Proposing learning activities to promote students' career orientation in Biology grade 10

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ABSTRACT: *Teaching Biology at the upper secondary school level is considered to be the most important basis for developing students' interest in science and then into careers in the field of Biology. This study's purpose was to suggest some learning activities of Biology grade 10 to promote students' career orientation competencies. This study investigated the contents of the Biology grade 10 programme of the General Education Curriculum 2018, and the types of learning activities that can be organised to promote students' career orientation competencies. The results of the study included: 1) Defining learning activities represented by various forms such as research activities, project activities, explore activities, experimental activities, career discovery, experience activities,... depending on the characteristics of contents and the requirements that need to be achieved in the Biology grade 10 programme; and 2) Proposing the illustration for designing learning activities which can be organised in 5E inquiry learning model to enhance students' career orientation in teaching Biology.*

KEYWORDS: **Career orientation, Biology grade 10, Biology learning and teaching, the General Education Curriculum.**

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1. Introduction

Career-oriented competencies include giving thought to one's own motivations and aptitudes (career reflection), giving one's career path by exploring options in research and work (career discovery) directing their own learning process (career action). High school is a significant period for students in science and affects their future career decision (Subotnik, 2010). 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 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 subjects and science-related career because they may enhance students' interest and their career aspirations in the future.

It is believed that 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. Organising inquiry-based teaching in sciences that focus on student-led activities, not teacher-led activities (but with instructions and supports from teachers) is often through observation and experimentation (and possibly similar to real work) and this is an opportunity for students to apply more scientific methods. Teaching approaches, such as advocacy of debate, are also developmental and practice methods that reflect the applications of science professionals in their work. 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 the use of applied contexts as scientific skills and ideas (Stake & Mares, 2001). Cohen and Pattterson (2012) introduced career-inspired pedagogical strategies into science lessons. These strategies target 4 goals of STEM career-oriented development for students, which are: Awareness, Relevance, Engagement, and Self-Efficacy.

Aeschlimann et al. (2016) have used Eccles' expectancy-value model (Eccles' expectancy-value model), built 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. The 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) Provide information about career opportunities, (2) Ensuring easy-to-understand teaching, (3) Provide personal support to students, (4) Link subject-specific knowledge to life experiences.

Sheldrake (2017) analysed 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 science of students.

In Vietnam, career-oriented research for students through the subject has been interested in research by some authors (Nguyen, 2009; Phung, 2014; & Vu, 2017). However, there are not clear how to organise specific learning activities to orient careers for students in teaching Biology 10 according to the new General Education Curriculum (Ministry of Education and Training, 2018).

2. Methodology

In this study, theoretical research methods were used to analyse, synthesise, generalise and find the relationship between the content knowledge of Biology and biotechnological skills to identify the learning activities that can organise career-oriented teaching for students in the contents of the Biology grade 10 program and then design illustrative lesson templates.

3. Results

3.1. Learning activities to enhance students' career orientation in Biology grade 10

Bases for building career-oriented activities in Biology grade 10:

On the basis of analysing Biological 10 content structure and learning contents which can be organised by teaching career orientation combined with the process of building learning activities, some learning activities are suggested to promote students' career orientation in part 3 of Cell biology and part 4 of Microbial and Viral biology for the following reasons:

- Grade 10 is the first class of the high school, students need time to get used to the new learning environment. Learning contents in part 3 and part 4 are taught after the first-time students get familiar with the subject through the first 2 parts, so it is convenient for the organization of experiential activities, experimental discoveries and category excludes psychological factors affecting experimental results.

- Competency formation and development must take place in an appropriate process. In order to ensure a relatively accurate assessment of the developmental manifestations of the career-oriented capacity, in research design, we design some learning activities and organise teaching activities for this content to create a continuous process that goes on for a long enough time. Topics of Cell biology and Microbiology, virus in the program of Biology grade 10 is advantageous to do this.

- Because the career-oriented capacity is formed in only one process, so in the teaching process, it does not focus on a learning content

but needs to continuously and thoroughly exploit each content circuit, so the selection chooses the content and time mentioned above to easily organise learning activities to develop career-oriented capacity for students.

- Develop learning activities to orient careers in Biology 10 for each topic based on the content and required requirements of the topic, formulate ideas based on types of career-oriented activities (activity of acquiring knowledge Biology, career-oriented practice activity, career-oriented connection activity) to build activities of experience, discovery to orient career for students.

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

The learning activities used in teaching Biology 10 should be the combination of 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: 1) knowledge perceiving activities, 2) practical activities, 3) work-life connection. Each type of learning activity depends on or serves a particular goal. Types 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,…). Types of career-oriented practical activities for students in teaching Biology include games and simulation, practical activities, explore activities,… Types of career-oriented connection activities include research activities, specialized discussion, career support,…

Some learning activities aimed to enhance students' career orientation in Biology grade 10 are shown in Table 1 which are developed from the previous bases.

Table 1: Some learning activities to aim at foreign language reading for students

Content/ topic	Career-oriented activities
Part 3: CELL BIOLOGY	
Chemical composition of Cells	- Project activities: Find out the role of trace elements, macronutrients in cells and use in diet, build hydroponic plants, preserve food, diagnose and treatment of diseases related to biological molecules (dyslipidaemia, sickle cell anemia,...); the role of DNA in bloodline identification, crime detection, ...). - Act as a food technology engineer (test and read product labels), play the role of a doctor, a test technician (read biochemical test results). - Practical activities: Identify (qualitatively) some of the chemical components present in cells (proteins, lipids, ...), and apply them to read biochemical test results in medicine.
Cell structure	
Prokaryotic cells	- Explore activities: Find out the functional structure of the cell wall and explain the mechanism of action of Cefuroxime antibiotics on bacteria. Develop skills to read information about the impact of antibiotics (related to the profession of Medicine - pharmacy).
Eukaryotic cells	- Research activities: Explain the rejection phenomenon when transplanting tissues, organs from one person to another. - Practical activities: Practice making and observing prokaryotic cells (bacteria), eukaryotic cells (onions, oral sinus mucosa cells, ...) and observe the template.
Enzyme	- Practice activities, career exploration: perform experiments to analyse the effects of some factors on enzyme activity. Application of Enzyme technology in industries (agriculture, environment, food processing technology, ...).

Content/ topic	Career-oriented activities
Cell cycle and cell division	
Mitosis and meiosis	- Project activity: Explain how abnormal cell division can lead to cancer. Find out information about cancer in Vietnam. Proposed preventive measures.
Cell technology	- Activities of experience and discovery: Learn technological principles and some achievements of plant and animal cell technology (cell culture, cloning, ...)
Part 4: MICROBIOLOGY AND VIRUS	
Microbiology	
Concept and groups of microorganisms	- Project activities: Determination of oral hygiene and sanitation system. - Research activities: Evaluate the level of bacterial infection in schools. - Experimental activities: Culturing microorganisms to form products for the application of fermentation techniques.
The synthesis and decomposition of substances	- Experimental activities: learn about the practical application of the synthesis and decomposition of microorganisms' substances in the locality, produce straw mushrooms, shiitake mushrooms, shiitakes for food, traditional fermentation, compost organic, waste water treatment, ... - Research activities, career connections: Propose a process to improve product quality. Experimental to prove the effectiveness of the proposed measures. - Experience activities: Future technology engineer experience report.
The process of growth and reproduction in microorganisms	- Research activities: Find out the meaning of using antibiotics to inhibit or destroy pathogenic microorganisms and the harm of abuse of antibiotics in human and animal treatment. - Research activities, career connection: Microbial growth and food safety and hygiene in the locality: + Experience, investigate the current situation of food preservation and processing in the locality: Learn the concepts: food, food safety and hygiene in the locality. Find out the causes of food poisoning. Learn about the status of food preservation and processing in households and food shops. - Assess the current situation of food safety and hygiene in the locality.
Some microbiological applications in practice	- Research activities: Modern achievements of microbiological technology, explaining the scientific basis of applying microorganisms in practice. - Project activities: Application of microorganisms in practice (food production and preservation, drug production, environmental treatment,...). Implement projects or topics to learn about microbiological technology products. Making a journal of articles and pictures on microbiological technology. - Experimental activities, career discovery: Making some products fermented from microorganisms (yogurt, pickles, bread,...). Explore a number of occupations related to microbiological technology (food technology) and their growth prospects.

Some career-oriented learning activities in the thematic part are shown in Table 2.2:

Table 2: Some learning activities for career orientation in topics of Biology grade 10

Topic	Career-oriented activities
Topic 1: Cell technology	- Research activities, career connection: Find out some modern achievements of cell technology, stem cells. Find out the prospects of future cell technology and related careers. - Project activities: learn about tissue culture achievements, stem cell achievements. Designing a journal of articles and pictures on cell technology. - In-depth discussion activities: Express your own views on the importance of using stem cells in practice. Debate views on cloning animals and humans

Topic	Career-oriented activities
Topic 2: Enzyme technology and application - Scientific basis for applying enzyme technology - Enzyme production technology process - Application of enzyme technology	- Explore activities: Discover achievements of enzyme technology, enzyme production technological process applied by enzyme technology. - Research activities: Deploying scientific research on enzyme production. - Research activities: application of enzymes in the fields of food technology, medicine and pharmacy, genetic engineering.

3.2. Illustration for learning activities to enhance students' career orientation in Biology grade 10

The 5E Inquiry Learning model is used to design the illustration for learning activities to enhance students' career orientation in Biology grade 10. The 5E model of instruction includes five phases: Engage, Explore, Explain, Elaborate, and Evaluate. It provides a carefully planned sequence of instruction that places students at the centre of learning. It encourages all students to explore, construct the understanding of scientific concepts, and relate those understandings to phenomena or engineering problems and career orientation (Bybee, 2009).

Topic: Enzymes and application of enzyme technology

I. Learning objectives

1. Knowledge objectives

- Presenting the concept, structure and role of enzyme. in material and energy metabolism.

- Determining the factors affecting enzyme activity.

- Defining the appropriate relationship between enzyme structure and function was analysed.

- Conduct experiments. and explain the effects of these factors on enzyme activity

- Analysing the scientific basis of enzyme technology application.

- Analyse and apply enzyme technology in a number of industries.

- Proposing solutions to improve the efficiency of enzyme preparations.

2. Competencies objectives

- Skills to practice, analyse, and find information.

- Skills awareness of their own interests, application of knowledge in practice, career discovery.

3. Attitude and behaviours

- Actively participate in activities to learn about enzymes and apply them in practice, with an attitude of respecting achievements in enzyme technology.

II. Organise learning activities

Warm-up: (Engage)

- Teacher shows a clip about enzyme activity in the digestive system.

- Ask students to discuss and answer the question: why do people digest starch but can't digest cellulose?

- Teacher leads on topic.

Forming knowledge:

Activity 1: Experiment (Explore)

- Teacher divides the class into groups of 5-6 students.

- Teacher assigns tasks to students to practice:

• Place hydrogen peroxide on raw potato slices and cooked potato slices.

• Observe whether or not air bubbles appear.

• Interpret the results.

- Students conduct learning tasks.

- Teachers comment, evaluate and support students.

Activity 2: Exploring structure, role, factors influencing enzyme activity (Explain)

- Teacher asks student groups (5-6 students/ group) to collect information about enzymes in documents, websites, magazines,... to answer questions:

• What is an enzyme?

• What is the structure of an enzyme?

- Teacher projects some graphs showing the effect of temperature, pH, substrate concentration, enzyme concentration on enzyme activity.

- Ask students to analyse and comment on the effects of these factors on enzyme activity.

- Groups discuss and report on the results.

- Teachers support and comment on students' performance.

Activity 3: Research project: Explore the application of enzyme technology, experiment and manufacture enzyme products (Elaborate)

- Teacher divides groups of 5-6 students.

- Teacher assigns the tasks:

Study enzyme technology, apply enzyme technology in a number of fields and trades (biotechnology, food, medicine - pharmacy, chemistry, textile industry, tanning,...).

Research and experiment to manufacture enzyme products.

Poster design, presentation.

- Implementation time: 2 weeks

- Students: Assign tasks in groups, research, learn, process information, design posters, make class presentations.

Presentation on the application of enzyme technology, display of manufactured products

- Teachers organise groups of students to share research products, present the results of implementation based on the implemented poster.

- Students listen, comment, debate and evaluate other groups.

- Teachers support, orient and evaluate students' working results.

- Good studies will continue to participate in the School's science fair.

Activity 4: Evaluate, career relationships

- Teacher asks students to answer the questions in section IV.

III. Evaluation

Question 1: Explain why when producing detergent, the manufacturer adds more enzymes?

Question 2:

Quantification of glucose by enzyme method

Glucose Oxydase (Glucose Oxydase) is a method of biochemical assay in Medicine. The principle of this approach is to use the enzyme Glucose Oxidase (GOD) that oxidizes the glucose to gluconic acid and hydrogen peroxide (H2O2). The resulting hydrogen peroxide is broken down by the enzyme peroxidase (POD) and released by oxygen. Oxidative oxygen-releasing oxygen 4-aminophenzon (4-AAP) and phenol create a quinonimine complex with a red pink colour. Colour intensity is proportional to the Glucose content.

Normal, serum glucose concentration: 0.75 - 1.15g/l (4.1 - 6.4mmol/l). Patient A has a serum glucose concentration of 7.6mmol / l. In this case, what should the doctor advise the patient?

Question 3: In your opinion, how do you think it is necessary to plan your study and career in order to become a person working in the industries applying enzime technology?

4. Conclusions

Based on analysing the Biology program and theory of career orientation for students, the paper proposed some learning activities of Biology grade 10 to promote students' career orientation competencies. The learning activities used in teaching Biology grade 10 should be the combination of 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: 1) knowledge perceiving activities, 2) practical activities, 3) work-life connection. Thus, these learning activities are represented by various types of activities such as research activities, project activities, explore activities, experimental activities, career discovery, experience activities,... appropriate for the characteristics of the contents and requirements that need to be achieved in the Biology grade 10 program. The paper also suggested the illustration for designing learning activities that can be organised in the 5E Inquiry learning model to enhance students' career orientation in teaching Biology of learning activities. This instruction has a variety of learning activities that encourage all students to explore, construct the understanding of scientific concepts, and relate those understandings to engineering problems and promote career orientation.

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