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POSSIBILITIES FOR PROMOTING STUDENTS' CAREER-ORIENTED COMPETENCIES BY ORGANIZING THE 5E MODEL AND EXPERIENTIAL TEACHING

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Abstract. Promoting students' career orientation is an important goal in the 2018 General Education Curriculum. This study's purpose is to identify career-oriented competencies and propose teaching methods to enhance students' career orientation in teaching science subjects such as Biology. The study investigated theoretical models of career orientation for students and inquiry-based, experiential teaching approaches. The results of the study were: (1) proposing the structure and expressions of career-oriented competencies; (2) analyzing the theoretical basis for using teaching methods such as 5E inquiry teaching and experiential teaching to explore scientific applications and professional experiences to improve students' career orientation; and (3) theoretically determining and empirically analyzing the correlation between the characteristics of the 5E teaching model, experiential teaching, and the corresponding manifestations of teaching career-oriented competence.

Keywords: career-oriented competencies; experiential teaching; 5E inquiry teaching; Biology.

1. Introduction

Education in Vietnam is facing strong innovation requirements to meet socio-economic development, the industrial revolution, and globalization, so the goal of career-oriented education is particularly important during high school education. The General Education Curriculum [1] also sets a goal for upper secondary education to help students continue to develop the necessary qualities and competencies for workers, civic consciousness and personality; the ability to choose a career suitable to one's capacity and interests, conditions and circumstances to continue education, vocational training or participation in working life; ability to adapt to changes in the context of globalization and the new industrial revolution.

Career orientation helps students be aware of their strengths, understand the fields of industry, and know how to evaluate information about labor needs in the locality, in Vietnam, and in the world. Therefore, students can choose a career in line with their interests and hobbies, family conditions, and the development trend of the socio-economic situation. However, learners today are still in a state of lack of information and are not career-oriented in the right direction.

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Career-oriented competencies include giving thought to one's motivations and aptitudes (career reflection), determining one's career path by exploring options in research and work (career discovery), and directing their learning process (career action). High school is a significant period for students in science and affects their future career decisions [2]. It is believed that experiential 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.

Science aspiration and career choice

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, and experiential learning (often laboratory experiments) are still valuable in teaching science subjects, for example, through simulated real work to reproduce the empirical nature of science, but other views and contrasting views are possible [3].

B. Aeschlimann et al. (2016) have used Eccles' expectancy-value model (Eccles' expectancy-value model) and built simulation models to prove that classroom support measures will promote students' learning motivation in Math and Science and Advanced STEM subject choice and STEM career options [4]. R. Sheldrake (2017) analyzed the results of the PISA 2006 and PISA 2015 assessments 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 in students [5].

According to the Expectancy-value theory model [6], the student's expected outcome is measured as the student's confidence in performing various applied science tasks. The subject values of students are measured according to their interests in science and the student's awareness of scientific applications.

In general, studies have found that students' attitudes towards science subjects are closely related to their academic and career aspirations. It would be beneficial to clarify this, especially as to whether there are any teaching approaches related to student aspirations and attitudes that tend to promote aspirations in students. In summary, it is still unclear at present what factors may be related to (and therefore potentially influence) students' interest in science subjects and their perception of practical applications of science.

Methods of teaching to promote students' career orientation

Students' academic and career aspirations are difficult to change directly. To increase the number of students with career orientation in the field of science and technology, teachers need to improve students' attitudes, such as awareness of science and technology applications through the interpretation of phenomena and the work of the scientific professions, and apply a variety of teaching methods to inspire or engage students.

Various measures have been taken to promote students' attitudes towards science. Various approaches have been adopted to enhance students' interest in science subjects, for example, by highlighting the link between scientific knowledge and interpreting the experiences and work of scientists. Likewise, promoting the relevance and practical application of science to students and their parents is associated with increased student interest and learning outcomes, and influences students' choice of science majors. To summarize, teachers can interpret scientific careers

or broader scientific applications in a variety of ways, using active teaching methods and organizations.

- Practical work and experiential learning (usually laboratory experimentation) are still valuable in teaching science subjects, for example, real work simulated to confirm and define the empirical nature of science.

- Inquiry-based teaching of science subjects that focus on student-led activities, not teacher-led activities (but with some guidance and support from the teacher), usually through observation and experimentation (and possibly parallels to real work) and this is an opportunity for students to apply scientific methods a lot.

- Teaching approaches, such as debate, are also development and practice methods that reflect the applications of science professionals in their work.

- Experiential, context-based teaching is more focused on enhancing students' interest and love of the subject and the relevance of subject knowledge to real-life applications, through the use of applied contexts such as scientific skills and ideas.

Methods of teaching organization are often considered in the context of receiving, ensuring that teaching activities are organized optimally. Studies show that discovery teaching has an impact on improving learning outcomes, with teacher support. The benefits of argumentative methods appear less obvious. Experiential, context-based teaching methods have emerged widely, related to developing students' understanding and enhancing students' attitudes toward science. Both the discovery teaching method and the context-based experiential teaching method are often associated with students' interest in science.

Meijers, F., Kuijpers, M., and Gundy, C. (2013) have emphasized that 'applied science' teaching (teaching about the broader applications of lesson knowledge and the relevance of science knowledge in the lesson to students' lives) is a unique teaching method that is consistently and positively measured compared with other teaching methods [7].

According to our previous research results in Vietnam, students' experiences of solving a real job for a person working in a certain science have not been carried out effectively. Studies in Vietnam have shown that project-based teaching is an effective career-oriented teaching method [8]. It is found that the teaching activities that are regularly organized by teachers in many lessons are whole-class discussions with the participation of teachers and small group discussions among students. Experiential activities, and practical applications, such as students drawing their conclusions after experiments, doing scientific research, and studying problems related to the lesson are rarely organized by teachers. Teachers still play the leading role in the learning process. Students' initiative and creativity have not been facilitated to develop through learning activities. To fulfill the requirements of experiential teaching, teachers can perform at a good level or higher in the design of experiments, and practical activities for experiential teaching. Most teachers can do a good job of giving appropriate learning tasks to each student. Most teachers are willing to create conditions for students to discuss how to interpret the experimental results. These are favorable conditions for the implementation of experiential activities and the application of lessons learned by practice for students. Based on search results, most teachers assign short-term tasks to students. Only 13.3% of teachers assign tasks to students to implement projects with a frequency of 1 per/month or more. Thus, exploratory teaching activities are rarely organized by teachers in teaching practice [9].

In Vietnam, career-oriented research for students through the subject has been interesting in research by some authors [10-12]. However, there is a lack of clarity about students' career-oriented competencies and how to organize learning activities to enhance career-oriented

competencies for students to meet the goal of the new General Education Programme. Based on the previous research, we choose to organize the discovery activity (5E Inquiry Learning Model) and teach experience to organize teaching activities to explore the application of science and professional experience to improve career orientation for students through Biology 10.

2. Content

2.1. Career-oriented competencies

2.1.1. The concept of career-oriented competencies

In the publication on Nordic perspectives on vocational competence and guidance, career-oriented competence is defined as the ability to self-study and self-develop, to discover life and the world of study and work; and to adapt to life, learning, and working in times of change and transformation [13]. Thus, developing career-oriented competence in students means developing an awareness of their interests and strengths, identifying possible study and career paths, and making plans to do so.

The General Education Curriculum in Vietnam conceives that career-oriented competence is a component of self-directed and self-learning competence. At the upper secondary level, the required requirement of career-oriented competence is that students "be aware of their personality and values, acquire key information about the labor market, requirements, and development career aspirations, determine the appropriate development direction after high school, make a plan, choose to study subjects suitable to their career orientation."

Through studying the definitions of career-oriented competencies above, we find that the views given are quite consistent because they all focus on three components: self-awareness, career exploration, and career planning.

In this study, based on the above research and the perspective of the General Education Curriculum, we proposed the structure and analyzed career-oriented competence based on the following definition of career-oriented competence: Career-oriented competence is the ability to be aware of one's personal identity, interests, and strengths, career awareness, and planning to meet individual career goals (Figure 1).

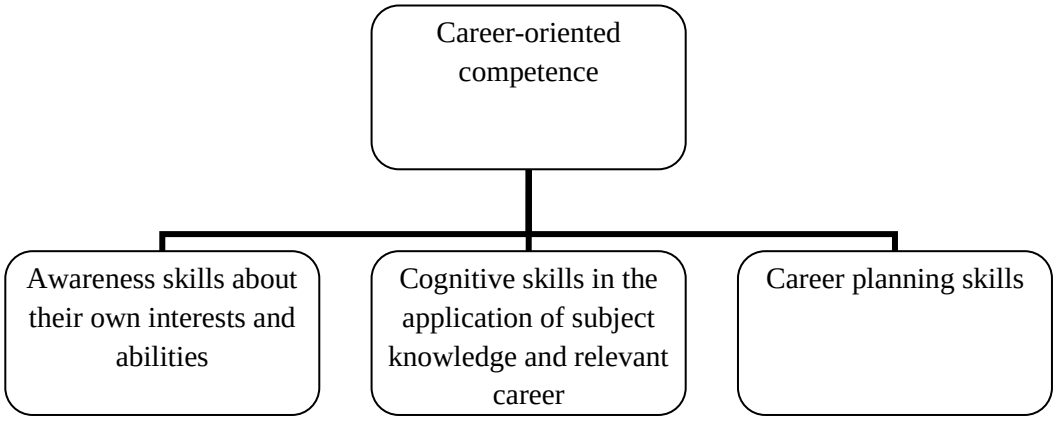

Figure 1. Structure of career-oriented competence

2.1.2. Manifestations of career-oriented competence

Career orientation is influenced by many factors. To determine a person's career-oriented capacity, scientists and educators have used index tables showing outwardly career-oriented competencies. This will be demonstrated in the following studies. According to the National Career Development Guidelines Competencies and Indicators - High, manifestations of people with career-oriented competence include: self-awareness, career exploration, and career planning [14]. The expression of career-oriented competence in the STEM field of high school students is reflected in the following aspects: awareness, skills, and attitude [15]. As a result of our research, we found that each person's career orientation is influenced by internal and external factors. Internal factors such as personal characteristics of interests, gender characteristics, and physical characteristics are formed and developed mainly through life activities and personal experiences and are heavily influenced by psychological factors [16].

Based on the analysis of the authors' perspectives on career-oriented competence and the characteristics of Vietnamese education, we select typical characteristics and propose manifestations of career-oriented competence in Table 1.

Table 1. Career-oriented competencies

Component skills	Expression
1. Awareness skills about their interests and abilities.	- Identify your interests and abilities. - Demonstrate an understanding of personal characteristics relevant to the achievement of individual career goals. - Determine your desires, expectations, and goals and use them for lifelong career orientation.
2. Cognitive skills in the application of subject knowledge and relevant career.	- Identify the core knowledge of the subject. - Identify and explain the relationship between learning content and practical application in professional fields. - Analyze information about occupations, agencies, and businesses and use this knowledge to decide on a career choice and future workplace.
3. Career planning skills.	- Identify learning goals related to choosing a career for yourself. - Determine expected career priorities. - Identify measures to develop professional skills (volunteer participation, extracurricular activities, part-time work, transition programs from school to work, etc.). - Develop a personal career plan.

2.2. Basis for designing and organizing 5E inquiry teaching activities and experiential teaching to orient students' careers

Based on previous research results and advantages in meeting career-oriented goals, we chose to organize inquiry activities (following the 5E Inquiry Learning Model) and experiential learning to organize teaching activities to explore scientific applications and professional experiences to improve students' career orientation through Biology. These teaching methods will be used in Biology teaching, designed, organized, and proven effective in enhancing interest in the subject and promoting related academic and career aspirations to students based on the theoretical model of expected value by Eccles (2009).

**** 5E Inquiry Learning Model***

In 1987, Rodger W. Bybee and his colleagues working in the American Organization of Biological Sciences Curriculum Study (BSCS) proposed an improved teaching model for the Biology Curriculum. The 5E model is based on the constructivism theory of learning, whereby learners construct knowledge from experiential processes. Through understanding and reflecting on past activities, both personal and social, learners can reconcile new knowledge with previously known concepts.

The 5E Model stands for Engage, Explore, Explain, Elaborate, and Evaluate. The 5E Inquiry Learning Model *is* quite popularly applied in science classrooms and STEM-integrated programs in the US, the 5E model is based on cognitive constructivism of the learning process, whereby students construct knowledge new knowledge based on knowledge or experience.

The 5E teaching model consists of five stages as follows [17]:

- *Engage:* Teachers need to recall students' existing knowledge, encourage interest in new concepts through short activities that foster curiosity in students, and engage with old knowledge. Teachers can make students ask open-ended questions or record what they already know about the topic. Teachers attract students' attention and interest, create a classroom atmosphere, and students feel connected and connected with previous knowledge or experiences. At this stage, new concepts will also be introduced to the children.

- *Explore:* At this stage, students are actively exploring new concepts through concrete learning experiences. Teachers provide basic knowledge or experience, from which new knowledge can be started. Students will directly explore and manipulate prepared materials or tools. Students perform activities such as observing, doing experiments, designing, and collecting data.

- *Explain:* Students synthesize new knowledge and ask questions if they need more clarification. Teachers allow students to present, describe, and analyze the experiences or observations obtained in the Discover step. In this step, teachers can introduce new terms, new concepts, and new formulas, helping students make connections and see connections with previous experiences. For this stage to be effective, teachers should ask students to share what they have learned in the Explore phase before introducing the details more directly.

- *Elaborate*: Teachers give students space to apply what they have learned, help students deepen their understandings, refine skills, and make them applicable in a variety of situations and contexts. This helps to deepen the knowledge.

- *Evaluate:* During this stage, teachers can observe students through small or large group activities to see how they interact in the learning process. Teachers can evaluate including self-assessment, written and multiple-choice assignments, or products. Moreover, teachers will flexibly use a variety of assessment techniques to recognize the cognitive process and ability of each student, thereby offering appropriate adjustment and support directions for students.

**** Experiential teaching***

Some experimental research showed that students' attitudes were positively affected by experiential teaching and practice. This is effectively confirmed when students are provided regular opportunities to generate independent hypotheses and draw their conclusions [18].

Experiential learning has been included in modern education since the early 20th century. The International Association for Experiential Education has defined “experiential teaching as a

category encompassing a variety of methods in which teachers encourage learners to participate in real-life experiences, then reflect and summarize to increase their understanding, develop skills, shape life values and develop their potential, to make positive contributions to the community and society".

The essence of experiential learning is to organize students to carry out actions individually or in groups. Through those activities, students can interact with objects in certain circumstances, forming current experiences.

In experiential teaching, there is an interaction between existing experiences and currently acquired experiences, in which the subject analyzes and breaks down existing experiences into current experiences, thereby forming new experiences (new capacity) and using them as a means to solve a new situation or launch a new activity.

**** David Kolb's experiential teaching model***

The experiential learning model consists of four stages: concrete experience; reflective observation; and conceptual abstraction; Positive testing is as follows:

(1) Concrete Experience: learning through specific activities, behaviors, and manipulations, directly associated with actual contexts, learners participating in a new experience, experiences gained through doing, and works in specific circumstances. This is where the data of the learning cycle is generated.

(2) Reflective Observation: learners reflect on their experiences and systematically examine them, discovering their characteristics and meanings. From there, share, analyze, and discuss together to agree on a systematic view and view of the problem. Students need to analyze and evaluate events and experiences by reflecting on those experiences for themselves.

(3) Abstract Conceptualization: learning by building concepts, synthesizing and analyzing observations, and developing theories to explain observations or abstract concepts as a result. The true perception of the nature of the object is obtained by receiving what is inherently specific to reality and manipulating the subject's thinking to obtain the true perception of the nature of the object.

(4) Active Experimentation: learning through suggestions and testing problem-solving solutions. Learners use theory to solve problems and make decisions.

The basis of the design and use of 5E inquiry teaching on the application of science and technology and teaching experience related to careers with career-oriented capacity development for students is shown in Figure 2.

Figure 2 shows that to design and organize 5E inquiry learning about the application of science and technology and teaching experiences related to careers to develop career-oriented competencies for students, it is necessary to first rely on the structural framework of career-oriented competencies, analyzing the component skills of career-oriented competencies. For each learning topic, it is necessary to define specific component skill development goals to determine appropriate exploratory and experiential learning activities to develop each component's competence. From there, choose to design and organize activities according to the 5E inquiry teaching model or experiential teaching in the direction of developing career-oriented competencies for students. The relationship between students' learning activities, design, and organization of activities for students with each component capacity constituting career-oriented competence is shown in detail in the following section.

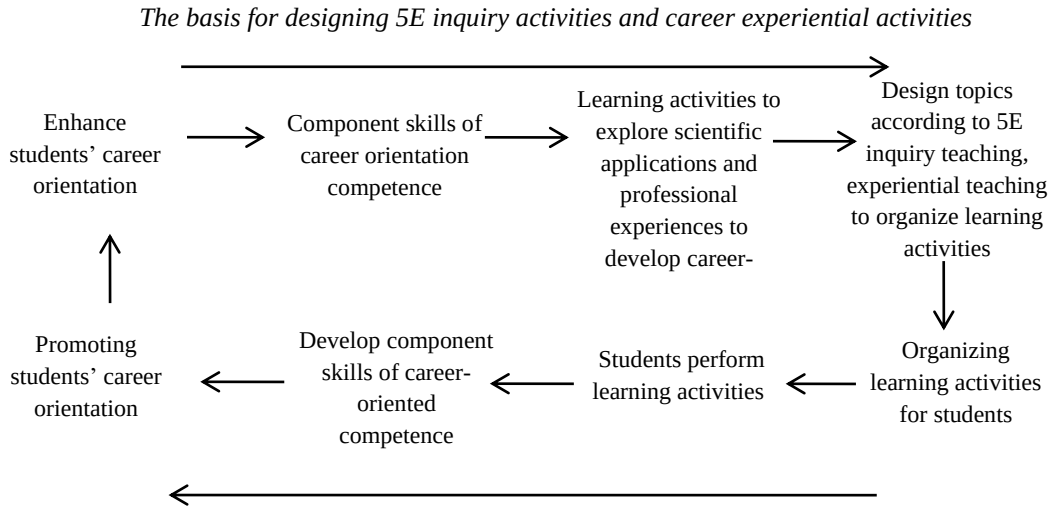

Figure 2. The basis for designing and organizing 5E inquiry teaching activities and experiential teaching to orient students' careers

2.3. Possibilities for developing career-oriented competencies when organizing inquiry learning according to the 5E Inquiry learning model and experiential learning

2.3.1. According to the 5E Inquiry teaching model

Inquiry teaching according to the 5E model has many opportunities for teachers to practice career-oriented competence for students. This relationship is shown in Table 2.

Table 2. Possibilities to develop career-oriented competencies when organizing the 5E model

5E inquiry teaching model	Possibilities to develop career-oriented competencies
1. Engage Attracting students' attention and interest through practical situations, industry problems, and scientific applications	- *Identify the relationship between the subject and practical application* Through the situations and practical problems of professions given by teachers when starting to teach a topic, students can realize the role of scientific application in professions with theoretical basis as content, knowledge of the subject they will learn, thereby seeing the meaning of the subject, the relationship between the subject and the practical application of the profession. From this, students have more interest in the subject.
2. Explore Students participate in practical activities, experiments, practical experiences, etc. to explore learning topics.	- *Awareness of own interests and hobbies* By participating in exploratory activities to solve specific learning tasks, students will demonstrate their abilities and skills and see themselves as having strengths and a forte in good subjects. When students have good task performance skills, they will achieve good results, from which they will be more confident when performing the next task and have a greater interest in the subject.

3. Explain Students describe, analyze, comment, and draw conclusions after participating in experiments and practice.	- *Cognitive skills to apply relevant subject and professional knowledge* By analyzing and interpreting the results of experiments and practices in the context of a real-world problem, students can identify the relationship between learning topics and applications in life.
4. Elaborate Students apply knowledge to solve practical problems.	- Through performing tasks in this phase, students can apply subject knowledge to solve specific problems in several professions. - *Skills in building career plans*: Through solving specific problems of the profession, students see the knowledge and skills needed to meet that profession, from which they identify the measures to develop the career skills they want to pursue in the future.
5. Evaluate Students evaluate their progress after performing the learning task.	- *Skills in building career plans:* Through assessing their progress in learning, students find that they are suitable with their abilities and interests to identify and adjust their career guidance plans.

2.3.2 According to experiential learning

Experiential teaching is a teaching method that has a positive impact on raising students' interest in the subject, thereby contributing to the development of their career-oriented capacity. By analyzing the manifestations of career-oriented competence and the characteristics of experiential teaching above, we determine the correlation between the characteristics of experiential teaching and the corresponding manifestations of teaching competence. The career orientation force is shown in Table 3.

Table 3. Possibilities to develop career-oriented competencies when organizing experiential learning

Experiential teaching	Possibilities to develop career-oriented competencies
Concrete experience: (Students engage in a new experience, experience gained through activity in a particular context).	- *Awareness of own interests and hobbies* By participating in a new experience, the experience gained through working in a specific industry scene, students can recognize their abilities and skills and use them to implement the experience and have an interest in the subject. Therefore, students can identify personal characteristics that are suitable for their future career goals.
Reflective Observation: (Think back to the past activity, discover its characteristics, its meaning)	- *Identify the relationship between the subject and practical application* Based on the analysis of real-life industry experiences with the application of knowledge of the subject of study, students can identify the relationship between the subject of study and its application in life.

Abstract Conceptualization: (Build concepts, synthesize and analyze observations	*- Cognitive skills to apply relevant subject and professional knowledge* Through systematizing the knowledge of the lesson, students identify the foundational knowledge and apply that knowledge to explain its application in industry practice.
Active Experimentation: (Students propose and test solutions to the problem. Students use theory to solve problems and make decisions.)	*- Career planning skills* By applying lesson knowledge to experiment with simple technological processes or solve industry-specific problems, students can acquire the knowledge and skills needed to meet that profession, from students then identify measures to develop the career skills they want to pursue in the future. From there, identify measures to develop professional skills (volunteer participation, dynamic extracurricular activities, etc.) and update information for your career guidance plan.

2.4. Impact model of career-oriented teaching

We chose some topics for Biology grade 10 to experiment with Chemical composition of cells and applications, Enzymes and applications of enzyme technology, Mechanism of cell division and cell technology, Microbiology and applications. For each experimental topic, teachers organize experiential and inquiry teaching activities according to the 5E model according to the provided lesson plan.

We used questionnaires to assess the expression of career-oriented competence through teaching Biology grade 10 to students before and after the experiment, based on the theoretical model of Eccles (2009) to statistic the relationship between the variables, thereby testing the proposed scientific hypothesis.

The questions were referenced from previous studies (Stake, J.E., and Mares, K.R., 2001; Ornstein, 2005; Eccles, 2009; OECD, 2015) and adjusted to fit the research context. Moreover, we tested the draft questionnaire with 42 high school students to assess the relevancy of each question. After a mock assessment, the questionnaire was revised to ensure its ease of understanding and sufficient reliability for use in this study. The experiment included 319 grade 10 students from three different high schools. The investigation is carried out through direct investigation. The total number of answer sheets included in the official analysis was 319; this number of samples met the criteria for statistical significance because it was greater than 200 according to the study by Comrey and Lee (1992).

The analysis of the correlation between factors shows that there is a correlation between the organization of career experience teaching, 5E inquiry teaching about the application of science and technology with three component skills of career orientation competence (such as awareness skills about their interests and abilities, career planning skills and cognitive skills in the application of subject knowledge and relevant career), and career aspirations of students is shown by the Pearson correlation coefficient from 0.158 to 0.719 (Table 4).

The results also show that students' subject-related career aspirations are closely related to the three component skills of career-oriented competence. As a result, there is the strongest relationship between students' awareness skills about their interests and abilities, as shown by the Pearson correlation coefficient of 0.342. Moreover, teaching career experience and teaching 5E

about science and technology applications have the closest correlation to students' career planning skills, as shown in correlation coefficients of 0.232 and 0.293.

Table 4. Correlation analysis among factors

Factors		1	2	3	4	5	6
1. Awareness skills about their interests and abilities	Pearson Correlation	1					
	Sig. (2-tailed)						
2. Career planning skills	Pearson Correlation	-0.297**	1				
	Sig. (2-tailed)	0.000					
3. Cognitive skills in the application of subject knowledge and relevant career	Pearson Correlation	0.299**	0.080	1			
	Sig. (2-tailed)	.000	0.152				
4. Career aspirations	Pearson Correlation	0.342**	-0.257**	0.158**	1		
	Sig. (2-tailed)	<0.001	<0.001	0.005			
5. Experiential teaching about career	Pearson Correlation	0.222**	0.232**	0.244**	0.206**	1	
	Sig. (2-tailed)	<0.001	<0.001	<0.001	<0.001		
6. Teaching and discovering 5E about the application of science and technology	Pearson Correlation	0.211**	0.293**	0.153**	0.217**	0.719**	1
	Sig. (2-tailed)	<0.001	<0.001	0.006	<0.001	<0.001	

Note: Pearson correlation coefficients are shown in the table. Statistically significant values ($p < 0.05$) are highlighted in bold

3. Conclusions

Based on analyzing some theories of career orientation for students, we have proposed the structure of career-oriented competencies and described the expression of career-oriented competencies. Career-related competencies include three component skills such as: self-awareness

of one's interests and abilities; cognitive skills in applying subject knowledge and relevant careers; and career planning abilities. By analyzing the manifestations of career-oriented competence and the characteristics of experiential teaching above, we determine the correlation between the characteristics of the 5E teaching model, experiential teaching, and the corresponding manifestations of teaching competence. Inquiry activities (following the 5E Inquiry Learning Model) and experiential learning are appropriate to organize teaching activities to explore scientific applications and professional experiences to improve students' career orientation. The results of the impact model also show that students' subject-related career aspirations are closely related to the three component skills of career-oriented competence. In which, teaching career experience and teaching 5E about science and technology applications have the strongest correlation to students' career planning skills. This instruction is the basis of organizing learning activities that encourage all students to explore, construct an understanding of scientific concepts, relate those understandings to engineering problems, and promote career orientation in teaching Biology.

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