

DESIGNING LEARNING ACTIVITIES IN BIOLOGY GRADE 10 TO ENHANCE STUDENTS' CAREER ORIENTATION

Ho Thi Hong Van¹, Le Ngoc Hoan² and Dinh Quang Bao²

¹*The Vietnam National Institute of Educational Sciences*

²*Faculty of Biology, Hanoi National University of Education*

Abstract. Career orientation for high school students in teaching subjects has been identified as an important goal in general education so far and is especially reflected in the General Education Program 2018. This study has proposed the process of designing learning activities and types of learning activities in teaching Biology grade 10 to promote students' career orientation. Since then, we suggested to teachers when using learning activities according to 5E model and experiential teaching to improve the effectiveness of career-oriented teaching for students. The study has designed a learning topic illustrating the steps in the process of designing teaching activities to orient careers for students in teaching Biology grade 10 according to the Biology curriculum 2018.

Keywords: Biology teaching, career orientation, designing learning activities, teaching approach.

1. Introduction

High school is a significant period for students in science and affects their future career decision [1]. It is believed that experience activities at a school play a particularly important role in enabling students to select future careers in the field of science such as Biology. However, students still lack clear and timely instructions in planning their careers. Therefore, teachers' teaching approaches and learning activities in teaching Biology grade 10 are designed to promote student attitudes such as interest in science and thereby promote science-related career aspirations. It is especially important to use specific teaching methods such as using real work experience or project-based activities and exploring the relevance of biology school subject and science-related career because they may enhance students' interest and their career aspiration in the future. Many approaches have been applied to enhance students' interest in science subjects, for example highlighting the relationship between scientific knowledge and explaining the experience and work of scientists, practical work, experiential learning (often laboratory experiments) are still valuable in teaching science subjects, for example, through simulated real work to reproduce confirms the empirical nature of science, but other views and contrasting views are possible [2]. Organize inquiry-based teaching in the sciences that focus on student-led activities, not teacher-led activities (but with instruction and support from teachers), often through observation and experimentation (and possibly similar to real work) and this is an opportunity for students to apply more scientific methods [3]. Teaching approaches, such as advocacy of debate, are also developmental and practice methods that reflect the applications of

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Contact Ho Thi Hong Van, e-mail address: vansinhsp@yahoo.com

science professionals in their work [4]. Experimental, context-based teaching that focuses more on enhancing students' interest and interest in the subject and the relevance of subject knowledge with application in life, through use of applied contexts as scientific skills and ideas [5].

Cohen and Patterson has researched and searched for solutions to help ensure the breadth and depth of the STEM workforce (science, technology, engineering, math). The project has researched teaching strategies for Science subjects to promote career awareness of high school students. This study introduces career-inspired pedagogical strategies into science lessons. These strategies that target 4 goals of STEM career-oriented development for students are following:

- Awareness: expanding occupational awareness. Students develop understanding and evaluation of many different STEM careers (e.g., knowledge of essential skills, education, work/life issues).

- Relevance: seeing the relevance of the topic to his or her life. Students see meaningful content (for example, related to life experiences or decisions that students may need to consider in the future).

- Engagement: participate in STEM learning and career topics. Students show an interest in learning and experiencing more (for example, actively participating in discussions, asking questions beyond the content presented).

- Self-Efficacy: feel comfortable using scientific tools. Students develop confidence in accessing scientific tasks and mastering tools used by scientists in practice (C. Cohen & David G. Patterson, 2012) [6]. The author has identified four cognitive building blocks for career development and proposed four methods to raise awareness of science-related careers. The author then provides a category of ten scalable practice strategies, with examples attached.

B. Aeschlimann *et al.* (2016) have studied how to enhance learning motivation in Math and Science to enhance career options in STEM field in Swiss high schools. The study used Eccles' expectancy-value model (Eccles' expectancy-value model), built a simulation model to prove that classroom support measures will promote students' learning motivation in Math. and Science and Advanced STEM subject choice and STEM career options. B. Aeschlimann's research has evaluated the student's individual characteristics shown in two aspects: learning motivation and learning results. Designing lectures promoting learning motivation is assessed in aspects: personal support of teachers, easy-to-understand teaching, related to student's life experiences. These two factors will be assessed the degree of influence on STEM field learning choices. Research has confirmed that lesson designs that ensure the following 4 principles will promote learning excitement and improve learning outcomes in Math and Science: (1) Providing information about career opportunities, (2) Ensuring easy-to-understand teaching, (3) Providing personal support to students, (4) Linking subject-specific knowledge to life experiences [7].

R. Sheldrake (2017) analyzed the results of the PISA 2006 and PISA 2015 assessment of students in the UK and emphasized that teaching 'scientific application' (teaching applications and the relevance of science to the student's life) is a teaching method that has an effective impact on student interest in the subject, awareness of the application of science in students, thereby promoting career aspirations related to the science of students [8].

In Vietnam, career-oriented research for students through the subject has been interested in research by some authors (Nguyen Phuc Chinh, 2009; Phung Dinh Dung, 2014; Vu Cam Tu, 2017) [9-11]. However, no studies are showing specific ways to design and organize teaching activities to orient careers for students in teaching Biology grade 10 according to the new General education Programme (Ministry of Education and Training, 2018) [12].

2. Content

2.1. The process of designing learning activities for career orientation for students in teaching Biology grade 10

Based on analyzing the theoretical basis, in this study, we designed the process of building learning activities of teaching Biology grade 10 to enhance career orientation competencies for students. This process is represented by questions, practical exercises, exploration activities, experimental activities depending on the characteristics of the content and the requirements that need to be achieved in the programme of Biology grade 10. Learning activities are built according to the following process of steps.

2.1.1. General process

Based on the content of Biology grade 10 which can be organized learning and teaching activities for career orientation and career-oriented competency, we proposed 3 steps to design experiential and 5E exploration teaching for content as follows:

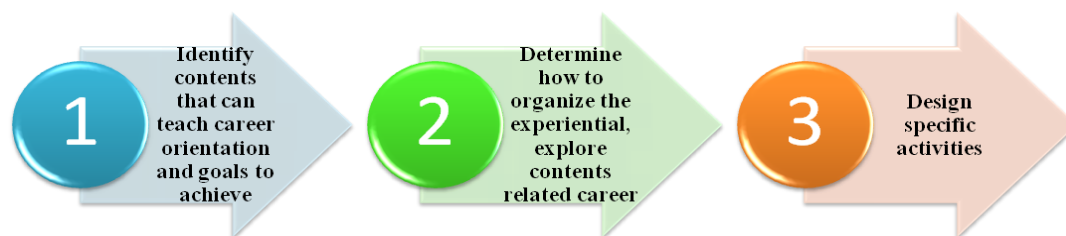


Figure 1. Process of designing learning activities

** Analyzing the process*

Step 1. Determine the content that can be career orientation teaching and the desired goal

Teachers need to determine what career-oriented content can be, what are the target knowledge, subject skills, and career-oriented goal when teaching this content. With different students, there are different goals, not only achieving the goal of memorizing lessons, but also developing what abilities. In designing teaching activities to develop career-oriented competencies, teachers need to identify what content can organize career-oriented teaching for students and clearly define the target to be cognitive. and career-oriented skills when teaching this content. Therefore, teachers plan which contents can be built into activities to organize career orientation for students.

Step 2. Determine how to organize the experience, explore contents and related careers

Teachers need to identify activities to explore scientific application and career experience activities to organize the teaching of selected lesson content to develop skills/competencies identified in the target. Some types of activities can be organized such as experiments, practice, research projects, surveys, career role-playing, product testing, in order to connect lesson contents and science, technology applications, and related careers. The identification of knowledge content and career-oriented skills in each lesson is the basis for building activities, ensuring the implementation of the lesson objectives, the cohesion of theory, and practical application. Therefore, it is necessary to identify and select Biological knowledge related to occupations and corresponding to career-oriented skills that need to be trained and developed for students. This is the basis to design learning and teaching activities to enhance students' career orientation competencies.

Step 3. Design specific learning activities

Based on the results of step 1 and step 2, the teacher designs a specific learning activity for the student. These activities are often expressed by questions, exercises, projects, research topics, the teacher needs to identify the resources support needed to do that activity. In order to design activities effectively, teaching activities need to enhance the experience, discovery, and application in solving practical problems, and occupations in society.

*** Some types of learning activities can be used in teaching Biology grade 10 to orient careers for students**

The learning activities used in teaching Biology grade 10 should be the combination of the biological knowledge cognitive activities, knowledge practice, and the connection of knowledge learned with the professional fields in society. Three types of learning activities can be used to orient careers for students: knowledge perceiving activities, practical activities, work-life connection with relationships according to the following diagram:

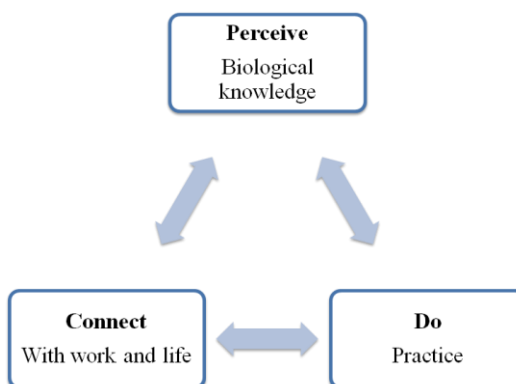


Figure 2. Types of learning activities in teaching Biology grade 10

Learning activities to perceive biological knowledge

Each type of learning activity depends on or serves a particular goal. Type of activities to acquire Biological knowledge that requires students to see, hear, or observe (for example, presentations, sharing stories, reading documents about Biological content, visiting related vocational training institutions. to Biology, etc.). Some activities of perceiving specific biological knowledge are shown in Table 1.

Table 1. Learning activities to perceive biological knowledge

| Presentation | Sharing stories | Reading | Experiential activities |
|--|--|--|--|
| <ul style="list-style-type: none"> - Slideshow - Illustration movements - Illustrated by software - Videos contain information - Watch drama - Observe picture/picture | <ul style="list-style-type: none"> - Tell stories to students. - Let students share their own story. | <ul style="list-style-type: none"> - Personal documents Materials in the library - Material on the internet which has been selected. | <ul style="list-style-type: none"> - Visit research centers, training institutions, businesses. |

In term of Teaching methods and teaching techniques, Biology teachers can use when teaching the form of comprehension activities to orient careers such as presentations, software illustrations, videos containing information, watching plays, viewing pictures/photos about Biological knowledge grade 10 and application of knowledge in practical activities.

Practical activities to guide careers in teaching Biology

This type of activity requires students to practice and explore. Types of career-oriented practical activities for students in teaching Biology grade 10 include the following:

- Games and simulation: Students play games or simulate to apply Biological skills in a safe environment, therefore, students will have a deeper understanding of the profession, building their self-efficacy.
- Practical activities: Students apply knowledge, biological skills to solve practical problems, careers, according to the degree of simplicity (to follow), the degree of complexity (need instruction from the teacher).
- Exploratory activities: Students conduct experiments and discover careers in Biology. Students find out and discover the concepts and processes of applying biotechnology by themselves.

Teaching measures and techniques that need to be used in the form of practical activities to orient careers for students in teaching Biology grade 10 such as games, 3D simulation, virtual reality, experimental practice, activities projects to learn and solve practical problems, experience activities, career exploration of Biology.

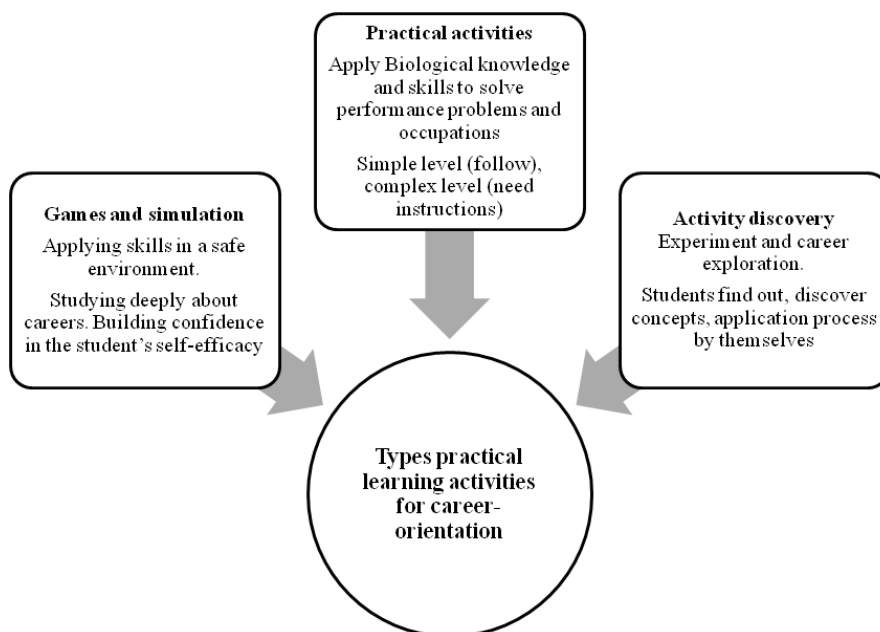


Figure 3. Types of practical learning activities for career-orientations in teaching Biology grade 10

Type of career-oriented connection activities

Characteristics of these activities help students to connect their learned knowledge with what they experience and apply their knowledge in real and future career contexts.

Activities for career orientation can be used in teaching Biology grade 10 such as:

- Research activities: Students define research and learning problems; Teachers ask students to find and solve problems in society related to a career in Biology.
- Specialized discussion: Students think, discuss in-depth the topic of Biology with practical applications that consider the problem under many different perspectives.

Students connect lessons that they learned with their known knowledge. Students make conclusions based on a combination of what they learned and their own experiences.

- Career support: Students apply the Biological knowledge which they have learned into practical careers in real society. Connecting the learning contents with application in real work in careers related to Biology.

- Practice: Students perform work in research and production establishments related to Biology, connecting what they are learned with real life, specific careers.

Teaching measures and techniques to be used in the form of practical activities to orient careers for students in teaching Biology grade 10 such as project activities, practical experience activities in professions, specialized discussion about the application of the topic Biology.

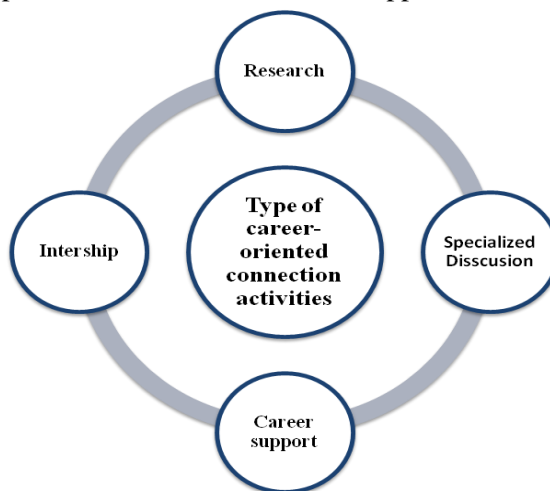


Figure 4. Connection activities aimed at career orientation in teaching Biology grade 10

In this learning activities designing process to develop career-oriented competencies for students, all 3 steps have a close relationship with each other. Results of step 1 will be the basis for conducting step 2, step 3. Moreover, based on the results in step 2, step 3, the teacher can go back to review and revise the previous step 1 and step 2 accordingly.

Based on the above types of activities and the content characteristics, required requirements, and the component skills of the career-oriented competency, when designing the topic of 5E discovery teaching about the application of public science technology and experience teaching Teachers can choose and arrange activities in each stage as follows:

*** Designing a 5E inquiry learning activities model**

- Activity 1: Engage: Students watch videos, pictures, share stories, research results ... about practical issues related to learning topics, connecting with related professions.

- Activity 2: Explore: Students conduct experiments, practice, research projects, explore the application of science in professions by learning topic content.

Activity 3: Explain: Students present experimental results, report on project implementation results, explain the implemented results, ...

Activity 4: Reinforce and apply (Elaborate): Students connect their knowledge of lessons with real jobs, specific occupations, think deeply about the learned problem, think about the problem below. many different perspectives, conducting experimental production applying simple technological processes into practice.

Activity 5: Evaluate: Students complete questions, assessment exercises after each topic, evaluate in groups, evaluate between groups, teacher comments.

*** *Designing the experiential learning activities model***

- Warm-up: Students observe videos, pictures, share stories, read research results identify practical problems related to learning topics, identify related occupations.
- Phase 1: Specific experience: Students conduct experiments to recognize ingredients of substances, specific work experience.
- Phase 2: Observe and reflect: Students conduct learning projects, research topics, ... about the content of learning topics connected with related professions.
- Phase 3: Generalizing the concept: Students systemize knowledge by thinking diagrams, concept maps, making tables.
- Phase 4: Positive test: Students play the role of a worker in a profession related to the learning topic (doctors, food technology engineers, etc.) using the learned knowledge to solve practical problems. (read biochemical test results, read food labels, make disease diagnosis, propose innovation in the product manufacturing process, etc.)

2.1.2. Illustration for designing learning activities to enhance students' career orientation in teaching Biology grade 10

Step 1. Determine the content that can teach career orientation and the desired goal.

Content: Topic "*Chemical components of cells*".

Learning objectives: To present structure and roles of water, chemical molecules in cells; to form and develop skills to perceive their own hobbies, skills to apply subject knowledge in career fields (skills to analyze product labels of workers in the food technology industry, skills of division analysis of test results on the lipid index in the blood of doctors, test technicians), ...

Step 2. Determine how to organize the experiential, exploring contents and related careers in the topic.

The topic "Chemical components of cells" has many practical applications (providing nutrients for plants, animals and humans, lipid metabolism disorders, glucose, the role of DNA in blood vessels), there are opportunities to organize activities to acquire biological knowledge, practice career-oriented and connect with practical careers such as:

- Watch clips on eating habits and association with metabolic diseases.
- Using simulation: show students science videos about metabolic diseases, scientific diet in humans.
- The project learns about the role of cell chemistry and its application in hydroponic vegetable cultivation, blood lipid disease research, blood bloodline determination.
- Play the role for students to experience by themselves: Students play the role of a food technology engineer who analyzes parameters on the food label to evaluate that food, making recommendations about the level of appropriate use. Acting as a doctor, the test technician reads the patient's biochemical test results and concludes about the patient's blood glucose and lipid level.

Learning and teaching activities:

- Teachers prepare product information labels, biochemical test results, instruct how to read information, ask questions
- Students: Roleplay, analyze, give comments, answer questions to draw lessons.
- Expectation results: product label, test result report.

Step 3. Design specific activities

Warm-up: Watch videos of some human diseases

- Students sit in groups, watching videos on the current state of some current issues such as water pollution, diabetes, obesity, high blood pressure, malaria, Down's disease.

- Ask students to discuss and answer questions: based on their understanding, please name and state the causes of those problems.

- Students and teachers list some causes, find relationships with topics.

*** *Perceiving knowledge***

Activity 1. Identify intracellular carbohydrates, lipids, proteins (Experimental activity)

Specific experience:

+ Teachers provide tools (test tubes, pipettes), reagents (Benedict, Sudan III, Buret, Lugol), samples (milk).

+ Students conduct experiments and fill in the observation results in the following table:

| | Benedict | Sudan III | Buret | Iodin (Lugol) |
|----------------|----------|-----------|-------|---------------|
| Colour of milk | | | | |

+ In your opinion, what are the main ingredients in milk nutrients? Why?

Give the reagent information (glucose: Benedict → red yellow, Sudan III: fat → magenta, protein: burette → purple, starch: iodine → blue).

Activity 2: Project activities (Observation and reflection activities)

The teacher assigns project implementation tasks:

- Teacher: divide into groups, assign tasks to students.

- Teachers assign tasks to implement projects for groups (5-6 students each):

+ Groups 1A, 1B: Exploring the structure and function of chemical elements and water. Application in hydroponic vegetable cultivation.

+ Groups 2A, 2B: Exploring structure and function of carbohydrates and lipids. Applied in research on blood lipid disease (dyslipidemia).

+ Groups 3A, 3B: Structure and function of proteins and their application in sickle-cell anemia research.

+ Groups 4A, 4B: Structure and function of nucleic acids and their application in determining bloodline and criminal investigation.

Student groups assign tasks to members, conduct research, research, discuss, build posters, present reports.

- Implementation time: 1 week

- Questions that students need to complete within periods 1 and 1 week before reporting results:

Chemical and water elements: Name the chemical elements in the cell:

- Why are the elements C, H, O N occupy a large proportion? Are other elements necessary?
- What are macronutrients, trace elements, and their roles?
- Why is carbon considered a particularly important chemical element in the structure of macromolecules?
- Present structure and state nature and role of water.
- What is a model of hydroponic vegetable cultivation? How is the chemical composition of the cells and water applied in this model?

Carbohydrates and lipids:

- Include all carbohydrates and state the chemical structure and function of carbohydrates and lipids.

- Find information about the causes and symptoms of some diseases: diabetes, cholesterol.

Protein:

- Presentation of structure and function of the protein.
- Applying to explain some phenomena such as: Why do we need to eat protein from many different food sources in our daily meals? Why beef, chicken, pork, hair, buffalo horn, silk, and spider silk are all composed of protein but are they so different in their properties?
- Study sickle cell anemia research.

Nucleic acid:

- Describe the structure and function of DNA and RNA.
- Learn about the application of DNA sequencing in bloodline identification and crime investigation.
- Teacher gives product evaluation criteria first for students (exact content, aesthetics, presentation, creativity, etc.).

Students proceed to deploy learning tasks.

Present results of the implementation

Groups presenting products and reporting results are done using the puzzle: puzzle group is made up of members of different expert groups. Posters are hung on the corners of the class, the transplant groups move in turn through the posters, the member of the group that made the poster will present to everyone in the group.

Teachers observe, support, and evaluate students' learning process.

Activity 3. Systemize knowledge by thinking diagrams (Conceptualizing activity)

- Teacher asks students to re-systemize knowledge about the chemical composition of cells in the form of a mindmap.
- Teacher draws a map on the board and asks students to report in a circle (each student reports 1 content, not identical to the previous report).

Activity 4. Career exploration (Positive test activity)

- Activities to explore food technology careers: playing the role of a food technology engineer:

Teachers let students observe how to read labels of packaged food products.

Students play the role of food technology engineers who analyze information on product labels and advise consumers to choose suitable products.

- Activities to explore the profession of Medicine - Pharmacy: Identify some chemical components present in cells (proteins, lipids, etc.), apply them in reading biochemical test results in medicine. Play the role of doctor, testing technician:

+ Teacher lets students observe the biochemical test results of a patient.

+ Students act as a doctor to analyze glucose, lipid blood test indicators and give comments on the health status of patients and give advice on diet for patients.

Activity 5. Evaluation

Question 1: Vegetables are common foods used in daily meals. Vegetables can be preserved in many different ways.

1. In the cold storage, green vegetables are stored at a temperature of 8 - 10 degrees C (cool compartment of the refrigerator) should not be stored in the freezer. Based on the characterization of the existence of water in the cells, explain this method.

2. There are 2 ways to preserve vegetables in the refrigerator:

Option 1: Pick up vegetables, wash them, close the bags and put them in the cupboard, use them.

Option 2: pick up vegetables, put them in bags, put them in a cupboard, when using them, wash them, and use them.

In your opinion, which way of preservation is more reasonable?

Question 2: Surgery is essential to the treatment of many medical ailments, performed in a specially equipped operating room. Patients may not be able to eat or drink after surgery, so they will be given fluids containing water, sugar, and mineral salts. Why are sugars introduced into the infusion fluid for patients after surgery?

- A. To avoid dehydration
- B. To control pain after surgery
- C. To treat post-operative infections
- D. To provide the necessary nutrition

Question 3: How should you do to plan your studies to become a person working in the fields of applying knowledge of chemical components of cells?

3. Conclusions

Based on analyzing the theoretical basis, we designed the process of designing learning activities of teaching Biology grade 10 to promote students' career orientation competencies. These learning activities are represented by questions, practical exercises, explorational activities, experimental activities depending on the characteristics of the content and the requirements that need to be achieved in the Biology grade 10 program. We have proposed three types of learning activities which can be organized in the 5E inquiry learning model and experiential learning cycle to career orientation in teaching Biology.

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