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Vietnamese Student Teachers' Existing Ideas about Integrated Teaching in Chemistry and STEM Education

An Dang Thi Thuan
University of Education, Hue University, Hue City, Vietnam

Duc Nguyen Mau*
Faculty of Chemistry, Hanoi National University of Education, Vietnam
*The corresponding author's e-mail : nmduc@hnue.edu.vn

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Abstract. The study aimed to examine Vietnamese Teachers' Existing Ideas about Integrated Teaching in Chemistry and need for STEM education. Participants were 292 Vietnamese chemistry student teachers. These included 104 chemistry student teachers in Dak Nong province, 76 chemistry teachers in Hue province, and 112 chemistry student teachers in Thai Nguyen province who were working in school year 2017 – 2018 and 2018 – 2019. Data collection, the questionnaire of the awareness levels of integrated teaching based on STEM educational orientation (QAIT-STEM) was completed by participants. And, then, some of participants were selected for informal interview. The informal interview was carried out to probe what they exactly percieved on their rating on the QAIT-STEM. The participants' rating on QAIT-STEM was analysed for descriptive statistics. The informal interview was interpreted for confirming their rating on QAIT-STEM. The findings revealed that most teachers have not had much access to the theoretical basis of integrated teaching and application in the teaching process at high schools. They held some perceptions about STEM education as another process of integrated teachers. This may have implications for developing professional development program for chemistry student teachers to develop their pedagogical knowledge of integrated teaching and STEM education.
Keywords: Integrated teaching, STEM education, Chemistry

1. Introduction

STEM education appeared in Vietnam a few years ago. It has just been the stage of media announcement and experimental. It has not been an official education activity in high school. The new curriculum in Vietnam (July, 2017) indicates that the importance and enhancement of STEM activities is a radical innovation of the new curriculum (Duc et.al., 2019; Linh et.al., 2019).

Internationally, teacher preparation for STEM education has been also focused. It found that many teachers are unaware of the existing STEM attempts and are unsure of the contributions they can make for students to better understand and learn STEM subjects (Sutaphan and Yuenyong, 2019). Many organizations and ministries of education have provided various kinds of professional development programs and

learning environments to scaffold teachers in teaching based on a STEM view (ASE, 2010; Krung, 2012; Sutaphan and Yuenyong, 2021; Yuenyong, 2019).

STEM education with the tasks of providing crucial knowledge and skills for students in 21st Century will become a widespread education model in the future (Brown, 2012). Therefore, STEM education is highly needed the concern and awareness of the whole society. To move further on STEM education in Vietnam, the studying of what they organize the STEM activities may provide baseline of developing STEM education in Vietnamese schools (Duc et.al., 2019). STEM is a curriculum based on the idea of educating students in four specific disciplines - science, technology, engineering and mathematics - in an interdisciplinary and applied approach and learners can apply it into daily life. Instead of teaching four subjects as separate and discrete subjects, STEM-oriented teaching combines them into a coherent learning model based on practical applications. STEM is known as a special education method that integrates elements of Science, Technology, Engineering and Mathematics. This integrated approach not only helps students understand the principles but also can bridge the gap between academic knowledge and practice to create products in daily life (Bybee, 2010; De Jarnette, 2012; Tinh et.al., 2021). Literatures suggested conceptions of STEM education that was the teaching and learning of content and practices of integrated knowledge. These integrated knowledge included science and/or mathematics through the integration of the practices of engineering and engineering design of relevant technologies. The content and practices of integrated knowledge would provide students' judgement on their problem solving through teamwork. The development of 21st century skills should be enhanced in students' practicing integrated knowledge (Moore et.al., 2015; Yuenyong, 2019).

It seems that integrated teaching would be key feature of teaching and learning on STEM education. It could be mentioned that integration has become a major trend in organizing knowledge as well as the number of integrated syllabus of natural subjects in some developed countries increases rapidly. A study of the program survey about 20 countries by the Vietnam Academy of Educational Sciences shows that 100% of those countries have developed programs in an integrated orientation, typically Korea, Singapore, Malaysia, Australia, France, England, USA, Canada (Imig, 2002). Integrated teaching is an indispensable trend in education today. From the XV to the XIX century, the natural sciences studied the natural world according to analytical thinking and each of the natural sciences studied a physical l form, a moving form of matter in nature through the prism of each major by independent way (Gardner, 1999). In Vietnam, integrated teaching is not a new method because it already exists at many levels. In elementary, there is usually inter-subject or internal integration, then gradually decreases from secondary school to high school (internal integration). (MOET, 2006).

Integrated teaching is the teaching process that provide participation and connection of knowledge of different professional fields or subjects in order to develop students' ability to solve complex and practical problems (MOET, 2018; Tremblay, 2002). Integrated teaching may links research, teaching, and learning subjects on the same field or several different fields in the same teaching plan. Integrated teaching is one process in which capacity components are integrated with each other based on specific situations to build capacity for learners (Brown et.al., 1989; Opara, 2011). Some targets of integrated teaching could be provided as following; (1) Integrated teaching is to develop capacity of learners, (2) Integrated teaching makes the learning process meaningful, (3) Distinguishing the essential from the less important, (4) Teaching how to use knowledge based on every situation, (5) Creating connection among definitions learned (Leach and Scott, 2003; Phormenko, 1996; Seattha et.al., 2015)

To enhance teachers to provide the integrated teaching, the quality of the teachers is an important factor in the success of a comprehensive renovation of Vietnamese education in the new period. In the context of globalization, it requires a new workforce

with good adaptive capacity, creative thinking to meet the requirements of a competitive and developing economy. To meet that requirement, teachers should understand about integrating science teaching, teach students how to collect and select; process information and apply the knowledge in real-life situations. Chemistry is a subject that connects into many disciplines and also relates to various issues in everyday life. Chemistry student teachers, therefore, need to develop their pedagogy knowledge about the integrated teaching. The examining Vietnamese teachers' existing ideas about integrated teaching in Chemistry and need for STEM education may suggest some assumptions for developing integrated teaching capacity following STEM educational orientation for pedagogical chemistry student teachers.

2. Methodology

Methodology regarded mixed method. The quantitative and qualitative data were collected to examine Vietnamese Teachers' Existing Ideas about Integrated Teaching in Chemistry and need for STEM education.

2.1 Participants

Participants were 292 Vietnamese chemistry student teachers. These included 104 chemistry student teachers in Dak Nong province, 76 chemistry teachers in Hue province, and 112 chemistry student teachers in Thai Nguyen province who were working in school year 2017 – 2018 and 2018 – 2019.

2.2 Data Collection

The questionnaire of the awareness levels of integrated teaching based on STEM educational orientation (QAIT-STEM) is the rating scale. It consists of 4 scales including unknown: 1, know: 2, understand: 3, and application: 4. The items of QAIT-STEM were asked teachers to rate about what they understand about aware integrated teaching and need of integrated teaching based on STEM education.

The questionnaire of the awareness levels of integrated teaching based on STEM educational orientation (QAIT-STEM) was completed by participants during school year 2017 – 2018 and 2018 – 2019. And, then, some of participants were selected for informal interview. The informal interview was carried out to probe what they exactly percieved on their rating on the QAIT-STEM.

2.3 Data analysis

The participants' rating on QAIT-STEM was analysed for mean of rating in each items. And, the descriptive statistics of participants' rating also was provided including standard deviation, reliability coefficient, variance. The informal interview was interpreted for confirming their rating on QAIT-STEM.

3. Findings and discussion

3.1. The reality of awareness of Chemistry teachers in high school and improvement needs of integrated teaching following STEM education

Table 1: The survey of awareness levels result about the integrated teaching of Chemistry is taught in high school

No.	Understanding the issues at different levels	Mean	S.D.	r	σ^2
1	Integrated teaching definition	2.51	0.706	0.516	0.499
2	Integrated teaching based on STEM educational orientation aimed at developing learners' capacity	2.37	0.602	0.494	0.363
3	Reasons to implement integrated teaching based on STEM educational orientation	2.15	0.748	0.506	0.559
4	Criteria to design some integrated teaching topics based on STEM educational orientation	1.93	0.698	0.527	0.487
5	The way to design some integrated teaching topics based on STEM educational orientation to form the corresponding capacity in students	1.97	0.709	0.517	0.503
6	Ways/techniques to help design an integrated teaching topic based on STEM educational orientation	1.84	0.683	0.562	0.466
7	The way to evaluate students in integrated teaching based on STEM educational orientation	2.37	0.684	0.498	0.467
8	ICT applications in integrated teaching	2.63	0.666	0.519	0.444

Through Table 1, it shows that most of the teachers surveyed understand why it is necessary to implement integrated teaching based on STEM educational orientation, but not in a deep understanding about integrated teaching and how to design some integrated teaching topics in STEM educational orientation to form the corresponding capacity in students. In addition, the understanding of integrated teaching methods and the way to evaluate students in integrated teaching in high schools and ways/techniques to help design integrated teaching topics are still limited. The survey results show that teachers in high schools have certain knowledge about the integrated teaching, although most teachers have not had much access to the theoretical basis of integrated teaching and application in the teaching process at high schools.

3.2 Needs of integrated teaching based on STEM educational orientation

The survey result of improvement needs of integrated teaching based on STEM educational orientation

Table 2: The survey of improvement needs result in the integrated teaching capacity of Chemistry teachers in high school

No.	Understanding the issues at different levels	Mean	S.D.	r	σ^2
1	Integrated teaching based on STEM educational orientation aimed at developing learners' capacity	2.36	0.653	0.044	0.427
2	Reasons to implement integrated teaching based on STEM educational orientation	2.46	0.667	0.005	0.445
3	Criteria to design some integrated teaching topics based on STEM educational orientation	3.15	0.810	0.048	0.657
4	The way to choose and design some integrated teaching topics based on STEM educational orientation to form the corresponding capacity in students	3.34	0.761	0.005	0.579
5	Ways/techniques to help design an integrated teaching topic based on STEM educational orientation	3.40	0.699	0.123	0.489
6	The way and reason to implement integrated teaching in high school	2.72	0.704	0.112	0.496
7	Modern teaching methods/techniques positively enhance students	2.29	0.712	0.060	0.507
8	ICT applications in integrated teaching	2.25	0.674	0.024	0.454
9	Ways of evaluating students in integrated teaching according to STEM educational orientation	2.81	0.842	0.023	0.709

From the results of integrated teaching needs survey based on STEM educational orientation, most teachers see the need to train integrated teaching issues, in which the criteria to design integrated teaching topics based on STEM educational orientation; the way to choose and design some integrated teaching topics based on STEM educational orientation in order to form the corresponding capacity of students; methods of evaluating students in integrated teaching according STEM educational orientation are interested by teachers.

According the results of the survey on the situation and the training needs of teachers in integrated teaching, it shows that the addition of the theoretical foundation for integrated teaching and application in the teaching process to create integrated teaching capacity for students at Universities of Education are essential to help students after graduating.

4. Conclusion

The Vietnamese teachers' existing ideas about integrated teaching in Chemistry revealed that most teachers have not had much access to the theoretical basis of integrated teaching and application in the teaching process at high schools. They held some perceptions about STEM education as another process of integrated teachers. They, therefore, need some conceptual framework for designing an integrated teaching topics based on STEM educational orientation. These information may orient the further study about professional development program of integrated teaching and STEM education. To enhance chemistry student teachers to develop their pedagogical knowledge of integrated teaching and STEM education, the PD program may provide particular activities to develop their understanding in the following issues. These include theoretical framework for some integrated teaching topics based on STEM educational orientation, ways/techniques to help design an integrated teaching topic based on STEM educational orientation, and ICT applications in integrated teaching

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