relationship between the process of visual teaching and components of competence in gaining knowledge and communication and process assessment tools

The visual teaching process	**The components of competence of gaining knowledge and communication**	**The measures of process assessment**	**The process assessment tools**
Step 1: Identify the content to be implemented and the goal of using visual media	CGKC 1: Propose problems and ask questions.	Observation, question, and answer	Questions, exercises, checklists (Use Google form, Quizizz)

Step 2: Prepare visual media	CGKC 2: Make judgments and build hypotheses		
Step 3: Design learning assignments	CGKC 3: Plan and Implement	Assessment through academic records	
Step 4: Use visual media in the teaching process	CGKC 4: Implement the plan	Evaluation through learning products	Checklist, rubrics, rating scale, Questions/exercises (Use Google Form, Kahoot)
Step 5: Learn from experience and reform the teaching plan	CGKC 5: Write, present reports, and discuss.	Observation, question and answer, evaluation through learning products	
	CGKC 6: Make decisions and suggest ideas.		

2.2.3. The current situation of applying capacity assessment to develop the natural inquiry capacity through process assessment in teaching Natural Sciences

Through the survey results of about 350 students and 24 teachers of Natural Sciences in schools in Hanoi and Thai Binh, we found that most of the teachers know process assessment (about 85% know the concepts and subjects participating in assessment in process assessment) but most teachers have not applied process assessment in teaching. Only about 32.25% of teachers have applied and achieved efficiency accounting for about 15% and 15% achieved efficiency. Most teachers do not clearly understand how to design and use methods and tools for process assessment (about 40%). Tools teachers often use are writing tests (accounting for 95%). Only 23% of teachers use visual teaching methods to teach. Teachers mainly still use traditional methods or other methods. This proves that the teaching method has not been promoted.

For students, about 85% of students are not in a position to explore and discover nature and they are less interested in their teachers' teaching methods, so their scores in Natural Sciences are not high. Very few students participate in process assessment (about 20%) and mainly teachers evaluate students. Therefore, students do not know how to self-evaluate and assess the process.

From the actual situation, it is shown that the use of competency assessment through process assessment and visual teaching methods to develop natural inquiry capacity is very necessary in the current period of the new general education program.

2.2.4. Illustrated lesson plans

Lesson plans are illustrated with the visual teaching method "*Introduction to chemical bonding*".

**** Objectives***

- *General competencies:* Communication and cooperation (CC) through the process of performing learning tasks, self-control and self-study (SC-SS) through self-fulfillment of assigned tasks, problem-solving, and creativity about chemical bonding (PSC).

- *Natural science competence:*

+ Natural scientific awareness: Perception 1: State the arrangement of electrons in the atomic shells of some noble gas elements; Perception 2: State the formation of ionic bonds; Perception 3: State the formation of covalent bonds.

+ *Learning about nature:* CGKC 1: Identify chemical bonds present in natural substances; CGKC 2: Make judgments and build hypotheses about chemical bonding; CGKC3: Plan to learn

about chemical bonding; CGKC 4: Implement a plan to learn about chemical bonding; CGKC 5: Present the results of the process of learning about chemical bonding; CGKC 6: Conclude the process of learning about chemical bonds.

- *Applying knowledge and skills learned:*

+ Ex1: Explain several phenomena in life based on scientific theory;

+ Ex2: Provide solutions to problems related to chemical bonds.

- *Qualities: Honesty, responsibility, and diligence.*

**** Teaching equipment and learning documents:***

worksheets, assessment sheets, and videos used in the lesson.

(https://drive.google.com/drive/folders/1utdRttoDp78hQPqhOEcnTv2m6aGYlxa-)

**** Teaching process***

- *Activity 1: Starting (5 minutes)*

+ Objective***:*** Creating interest in learning; SC-SS, honesty, CGKC 1.

+ Content: Students observe molecular images of substances in life such as bronze statues, oxygen gas, salt, and water, and answer the questions: Which substances are elements or compounds?; Which substance exists alone, not bonded to another atom; which substance is in the "combined" form with another atom?; When substances are in "combined" form, why do atoms stick together?

+ Products: The elements are oxygen gas and bronze statues. The compound is water and salt; Oxygen gas, copper statue exists in the form of a "stand-alone", not bonded to other atoms. Water, table salt in the form of "combined" with other atoms. Chemical bonds hold the atoms together.

+ Organization of implementation**:** The teacher asks students to observe some pictures of life and answer questions. Students answer and the teacher leads into the lesson.

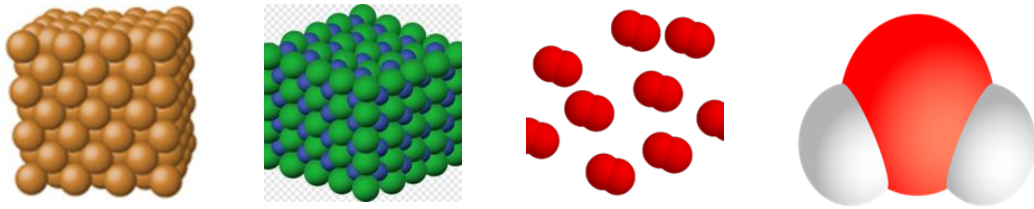


Figure 1. Molecules of copper, salt, oxygen, and water

+ Evaluation plan***:*** Students self-assess and peer-assess for preliminary assessment of knowledge about chemical bonds present in natural substances. Teachers observe and evaluate students' ability to view issues about science and technology. This activity has created excitement in learning and formed skills and competencies for students including SC-SS, honesty, and CGKC 1.

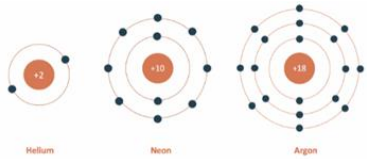
- *Activity 2: Forming new knowledge*

+ Activity 2.1. Stable electron structure of noble gases (30 mins)

Objectives: Forming the following competencies: Perception 1, CGKC 1, CGKC 2, and qualities including CC, SC-SS, honesty, responsibility, and diligence.

Content***:*** Students discuss in groups, observe models of noble gas electron shells, and videos of things to know about noble gases (https://www.youtube.com/watch?v=eUULzPOrxLg&t=46s) and complete the first worksheet.

WORKSHEET 1

Question 1: 	Observe the image showing the number of electron shells, and the number of electrons in the outermost shell of He, Ne, Ar. Comment on the number of electrons in the outermost shell of those noble gas atoms**.**
Question 2: Watch the video What You Need to Know about Noble Gases and the noble gas electron shell model, and make predictions about the combination of noble gas atoms with other elements under normal conditions.	

Products*:* worksheet answer 1 at the link: https://docs.google.com/document/d/1QD6WdkAkfjLgPIt-YsgCrOENmx-FyQam/edit

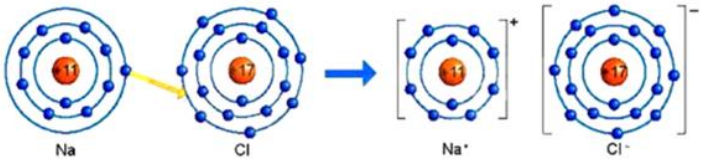
Organization of implementation: Students observe images of electron arrangement models in the atomic shells of some noble gases and videos of noble gas atoms; group discussion (6 groups) complete 1st answer sheet in 15 minutes; Teachers conclude about the tendency of atoms to participate in chemical bonding to achieve a stable electron structure of noble gases and expand further: Helium gas is an inert gas, difficult to explode, and lighter than air, so it should be injected into a hot-air gas. an alternative to hydrogen because hydrogen is flammable and explosive.

Evaluation plan: Students self-assess and peer-assess in groups through *1st evaluation sheet: Checklist to assess students' ability* (at a link: https://docs.google.com/document/d/1rb5YUsdMse8XqwGGrOtxgzsMUOxDjBoB/edit); The teacher evaluates the student's CGKC 1, and CGKC 2 through the 1st answer sheet. So, this activity has formed and developed students' CGKC 1, and CGKC 2 of the competence of gaining knowledge and communication and other competencies, qualities including perception 1, CC, SC-SS, honesty, responsibility, and diligence.

+ Activity 2.2. Learning chemical bonding (80 minutes)

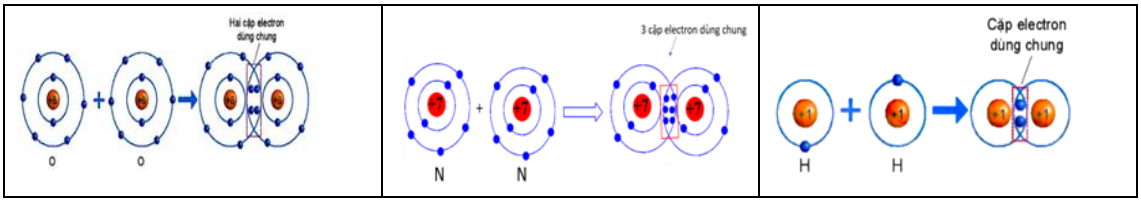
Objectives: Forming the following competencies: Perception 2, Perception 3, CGKC 1, CGKC 2, CGKC 3, CGKC 4, CGKC 5, CGKC 6 and qualities including CC, SC-SS, honesty, responsibility, and diligence.

Content: At home, students learn the video of bond formation in NaCl molecule, (https://www.youtube.com/watch?v=prIfqJgCIlQ) provided by the teacher; in class, students work in groups to play games "Amazing Race" and complete the worksheet stations 1, 2, 3; decipher the letter from the teacher.

Worksheet station 1
Question 1: Observe the figure, and compare the number of electrons in the outermost shell of the Na atom with the Na^+ ion and the Cl atom with the Cl^- ion. Indicate how many electrons Na and Cl atoms have given or received to form Na^+ and Cl^- ions. 
Question 2: Observe the video of the formation of the NaCl molecule and describe and draw the bond formation in the NaCl molecule. Give the name of the bond formed in the NaCl molecule.

Worksheet station 2

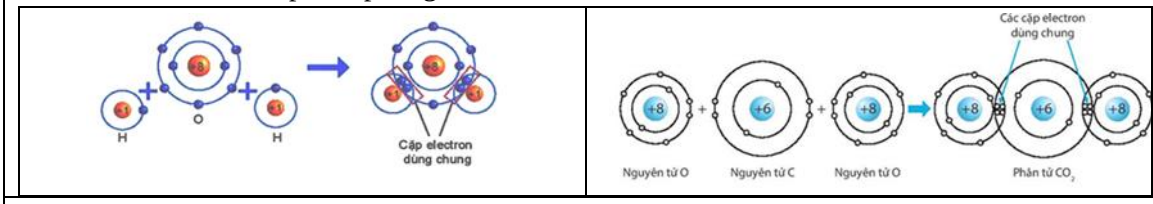
Question 1: Observe the picture, and show the number of electrons in the outermost shell of the atoms before and after the molecules participating in the chemical bonds



Question 2: Describe and draw the bond formation in molecular hydrogen from the tools provided at each station. Give the name of the bond formed in the Hydrogen molecule.

Worksheet station 3

Question 1: Observe the picture, and show the number of electrons in the outermost shell of the atoms before and after participating in the chemical bonds.



Question 2: Describe and draw the bond formation in the carbon dioxide molecule from the tools provided at each station. Give the name of the bond formed in the carbon dioxide molecule.

Secret Letter

Question 1: Why in nature, salt is usually solid, hard to melt, and hard to evaporate, while sugar and ice are in a molten solid state and water in liquid form is volatile?

Product: Answers for worksheet stations 1, 2, and 3 at the following link: https://docs.google.com/document/d/1XuJUYpUnqnPm3cQlbGhoZC2j2hA95oSy/edit?rtpof=true

Organization of implementation: At home, students learned the video provided by the teacher. In class, the teacher divides the class into 6 groups and turns the activity into a game called "Amazing Race" that requires station missions. Group 1, 2 - station 1; groups 3, 4 - station 2; group 5, 6 - station 3. Each station has tools, worksheets, and an instruction sheet. Each station takes 15 minutes to perform, and after the time is up, students move clockwise to the next station. When students complete 3 stations, they will receive and decipher the letter from the teacher, if the solution is correct and fastest, they will receive a gift from the teacher.

- Teachers answer the concept of ionic bonds, covalent bonds, the formation of chemical bonding, and the state of ionic compounds, and covalent substances.

Evaluation plan: Students self-assess and peer-assess in groups through *2nd evaluation sheet: Scale to evaluate the process of learning chemical bonds* (at a link: https://docs.google.com/document/d/1rb5YUsdMse8XqwGGrOtxgzsMUOxDjBoB/edit).

The teacher evaluates 6 components of competence of the competence of gaining knowledge and communication through the 2nd evaluation sheet. This activity has formed and developed students' CGKC 1, CGKC 2, CGKC 3, CGKC 4, CGKC 5, and CGKC 6 of the first competence of gaining knowledge and communication and other competencies, qualities including perception 2,3, CC, SC-SS, honesty, responsibility, and diligence.

- Activity 3: Practice (35 minutes)

Objectives: developing competencies including Ex1, Ex2; CGKC 1, CGKC 2, CGKC 3, CGKC 4, CGKC 5, CGKC 6 and the following qualities: CC, SC-SS, PSC, honesty, responsibility, and diligence.

Content: Students work in groups and answer questions: Question 1. Let's learn in practice 2 substances that are less volatile, difficult to melt, and form conductive solutions. Draw a diagram depicting the formation of chemical bonds in that molecule. *(Developing competencies CGKC1, CGKC 2, CGKC 3, CGKC 4, CGKC 5);* Question 2. Find out 3 gases present in the composition of the air. Draw a diagram depicting the formation of chemical bonds in that molecule. *(Developing competencies CGKC1, CGKC 2, CGKC 3, CGKC 4, CGKC 5);* Question 3. *(Development competency CGKC 6)* Explain the phenomena:

(1) Pure water hardly conducts electricity, but salt water conducts electricity. 	(2) When you put sugar in a pan and then heat it, you will see that the sugar quickly turns from a solid to a liquid, doing so with table salt will show that the salt is still in a solid state. 

Figure 2. The phenomena of the experiments

Products: Game answer at the link: https://docs.google.com/document/d/1f2qX4-Co6cZ5igBcKOUL0ysFjzIrtJZ6/edit

Organization of implementation: The teacher divides the class into 4 teams and asks the students to play the game "Learning about chemical bonds". The teacher shows questions, teams think and answer in 7 minutes. A correct answer gets 30 points, a wrong answer gets no points. If no team can answer, the teacher will answer. The team with the most points gets a gift from the teacher.

Evaluation plan: Students self-assess and peer-assess in groups through *3rd evaluation sheet: Rubric evaluates practice activities.* The teacher evaluates 6 components of the competencies of self-directed learning for students through the 3rd evaluation sheet. So this activity has formed and developed students' CGKC1, CGKC 2, CGKC 3, CGKC 4, CGKC 5, and CGKC 6 of the 2nd competence of gaining knowledge and communication and other competencies and qualities: SC-SS, CC, PSC, honesty, responsibility, diligence, Ex1, Ex2.

Table 3. The 3rd evaluation sheet of the Rubric evaluates practice activities

Component of competence	Criteria	Level 1 (Not Achieved)	Level 2 (Achieved)	Level 3 (Good)	Level achievement
CGKC 1	Able to identify the chemical bonding of some substances in nature.	Unable to identify the chemical bonding of some substances in nature.	Able to identify the chemical bonding of a few substances in nature but not in sufficient quantity.	Able to fully identify the chemical bonding of some substances in nature.	
CGKC 2	Able to make	Unable to make	Able to make predictions	Able to make specific and	

	predictions about the types of chemical bonding in some substances in nature.	predictions about the types of chemical bonding in some substances in nature.	about the types of chemical bonding in some substances in nature but not specifically.	detailed predictions about the types of chemical bonding in some substances in nature.	
CGKC 3	Able to develop a plan to study the chemical bonding of substances in nature.	Unable to develop a plan to study the chemical bonding of substances in nature.	Able to develop a fairly comprehensive plan to study the chemical bonding of substances in nature.	Able to develop a detailed and clear plan to study the chemical bonding of substances in nature.	
CGKC 4	Research the chemical bonding of substances in nature.	Research on chemical bonds of substances in nature has not been conducted.	Conducts research on the chemical bonding of substances in nature, but it is incomplete and lacks detail.	Conducts thorough and detailed research on the chemical bonding of substances in nature.	
CGKC 5	Creates diagrams illustrating the formation of bonds in substances found in nature.	Unable to create some diagrams illustrating the formation of bonds in substances found in nature.	Creates correct diagrams illustrating the formation of bonds in substances found in nature, but not with enough substances.	Able to create complete and accurate diagrams illustrating the formation of bonds in substances found in nature.	
CGKC 6	Able to explain practical issues related to the study of chemical bonding in substances found in nature.	Unable to explain practical issues related to the study of chemical bonding in substances found in nature.	Able to explain practical issues related to the study of chemical bonding in substances found in nature, but lacks persuasiveness and completeness.	Able to explain practical issues related to the study of chemical bonding in substances found in nature convincingly, comprehensively, and accurately.	

- *Activity 4: Applying (2 days at home and 40 minutes in class)*

Objectives: Developing competencies including CGKC 1, CGKC 2, CGKC 3, CGKC 4, CGKC 5, CGKC 6 and the following qualities: SC-SS, CC, PSC, honesty, responsibility, and diligence.

Content: At home, students experiment to show that ionic compounds are more heat stable and conduct electricity better than covalent substances, write a report in class in the worksheet on learning about chemical bonds in nature and present it in front of the class with the following contents: State the problem to be solved; repeat the learned knowledge related to the problem; make hypothetical predictions about the problem; select and propose experimental methods and instruments to verify predictions; conduct experiments; experimental results and phenomenon explanations; conclude the problem.

Products: Students' experiment video at the link: https://drive.google.com/drive/folders/1sGfFZ4qVzpfQWku5BFT7TxmA0ghXhFR2 and worksheet's answer at the link: https://docs.google.com/document/d/1uy5aCszbc7ivfhPOS mLi6a_af30IMdG1/edit?rtpof=true.

Organization of implementation: In the previous lesson, the teacher sent the students a sample experiment video: Comparing the thermal stability and testing the electrical conductivity of salt and sugar: https://www.youtube.com/watch?v=_1QyJIF2Aag https://www.youtube.com/watch?v=7dA64uDXOTc; At the same time, the teacher asked the groups to do the same experiment at home and record the video; In class, the groups wrote on the worksheet and presented it in front of the class.

Group 1, 2: Give an example to show that ionic compounds are more heat stable than covalent substances.

Group 3, 4: Give an example to show that ionic compounds conduct electricity better than covalent substances.

Evaluation plan: Students self-assess and peer-assess in groups through the *4th evaluation sheet: Scale to evaluate the task of learning chemical bonds in nature.* The teacher evaluates 6 components of competence of the competence of gaining knowledge and communication through the 4th evaluation sheet. So, the activity has been formed and developed students' CGKC1, CGKC 2, CGKC 3, CGKC 4, CGKC 5, and CGKC 6 of the 3rd the competence of gaining knowledge and communication and other competencies and qualities include SC-SS, CC, PSC, honesty, responsibility, and diligence.

Table 4. The 4th evaluation sheet of Scale to evaluate the task of learning chemical bonds in nature

Component of competence	Expressions	Level 1 (Not Achieved)	Level 2 (Achieved)	Level 3 (Good)	Level 4 (Excellent)	Level 5 (Outstanding)
CGKC 1	Able to accurately state and express clear questions regarding the issue to be investigated about chemical bonding.					
CGKC 2	Able to identify appropriate hypotheses.					

CGKC 3	Propose the correct method and provide all necessary experimental tools.					
CGKC 4	Successfully and safely experiment					
CGKC 5	Able to state the results and provide notes during the experiment.					
CGKC 6	Able to conclude the issue investigated regarding chemical bonding.					

Level 1: Failed to implement; Level 2: Implemented, but there are still errors; Level 3: The implementation is known but not yet complete; Level 4: Already done; Level 5: Be able to implement it clearly and fully.

2.2.5. Pedagogical experiment

The pedagogical experiment was conducted in the school year 2022-2023 at Phong Chau inter-level high school - Dong Hung - Thai Binh and Hong Phong Secondary School - Chuong My - Hanoi. Pedagogical experiment results are shown through the test results before and after the impact; the rating scale, checklist, and rubric are as follows: https://docs.google.com /document/d/16cxrGY2eqN0GRNDVhbOGc_h2fQSXSGDJ/edit?usp=drive_web&ouid=115877101518091779727&rtpof=true (Link of test and data processing)

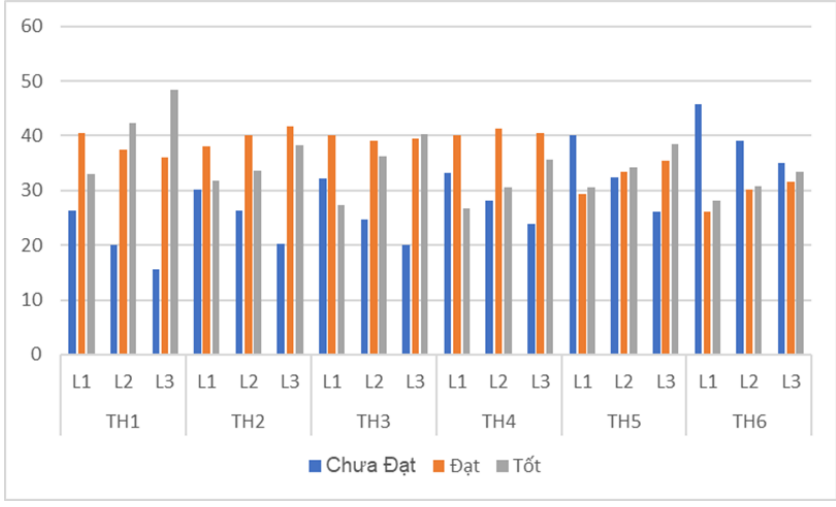


Figure 3. The results of the evaluation of the natural inquiry capacity through 3 times of impact

The results of the test before and after the impact are shown in Table 4.

Table 5. Statistical parameters comparing the 2 tests

Test	Average score	Median	Mode	Standard deviation	t-test depends	Influence level
Before Impact	10.71	11	6	4.28	$1.29.10^{-16}$	0.51
After impact	12.89	13	9	3.86		

From the above results, we find those things as follows:

- After 3 times of impact, all components of the competence of gaining knowledge and communication with the percentage of students at the good level have increased and at the unsatisfactory level have decreased compared to the original. This proves that the student's competence in gaining knowledge and communication has developed.

- The average scores (up 2.18 points), median, and mode all increase, and standard deviation decreases. This proves that the score increase has a higher concentration.

- The t-test value is very small, at less than 0.05, which indicates a significant effect.

- The level of influence is 0.51 according to the parameter, we see that the impact has an average effect.

From the above analysis, it can be said that through the visual teaching method, the application of process assessment is effective in developing the competence of gaining knowledge and communication.

3. Conclusions

From the research on the competence of gaining knowledge and communication and applying process assessment in teaching to develop the competence of gaining knowledge and communication for students in the subject of Natural Sciences in grade 7, we have built the tools of self-assessment and applied it in the topic of "Matter and its changes" illustrated in the lesson of *Introduction to chemical bonding*.

Experimental results show that all the competence of gaining knowledge and communication includes identifying the problem to learn, making a hypothesis for the problem, making a research plan, implementing the research plan, and presenting the results of the inquiry process. In conclusion, the problem-solving process is developed. This proves that the application of process assessment through visual teaching in the development of the competence of gaining knowledge and communication is feasible. Thus, teachers can completely apply process assessment in the development of the competence of gaining knowledge and communication for students in other lessons, and different topics of different subjects.

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