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BUILDING A SCALE OF COMPETENCE TO APPLY INTERDISCIPLINARY INTEGRATED KNOWLEDGE INTO PRACTICE FOR STUDENT

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Abstract

Vietnam began to implement a new general education program to replace the previous one in 2018. According to the new program, the content has many topics that integrate interdisciplinarity. Therefore, teachers need to be able to teach in the direction of interdisciplinary integration to develop students' competence. The current situation in Vietnam shows that teachers are still not confident because they do not have much interdisciplinary integrated knowledge in applying integrated knowledge into practice to the teaching process. This leads to the consequence that when they teach topics related to real life, it will not be feasible, reducing the effectiveness of teaching in schools, and difficult to achieve the goals required by the Ministry of Education and Training. For the above reasons, universities that train pedagogical students also need to make appropriate adjustments to foster and train pedagogical students' competence in applying interdisciplinary knowledge into practice. The article presents the research results on the process of building and designing the scale, which are specific criteria to measure and evaluate the

competence to apply knowledge in the practice of physics pedagogical students. In addition, we also propose an illustrative example to contribute to improving the quality of training for students of Physics pedagogy.

Keywords

Competence, Scale, Physics, Apply, Integrated Teaching, Knowledge

1. Introduction

Interdisciplinary teaching is an important means of solving practical problems (Klein, 1990). Students study many separate subjects but the lack of connection makes it impossible for students to apply their knowledge in life (Elvin, 1977). Integration can satisfy three needs in education: authenticity, meaningfulness, and efficiency" (Gavelek, et. al., 1999).

Integrated teaching offers some benefits to learners such as Increased understanding, retention, and application of general concepts, creative thinking and synthesis of knowledge beyond the normative, enhanced competence to identify, evaluate, and transfer critical information needed for solving new problems, encouraging collaborative learning and better attitudes (Roegiers, 2001; Sandra & Melissa, 1998).

Physics, biology, and chemistry subjects in the science discipline are not isolated from one and others (Wiyanto, et. al., 2018). Teaching students in the traditional method (teaching subjects separately) has risks in that Vietnam is implementing integrated teaching of the new general education curriculum in 2018. For example, teachers lack the competence to teach the knowledge of other subjects, Physics pedagogical students do not have access to knowledge of Biology and Chemistry (Hai & Tra, 2017). As a result of the above analysis, some of the problems identified are as follows:

- Integrated teaching has interested researchers since the early decades of the 20th century, aiming to combine the knowledge of many different subjects to solve real-life problems.
- Teachers are still confused when implementing teaching integrated content into schools, this is a barrier leading to difficulties in implementing Vietnam's 2018 general education program.

This article focuses on developing the competence to apply knowledge to the practice of physics pedagogical students, specifically answering the following questions:

- The competence to apply interdisciplinary integrated knowledge into practice for physics pedagogical students includes what components?

- How to apply the scale when teaching physics pedagogical students?

From the above analysis, we proceed to build and use the scale of competence to apply integrated knowledge into practice, giving specific examples to illustrate the use of the scale. The assessment of students through classroom learning activities, students' skills of applying knowledge, reducing assessment through testing in the form of memorization and memorization.

2. Methodology

To build a scale, first of all, it is necessary to clarify the definition of competence to apply knowledge into practice. From the concept, we describe some behavioral manifestations of students. In addition, we analyze the teaching process of students, the process is built so that the assessment of component competencies is done clearly, and students are assessed through classroom activities. The purpose of teaching is to develop students' abilities, so it is necessary to assign challenging tasks (Wang & Hazari, 2018). We choose active teaching methods such as problem-solving, group work, and experiments to teach physics to students. Designing detailed lesson plans and teaching activities.

Students self-assess the progress of their ability to apply interdisciplinary integrated knowledge into practice from the lecturer's questionnaire. The experimental subjects included 30 students studying in the second year at Can Tho University.

3. Literature Review

Raven J. proposed the competence table as a two-dimensional matrix. Horizontal content lists a series of criteria for component competence. The vertical describes skills, perceptions, and experiences (Raven, 1986).

The competence to apply knowledge into practice is the ability of learners to synthesize learned knowledge with a positive attitude to effectively solve practical problems related to nature, personal life, and community (Bao & Hoa, 2020)

Interdisciplinary integration increases the process of establishing interactions between disciplines to lead to the unity of knowledge, and promote the useful use of knowledge to answer questions about problems of practice (Tra, 2015)

In this article, the competence to apply interdisciplinary integrated knowledge into practice is the skill of learners to synthesize interdisciplinary integrated knowledge to solve problems related to practice.

According to the authors Raymond Lynch, Niall Seery, and Seamus Gordon (2008) students' learning process generalizes into several specific stages which are:

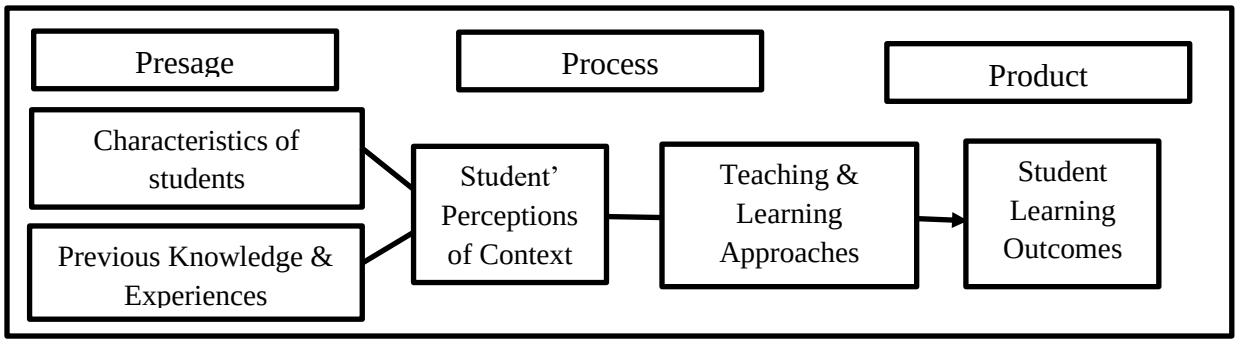


Figure 1: *Diagram of The Student Learning Process*

(Source: Raymond, et. al., 2008)

Based on the concepts mentioned in Section 3. combined with the process of teaching students in figure 1, we analyze the 4 stages of forming the competence to apply interdisciplinary knowledge into practice for students as follows:

Stage 1: The competence to search and synthesize interdisciplinary integrated knowledge: Synthesize and search for integrated documents is a time-consuming stage because it requires readers not only to look up information in books, and textbooks but also to know how to look up documents in other majors such as biology, chemistry.

Stage 2: Competence to connect knowledge of science majors to solve real-life situations: After searching, synthesizing, analyzing, and selecting integrated scientific knowledge, students need to must arrange the integrated knowledge in a logical sequence, "string" them together to clarify and explain problems in nature, this is called the competence to understand scientific problems.

Stage 3: Exchanging, speaking, and presenting knowledge on integrated topics in a logical sequence, accurately, and scientifically: Lecturers need to create opportunities for students to speak and discuss topics. The problem revolves around the learning content, helping students develop presentation skills

Stage 4: Competence to assess the impacts of science on the natural world: It is the competence to apply students' understanding to assess the positive and negative influences, limitations, and risks of science. This assessment is based on evidence (including fundamentals, basic concepts,

research methods, or processes), and this competence plays an important and relevant role. directly to decision-making, has the effect of training life skills for students.

4. Findings

In teaching languages, mathematics, or sciences, it is necessary to start from an appropriate learning situation, to lead to a pedagogical process consisting of several stages (Robillard & Marcel, 1994). Based on the analysis of teaching and learning activities, it can be seen that in order to achieve the objective of forming the competence to apply interdisciplinary integrated knowledge into practice for students, lecturers need to combine a series of activities different teaching and learning activities, these activities are arranged by the lecturer in a logical and scientific sequence.

4.1. Competence To Apply Interdisciplinary Integrated Knowledge into Practice for Physics Pedagogical Students:

Physics teaching becomes more interesting with learning activities such as answering questions, doing experiments, looking up information, solving problems, giving presentations, and discussing lessons learned. This will reduce the assessment of learners through the test of memorized knowledge for students. From the analysis of the stages of competence formation to apply interdisciplinary integrated knowledge into practice, the criteria for competence include:

- Synthesize interdisciplinary integrated documents
- Connect knowledge to solve practical problems
- Present
- Assess the impacts of science on the natural world

Table 1: *Table Describing Competence Levels to Apply Interdisciplinary Integrated Knowledge into Practice*

Criteria	**Scale 1**	**Scale 2**	**Scale 3**	**Scale 4**
Synthesize interdisciplinary integrated documents	Know how to synthesize integrated knowledge but there are a lot of errors	Know how to synthesize integrated knowledge but have to rely on instruction	Know how to synthesize integrated knowledge related to the integrated topic to solve the problem of practice, without instruction	Synthesize accurate integrated knowledge, without instruction
Connect knowledge to solve practical problems	Know how to arrange the integrated knowledge content but there are a lot of errors	Arrange the content relatively logically but must rely on instruction	Arrange integrated knowledge to solve real-world problems, but still not completely accurate	Arrange the content logically, clearly, accurately, and without instruction

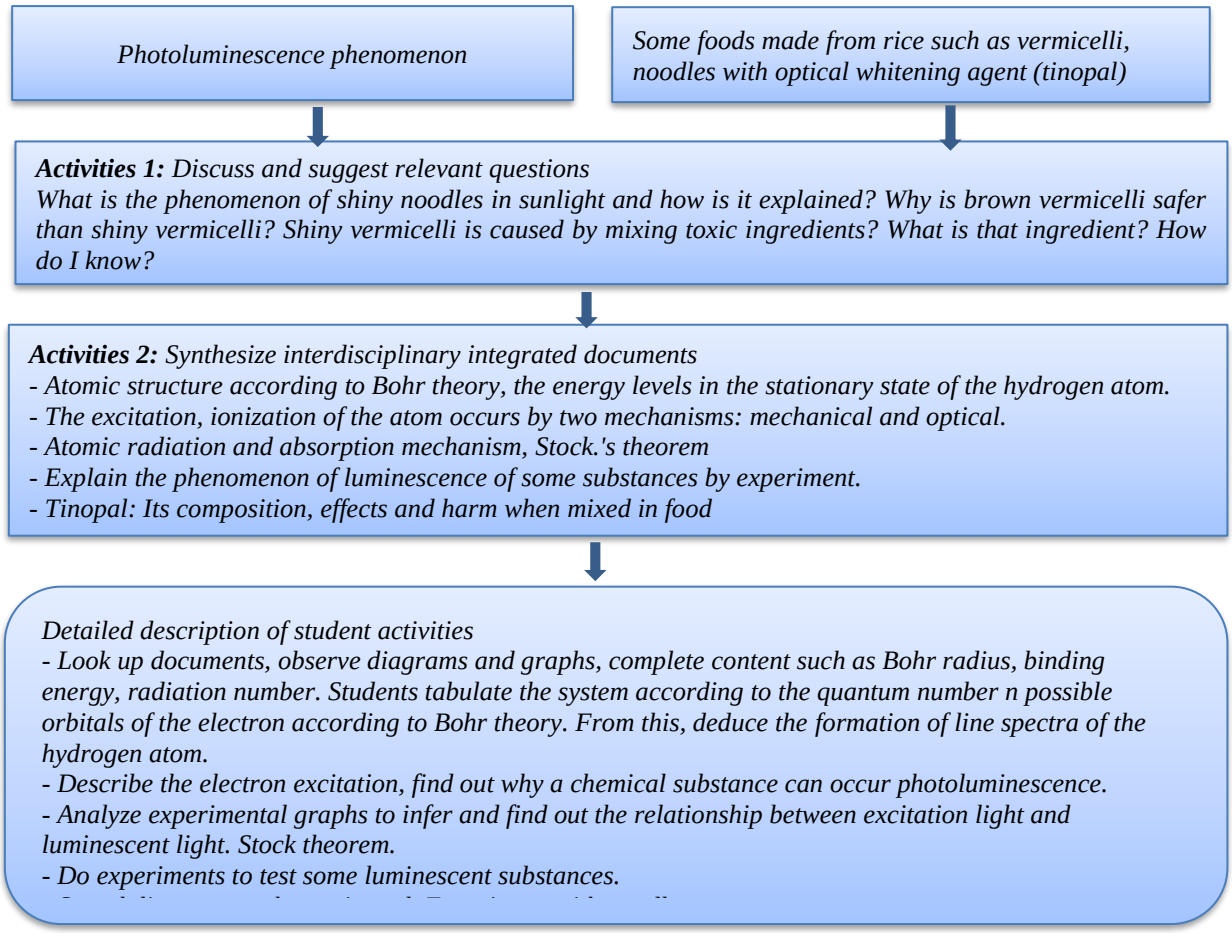
			and logical, without instruction	
Present	Know how to present but there are a lot of errors	Presenting when asked for help or instruction	Present when students receive instruction, without instruction	Present accurately, confidently, and creatively, without instruction
Assess the impacts of science on the natural world	Know how to assess the impact of science on the natural world but there are a lot of errors	Assess the impact of the natural world but must rely on instruction	Assess the impact of science on the natural world accurately and provide scientific evidence (incomplete), without instruction	Assess the impact of science on the natural world accurately and provide scientific evidence (complete), without instruction

(Source: Self)

In, the levels are explained as follows: **Level 1:** Poor/ Weak (Grade D); Level 2: Average (Grade C); Level 3: Good (Grade B); Level 4: Excellent (Grade A)

4.2. Applying The Scale to Design the Topic Teaching Process "Photoluminescence Phenomenon of Some Chemicals in Food":

Question for students: "Eating some foods made from rice such as vermicelli, and noodle soup, we should not choose white but should choose brown because they have a lot of potentials to cause cancer, why is that?". The graph to teach this topic is as follows:



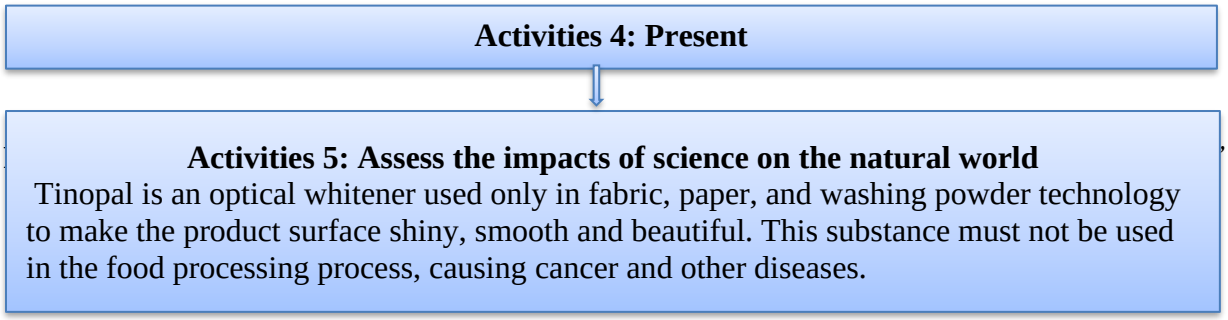


Figure 2: *Graph to Teach The "Photoluminescence Phenomenon of Some Chemicals in Food" Topic*

(Source: Self)

4.3. Matrix Design Criteria to Assess Students' Competence:

Synthesize interdisciplinary integrated documents:

Scale 1: Define the photoluminescence phenomenon, and know Stock's theorem.

Scale 2: Define the photoluminescence phenomenon, and know Stock's theorem. Learn about problems in biology and chemistry that fall under the extended application of Stock's theorem.

Scale 3: Chemical structure Tinopal has the structural formula. Suggest ways to test vermicelli by expanding it, and reading about documents affecting human health.

Scale 4: High School Physics Program, Physics 12, photoluminescence phenomenon proposes a new topic (or proposes an example of teaching by experiment to verify the accuracy of the theory).

- **Connect Knowledge To Solve Practical Problems**

  Scale 1: The explanation of the photoluminescence phenomenon is unknown based on the quantum theory of light.

  Scale 2: The toxic effect can be explained but not understood why the substance can be luminescent.

  Scale 3: Explain the phenomenon of shiny substance is due to any chemical composition inside, some problems are extended such as luminescence of scorpions, fluorescent lamps.

  Scale 4: Explain the luminescence problem clearly, expanding the problem based on the theory of energy levels in atoms.

- **Present**

  Scale 1: Embarrassing statements, wrong knowledge.

  Scale 2: Speech is awkward, and some knowledge is not clearly expressed.

  Scale 3: Speak confidently, clearly, and accurately with knowledge.

  Scale 4: Good presentation, accurate knowledge, confidence.

- **Assess The Impacts Of Science On The Natural World**

Scale 1: Students do not know how to answer the lecturer's topic questions, unable to solve the problem raised ("Why shouldn't you buy noodle soup with shiny color?)

Scale 2: Students received suggestions from the lecturer and presented that they should not buy shiny products such as vermicelli and pho, but could not explain why.

Scale 3: Students think that they should not buy noodles and noodles with shiny colors because they have been mixed with toxic chemicals, including chemical elements, which are not good for their health.

Scale 4: Students think that they should not buy noodles and noodles with shiny colors because they have been mixed with toxic chemicals, including chemical elements, which are not good for their health. Proposing to do verification experiments and make conclusions based on experiments.

Based on the criteria in Section 4.3 and the teaching process graph shown in Figure 2, the lecturer organizes classroom learning activities that contribute to improving students' ability to apply knowledge in practice (Figure 3).

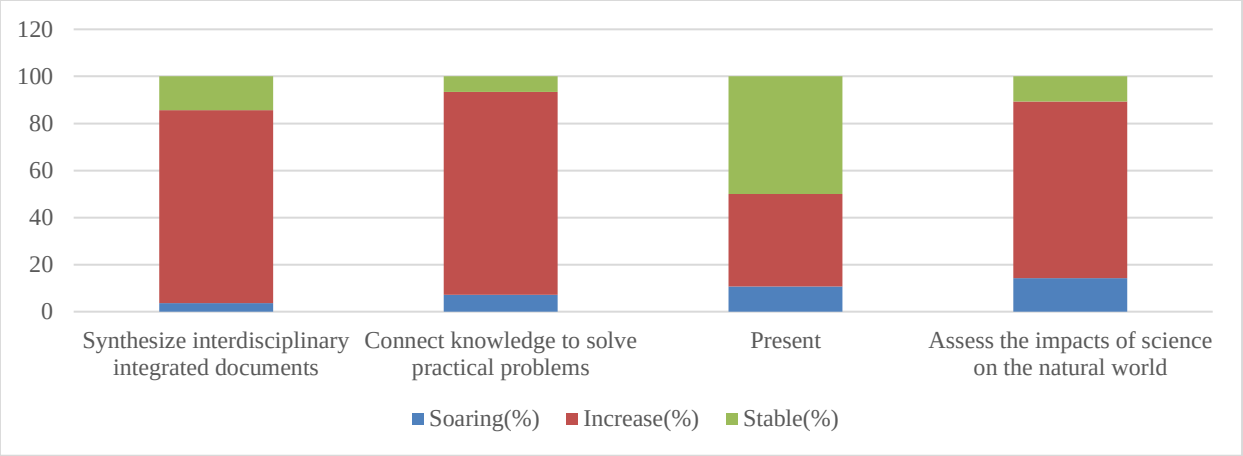


Figure 3: *Chart of Students' Self-Assessed Competence to Apply Interdisciplinary Knowledge into Practice*
(Source: Self)

5. Conclusions

The article presents a scale of competence to apply interdisciplinary integrated knowledge into the practice of physics pedagogical students. Interdisciplinary integration ideas are rarely learned in school but are fundamental to solving problems in our lives. Therefore, the article has contributed to promoting the teaching process towards solving problems requiring interdisciplinary knowledge, helping students acquire integrated knowledge and use it in high school teaching effectively.

The results of student self-assessment have shown a positive effect and teachers need to expand this teaching model in schools. However, the study did not conduct expert interviews to comment on the competence structure and the levels of the scale. Therefore, in future studies, we plan to use more questionnaires from education experts to adjust for the current correct and reliable scale.

In this study, there is a limit on the number of students over 30 students, so the survey data on the results of students' self-assessment in Figure 3 has reliability and cannot be used as a representative for all students. Therefore, in the future, it is necessary to organize teaching on a larger number of students and expand it to many other schools and regions in Vietnam.

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