



## Design Learning Activities for the Topic of Microbiology - Biology 10 toward Self-Study Competence Development

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### ABSTRACT

Nowadays, the world's enormous knowledge resources has become more accessible than ever thanks to the support of the Internet and technology. Students and learners are enabled to learn whenever and wherever they want. Teachers have encouraged students to improve their self-study competence to exploit this advantage. Designing the teaching process and activities to develop students' self-study competence plays an important role in many subjects, including Biology. Therefore, this study proposes a four-step learning process to develop students' self-study competence. The study also presents an example to illustrate this learning process and help teachers understand what they should do in designing a particular lesson to develop students' self-study competence.

## 1. INTRODUCTION

Self-study has become a focal point for those pursuing a better knowledge of their particular practice setting. Those with a concern for teaching and learning in parallel fields (such as reflection, action research, teacher research, participant research, and practitioner research) have been influential in remodelling how self-study is perceived and conducted (Loughran, 2005). Researchers and scholars mentioned the importance of self-study centuries ago. In the 17<sup>th</sup> century, Komensky found methods that encouraged students to talk and engage more in lessons. Some of his teaching principles are applied these days to improve students' active learning: the principle of going from the general to the specific, ensuring the importance of intuitiveness in teaching, and respecting objects' characteristics (Luong & Hoang, 2005). Many educators also believe that a crucial way to acquire knowledge is by yourself through self-discovery, self-exploration, and self-reflection.

According to Rubakin, to learn effectively, it is necessary to educate people with the proper motivation in the self-study process because the essential condition for students to be active in self-study is the suitable motivation. However, motivation is not enough, and learners need self-study skills to learn effectively (Rubakin, 1982). Singh (1986) emphasized the role of teachers in consulting students on their regular study process and life-long study and developing self-study competence for learners. How to personalize the learning process so that each individual's potential is revealed and fully developed is the main challenge for education (Singh, 1986).

Moreover, the students do not have enough time to study all the needed materials in the lessons. Therefore, teachers only briefly explain the material, focusing on the critical knowledge that can appear in the exam, together with exercises and questions (Ambarwati & Suyatna, 2018). The hour spent studying is an effort for self-study learners and reflects their willingness to make immediate sacrifices, for example, recreational time for eventual rewards. Even though the results remain controversial, there have been many empirical findings on the relationship between studying time and academic performance (Keitz, 1982; Krohn & O'Comner, 2005; Nonis & Hudson, 2010; OECD, 2011). After analyzing the collected data, some Korean researchers realized that more time spent on private tutoring for science leads to lower achievement levels for students, and self-study time or the self-study variable has a more significant effect on achievements than private tutoring (Sung & Kim, 2010).

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Others also reported that self-study hours, excluding schoolwork or private tutoring, positively affect the academic achievements of high school students in Korea (Rhee & Kwaug, 2010). Therefore, teachers must organize activities to foster self-study skills for learners during the teaching process. Assigning cognitive exercises to students during self-study is an important measure to improve students' positivity, independence, and creativity in learning. In recent years, many Vietnamese educators have focused on researching self-study and teaching methods to build up and further develop this competence for students. In teaching self-study skill, teachers play the role of consultants who organize, support, and instruct students to acquire knowledge and skills by themselves. The role of teachers will diminish when students are in higher classes and when self-study activities are organized at home and in school (Thai, 2010). The teaching protocols towards developing self-study competence were recommended for teaching Biology (Phan & Kieu, 2016; Dang & Phan, 2018) and Physics (Le & Pham, 2017). In this study, the principles of teaching design, teaching process, and an example related to the topic of Microbiology - Biology 10 are presented to give teachers an in-depth view of teaching towards developing students' self-study competence.

## 2. LITERATURE REVIEW

### 2.1. *The concept of self-study competence*

Hamel and Prahalad (1994) defined core competence as "the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies" (Hamel & Prahalad, 1994). According to Weinert (2001), it is skills and techniques learned or acquired by an individual to solve specific situations as well as readiness for social motivation and the ability to apply problem-solving approaches responsibly and effectively in flexible situations. However, in this study, competence is considered as an individual attribute formed and developed with existing qualities and the learning processes. It allows people to summarize knowledge, skills, and other individual attributes (such as interest, faith, effort, etc.), to successfully complete a particular activity and achieve desirable results in particular conditions.

There are many definitions of self-study competence. It is considered the overall integration of learning styles and skills that affect content in different situations and problems (Le & Pham, 2017). Another understanding is that self-study is the ability to learn, recognize, and apply knowledge in new circumstances or similar ones with high quality (Nguyen & Nguyen, 2007). Another researcher believed that self-study competence is the ability to use intellectual abilities and sometimes actions, with motives and emotions, to occupy a particular area of human understanding, turning that field into the property of an individual (Le & Pham, 2017). Self-study competence is defined as the ability to identify learning tasks voluntarily and proactively; set learning goals and strive to achieve them; use effective learning methods; adjust their own mistakes and limitations when performing learning tasks through self-assessment or suggestions from teachers and friends (Luong, 2015). Another definition is that: the ability to acquire, comprehend, and apply knowledge in a new or comparable context with high quality is considered self-study competence (Le, 2010). Self-study competence is demonstrated when the subject accurately recognizes their learning motivation, has the ability to self-manage his learning, and has a positive attitude toward activities to work and change his own activities. In order that they can work independently and collaborate with others, they must learn and self-study (Trinh, 2003). In this study, self-study competence is defined as the ability of learners to independently determine study goals, design and conduct study plans, self-evaluate, and self-regulate to optimize knowledge absorption and competence development (Phan & Kieu, 2016).

### 2.2. *The components of self-study competence*

There are 5 component competencies that establish self-study competence (Phan & Kieu, 2016). The expressions of those skills are illustrated in Table 1.

*Table 1. Components of self-study competence*

<b>Components of self-study competence</b>	<b>Behavioral expression</b>
Questioning competence	- Ask questions about the lesson. - Figure out what questions they can answer after the lesson.
Planning competence	- Determine the content of the lesson. - Predict necessary study materials, study tasks, and products.

Studying competence	- Study using determined tasks, including collecting information, analyzing information, and designing products.
Self-performing competence	- Present the study results in front of the class.
Self-assessing and self-regulating competence	- Self-assess the study process based on provided criteria or design criteria by themselves. - Self-regulate the study process based on experiences.

### 3. RESEARCH METHODS

Different research methods were used in this study, namely document analysis, experimental research, and consultation.

- Document analysis method: Many articles in Vietnam and the world were analyzed to find out the issues related to the topic, and then a literature review about the topic was composed.

- The experimental research method was used to investigate the teaching status in developing students' self-study competence.

### 4. RESULTS AND DISCUSSION

#### 4.1. Results

##### *The principles of designing learning activities towards developing self-study competence for students*

To develop students' self-study competence, all learning activities used in the process should follow three basic principles as below:

- Learning activities must ensure the learning objectives.
- Learning activities must be designed to improve self-study competencies for students.
- Learning activities must encourage students to engage in studying and stimulate their interest in learning actively.

##### *The process of designing learning activities towards developing self-study competence*

The process of designing learning activities can be conducted with four steps:

(1) *Determining the objectives of the lesson*: Teachers analyze the objectives in terms of knowledge, skills, attitude, and competences; focus on the objective of developing self-study competence for students; determine contents and activities which help students improve their self-study competence.

(2) *Analyzing contents and determining learning activities towards developing self-study competence*: Teachers should analyze the content of the lesson to determine the new knowledge to design suitable activities.

(3) *Designing learning activities towards developing self-study competence*: Teachers choose study materials and convert them into learning activities, including: + Making a study plan (In the study plan, students should determine contents for self-study, necessary activities, and appropriate teaching methods for each activity); + Solving learning problems: Students conduct planned learning activities; + Reporting study results; + Assessing study results.

(4) *Designing assessment criteria*: In this step, teachers create assessment criteria in terms of knowledge, skills, attitude, and competences for self-assessment or cross-assessment among students. Students also can create their own criteria and regulate their learning process.

##### *The assessment criteria and assessment tools for self-study competence*

Self-study competence has 5 component skills, so the assessment criteria of 5 component skills should be taken into account to evaluate the self-study competence. In the Table below, a set of criteria for self-study competence is shown.

Table 2. Assessment criteria for self-study competence

Component competences	Assessment criteria
Questioning competence	Ask questions about the lesson and questions related to applying knowledge in practice. Figure out what questions they can answer after the lesson, what questions remain unanswered and why.

Planning competence	Determine the targeted knowledge of the lesson.
	Predict necessary study materials.
	Predict study tasks and activities to learn.
	Predict the products which should be designed in the lesson.
Study competence	Be able to find different study material resources for different aims and tasks.
	Think and focus on answering teachers' questions.
	Concentrate on fulfilling study tasks and actively contribute to the groupwork tasks.
Self-performing competence	Design study products.
	Be able to present their study results by using mind maps, images, tables.
	Present their study results clearly, logically, and creatively.
Self-evaluating and self-regulating competence	Be able to compare their results with study goals precisely and comparatively, then point out their weaknesses and strengths.
	Be able to self-regulate their study process.
	Be able to apply their experiences in solving new problems.
	Build their own study methods.

**Example: Designing learning activities for the topic of Infectious diseases and immunity**

(1) *Determining the objectives of the lesson:* The objectives of the lesson are presented in the diagram below.

Knowledge	Skill	Attitude	Competence
<ul style="list-style-type: none"> <li>State the definition and causes of infectious diseases.</li> <li>Analyze the mechanism of spreading infectious diseases and point out the methods to avoid and prevent infectious diseases</li> <li>Give examples about infectious diseases caused by viruses.</li> </ul>	<ul style="list-style-type: none"> <li>Find study materials, analyze information.</li> <li>Present and summarize information.</li> </ul>	<ul style="list-style-type: none"> <li>Have the awareness to propagate disease prevention measures for themselves and society.</li> <li>Have the awareness to protect health and avoid infectious diseases caused by viruses.</li> </ul>	<ul style="list-style-type: none"> <li>Self-study competence</li> <li>Collaboration competence</li> <li>Biology competence</li> </ul>

Figure 1. The objectives of the lesson

(2) *Analyzing contents and determining learning activities toward developing self-study competence*

**Activities 1: Enquiring about infectious diseases**

- Students find information about diseases, including definition, disease-causing, infection conditions, and transmission methods. However, the main content should be about infectious diseases.
- The activities should be designed to develop self-study competence, so students can learn about infectious diseases by themselves, find out the causes and characteristics of diseases transmission methods, and prevention measures.

**Activities 2: Enquiring about immunity**

- Students learn about immunity; distinguish specific immunity and non-specific immunity, humoral immunity, and cellular immunity.

(3) *Designing learning activities toward developing self-study competence*

Table 3. Activities in the teaching process

Activity	Implementation steps	Teachers' activities	Students' activities
Learning about infectious diseases	1. Organising Expert group	Divide the class into 4 groups and assign study tasks to students. Group 1: Study Covid-19 disease. Group 2: Study measles. Group 3: Study syphilis. Group 4: Study cholera.	- Study according to the guidance of teachers. - In each group, students have to study individually to get information about: disease causing, characteristics, prevention measures then discuss the study results.
	2. Regrouping puzzle pieces	Choose 4 students from 4 professional groups to complete the task.	- Present the findings of step 1, then discuss the task in step 2. - Each group should state the definition and causes of infectious diseases. Analyze transmission methods and propose some prevention measures.
	3. Presenting		- Present their study results.
	4. Peer assessment		- Evaluate their own products and other teams' products.
	5. Evaluating and finalizing key knowledge	Evaluate students' products and summarize information.	- Students memorize by recording keywords or brief sentences.
Learning about immunity	1. Thinking		- State the definition of immunity. - Create a table to compare different kinds of immunity.
	2. Pairing - sharing		- Discuss and share with partners.
	3. Presenting		- Present their study results.
	4. Peer assessment		- Evaluate their own products and other teams' products.
	5. Evaluating and finalizing key knowledge	Evaluate students' products and summarize information.	- Students memorize by recording keywords or brief sentences.
Practice and application		Present a extract of an article about Covid-19 disease and ask students to do some tasks.	- Answer questions based on the provided information: + Prove that Coronavirus is the reason for the epidemic in the world. + Explain the term "incubation period". + State the transmission methods of disease caused by Coronavirus. + State the definition of infectious diseases and infection ways of microorganisms. + List some diseases caused by viruses and their transmission methods.

*(4) Designing assessment criteria*

Based on the assessment criteria, teachers and students can use some assessment criteria as below to evaluate the self-study competence.

Table 4. Assessment criteria for self-study competence in the topic of Infectious diseases and immunity

Component competences	Assessment criteria	Maximal point	Self-assessment	Peer assessment	Teacher's assessment
Questioning competence	Students can ask questions about infectious diseases, their causes and ways to prevent them. What role does the immune system play in protecting the body from infectious diseases?	1.0			
	Students can determine: What infectious and immunological disease questions were answered by the knowledge in the lesson? Are there any unanswered questions? Why?	1.0			
Planning competence	Students can identify the main knowledge of the lesson which are: infectious diseases and immunity.	0.5			
	Students can predict necessary study materials in the teamwork activity.	0.5			
	Students can predict study tasks and activities to learn about infectious diseases.	0.5			
	Students can predict products that should be designed in the lesson.	0.5			
Study competence	Students are able to find different study material resources for different aims and tasks: Understand infectious diseases; Understand immunity; Practice and application...	0.5			
	Students can answer teachers' questions.	0.5			
	Students can concentrate and complete assigned learning tasks.	0.5			
	Students can design study products.	0.5			
Self-performing competence	Students are able to present their study results by using mind maps, images, tables.	1.0			
	Students can present their study results clearly, logically, and creatively.	1.0			
Self-evaluating and self-	Students are able to compare their results with study goals precisely and comparatively, then point out their weaknesses and strengths.	0.5			

regulating competence	Students are able to self-regulate their study process.	0.5
	Students are able to apply their experiences in solving new problems.	0.5
	Students can develop their own study methods.	0.5
Total		

#### 4.2. Discussion

There are many methods to develop self-study competence for students. Some researchers have used a blended teaching model to effectively develop self-study competence of high school students, creating learning motivation, thereby improving the quality of education and training. With the explosion of science and technology, teachers have been provided with many modern means and materials to support the teaching process (Nguyen et al., 2020). The results showed that the blended learning model is perfectly suitable for improving self-study competence for students, contributing to improving the quality of teaching Physics.

In the study on Organization of Physics 10 teaching in the direction of developing students' self-study ability with the support of Working model software (Pham & Le, 2019), the authors pointed out that: With this software, the experiments can be conducted easily and simply with reliable results. It can also be used to teach students to develop self-study competency. Also, the article proposed criteria to assess students' self-study competence at high school.

Learning activities towards self-learning competence development play an important role in teaching Biology. The researchers proposed a process of designing learning activities towards self-learning ability development for students in teaching Biology 6. Some learning activities based on this process have been suggested as illustrations, such as experimental practice, problem-solving exercises, and content summary (Dang, Phan, 2018). The process of designing learning activities in the direction of developing self-study capacity consists of 5 steps: Step 1. Identifying learning topics; Step 2. Analyzing content, identifying learning activities to develop competence self-study; Step 3. Collecting, selecting and developing materials for the design of learning activities; Step 4. Designing learning activities to develop self-study capacity; Step 5. Designing plan using learning activities. Thus, compared with previous studies, in the process of designing learning activities to develop self-study competence in our research, assessment criteria have been clearly designed to help teachers and students assess self-study capacity. Students (with self-assessment and cross-evaluation) and teachers can participate in the assessment process to yield more accurate results based on these assessment criteria.

## 5. CONCLUSION

This study was conducted to understand the importance of self-study for students and teachers' difficulties in the teaching process. It is essential to provide clear guidance for teachers. Therefore, a set of principles and a process for designing learning activities to improve students' self-study competence are presented in this study. Specifically, the process includes four main steps: (1) Determining the objectives of the lesson; (2) Analyzing contents and determining learning activities towards developing self-study competence; (3) Designing learning activities toward developing self-study competence; (4) Designing assessment criteria. Besides, a five-step process of teaching microbiology and a set of evaluation criteria and tools were built to assess the effectiveness of teaching activities in building up and improving students' self-study competence. Based on the literature review and experimental research findings, there are some recommendations for teachers: Teachers should follow the teaching process and organize suitable activities to improve students' competencies. They also need to change and use new teaching methods that encourage students to engage in learning actively. They should be active in designing and organizing learning activities that are suitable for differentiated students. However, they also need to be supported by professional groups in schools to improve the quality of teaching.

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