DEVELOPING A TEAM OF NATURAL SCIENCE TEACHERS IN LOWER SECONDARY SCHOOLS IN VIETNAM TO MEET THE REQUIREMENTS OF FUNDAMENTAL AND COMPREHENSIVE EDUCATIONAL REFORM

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Abstract:
Lower secondary education plays a crucial role in shaping and developing human resources to support national growth. In practice, teachers in general, and natural science teachers in particular, represent a key human resource for the successful implementation of the general education curriculum. This study focuses on developing a team of natural science teachers in lower secondary schools through a competency-based approach, aiming to assess and propose solutions for improving teacher quality to meet the requirements of fundamental and comprehensive educational reform in Vietnam.

Keywords: education and training; competency and qualities; human resources; general education; lower secondary school teachers

1. Introduction

The General Education Curriculum (GEC) is developed based on the perspectives of the Communist Party and the State regarding the fundamental and comprehensive reform of education and training. At the same time, it inherits and builds upon the strengths of previous general education programs in Vietnam, incorporating advancements in educational science research and experiences from competency-based curriculum development models in advanced education systems worldwide.

> "*The GEC ensures the development of students' qualities and competencies through educational content that encompasses fundamental, practical, and modern knowledge and skills; harmonizing moral, intellectual, physical, and aesthetic values; emphasizing practice and the application of acquired knowledge and skills to solve problems in learning and daily life. It promotes high integration in lower grades and increasing specialization in higher*

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grades. Through modern educational methods and organizational forms, it seeks to foster the proactivity and potential of each student, employing assessment methods that align with educational objectives and teaching methods to achieve these goals." (MOET, 2018).

The requirements for reforming the overarching General Education Curriculum pose challenges during its implementation, necessitating the enhancement of teacher competencies and essential skills for school administrators. This is also a critical task for institutions responsible for the training and professional development of teachers (T) and school administrators (SA).

Based on a competency-based approach, this article utilizes document analysis and comparative methods, referencing several teacher competency frameworks from international scholars to provide a foundation for developing and improving the quality of natural science teachers in lower secondary schools in Vietnam today.

2. Research Methods

This study employs a qualitative approach to examine the development of Natural Science teachers in lower secondary schools through a competency-based framework. Document analysis was conducted on key educational policies and competency frameworks to identify standards and requirements for teacher development. Comparative analysis was used to explore international practices and their relevance to Vietnam. Additionally, interviews with education experts and case studies of selected schools were carried out to gain practical insights into the implementation of competency-based teaching and training. Thematic analysis was applied to synthesize findings and propose actionable recommendations for enhancing teacher competencies.

3. Research Results

3.1. The Position and Role of Natural Sciences in the General Education Curriculum in Vietnam Today

Natural Sciences (NS) is a subject developed based on the foundations of Physics, Chemistry, Biology, and Earth Sciences. NS combines theoretical knowledge with experimental practices, making practical activities and experiments conducted in laboratories, subject-specific classrooms, and in the field particularly significant. Many NS concepts are closely related to students' daily lives, providing favorable conditions for organizing experiential activities that enhance their ability to comprehend, explore, and apply scientific knowledge to real-world scenarios.

NS is continually innovated to meet the demands of modern life. Therefore, general education must continuously update new scientific advancements and reflect the progress of various scientific, technological, and engineering fields. This characteristic necessitates that the NS curriculum streamline descriptive content to focus on organizing

student-driven discovery and the application of fundamental scientific principles, forming the basis for practical applications in real life.

NS plays a vital role in the holistic development of students, serving as a foundation for shaping and developing a scientific worldview for lower secondary school students. Along with Mathematics, Technology, and Informatics, NS contributes to promoting STEM education (Science, Technology, Engineering, Mathematics), meeting the demand for young human resources in the industrialization and modernization phases of the country.

In the General Education Curriculum, NS is a compulsory subject at the lower secondary level. It helps students develop the qualities and competencies formed and nurtured during primary education while building foundational knowledge and skills for further education, vocational training, or entry into the workforce. NS evolves from the Science subject taught in grades 4 and 5 (primary education) and is taught in grades 6, 7, 8, and 9, with a total of 140 periods per academic year (35 weeks/year, 4 periods/week).

The NS curriculum is structured into two phases:
1) The basic education phase, and
2) The career-oriented education phase (MOET, 2018).

The implementation of the new curriculum in schools requires teachers (T) and school administrators (SA) to enhance their existing knowledge and experience while developing essential skills to effectively manage and implement the curriculum in educational institutions (Chung). Thus, the requirements of the overall General Education Curriculum reform and the challenges arising during implementation demand improvements in teacher competencies and the necessary skills of school administrators. The new General Education Curriculum emphasizes student-centered teaching in NS at the lower secondary level. NS teachers play the role of facilitators and supporters, helping students discover knowledge based on their prior experiences and understanding. Teachers focus on the entire learning process, students' learning methods, and the outcomes they achieve daily, providing timely feedback and assessment. NS teachers also aim to meet students' learning needs according to their respective levels of comprehension.

The competency-based education model for the NS curriculum requires teachers to integrate interdisciplinary knowledge, maintain an open system with other scientific disciplines, and strongly connect with real-world experiential activities.

3.2. The Position and Role of Natural Science Teachers at the Lower Secondary Level
The fundamental position and role of teachers in general and natural science (NS) teachers, in particular in schools, can be described as follows:

3.2.1. The Role of a Designer
Teachers, in general, and NS teachers, specifically, act as designers of the subject's teaching program and the framework for shaping and developing students' character.

Teachers select educational content, build activity processes, integrate various teaching and educational methods, design collective activities, and pay attention to individual student needs.

3.2.2. The Role of an Organizer

Teachers serve as organizers of the subject's teaching and other educational activities, facilitating interactions that help students fully develop their abilities, responsibilities, and creativity. Teachers also guide students in their process of self-education.

3.2.3. The Role of a Leader, Commander, and Motivator

In addition to being designers and organizers, teachers take on leadership roles, directing, adjusting, and encouraging the learning and training process. They guide students, provide corrections, motivate them, and remind them to actively shape and develop their personalities.

3.2.4. The Role of an Evaluator

Based on collected information about students' learning and training processes, teachers act as "arbiters" in evaluating students' progress and collective efforts. Teachers must possess sufficient competence and responsibility to identify and highlight students' strengths, provide accurate assessments of their abilities and character, and support the continuous improvement of the educational process.

As Hiền & Bích (09-2023) noted, "*the evaluation activities of teachers in general, and lower secondary teachers in particular, are key to assessing teacher quality and competencies. Evaluation results guide the entire process of improving the teaching workforce, encouraging self-adjustment among teachers, and assisting school administrators in planning strategies to enhance teacher quality in schools.*"

3.2.5. The Role of a Researcher

Given their role in teaching NS at the lower secondary level, NS teachers also act as scientists, demonstrating competencies in conducting research in natural sciences and guiding students in scientific research within the school setting.

3.3. The Position, Role, and Teaching Methods of Natural Sciences in Lower Secondary Schools

3.3.1. Position and Role of Natural Sciences (NS)

Globally, NS is commonly referred to as "Science," encompassing integrated teaching of Physics, Chemistry, Biology, and Earth Sciences. Each country or textbook series has its own approach to selecting and integrating topics, but all generally include fundamental scientific knowledge in three domains: Physical Sciences (Physics, Chemistry), Life Sciences (Biology), and Earth and Space Sciences. The topics are practical and closely related to students' daily lives.

The NS curriculum is built on three fundamental axes: Scientific Topics, General Scientific Principles/Concepts, and the Development of Competencies. Among these, the general principles/concepts serve as the core connecting various scientific topics throughout the curriculum (MOET, 2018). The curriculum contributes to shaping and developing students' qualities and competencies through core educational content that is fundamental, practical, modern, and up-to-date. It emphasizes practice and the application of knowledge to solve problems in learning and life. This is achieved through educational methods and organizational forms that foster students' initiative and potential, alongside assessment methods aligned with educational objectives. The curriculum ensures the progressive development of learners' competencies across grade levels, laying a foundation for higher education and lifelong learning.

Through practical activities in laboratories and real-world settings, students can master theoretical knowledge and apply NS concepts in life, production, and environmental protection, meeting the country's sustainable development goals. NS connects science learning with life, focusing on knowledge relevant to students' daily experiences and encouraging the application of scientific concepts to real-world situations. The curriculum develops students' adaptability in a rapidly changing society and ensures appropriateness to their developmental stages, allowing them to make progress in learning and develop competencies throughout various educational levels.

Along with other subjects, "*NS contributes to achieving the objectives of general education, helping students develop harmoniously in terms of physical and mental well-being; become active and confident learners; develop career awareness and lifelong learning habits; and cultivate good qualities and essential competencies to become responsible citizens, culturally competent workers, and creative individuals who can meet personal development needs and contribute to national development in the era of globalization and the Fourth Industrial Revolution"* (Phuong, 2020).

Furthermore, NS develops key qualities outlined in the General Education Curriculum, such as patriotism, compassion, diligence, honesty, and responsibility. It shapes students' scientific worldview and nurtures qualities like confidence, honesty, objectivity, love for nature, and respect for natural laws, helping them interact responsibly with the natural world in alignment with sustainable development goals (MOET, 2018).

NS also develops general competencies such as self-management and independent learning, communication and collaboration, problem-solving, and creativity. It fosters other competencies, including language, numeracy, technology, and, particularly, lifelong learning. Additionally, NS builds specialized competencies in exploring the natural world. Through active learning methodologies, NS emphasizes students' active acquisition of scientific knowledge, developing practical skills, observation, questioning, reasoning, prediction, hypothesis testing, modeling, explanation, application, and synthesis of scientific knowledge to address real-life problems.

3.3.2. Teaching Methods for Natural Sciences

Teaching methods for NS are primarily selected based on the following orientations:

- Organizing inquiry-based activities to explore the natural world.
- Training students in cognitive methods, learning skills, and logical thinking.
- Conducting experiments and experiential activities in natural environments and real-life settings.
- Enhancing the integration of individual learning activities with small group collaboration.
- Utilizing assessment, particularly formative assessment, as a method to organize learning activities.

As Khiem (2018) noted, "*Teaching NS primarily employs active teaching methods, where teachers act as organizers and guides, creating a friendly learning environment and problem-based scenarios to encourage students to actively engage in learning activities, develop independent learning habits, and harness their accumulated knowledge and skills for further development.*"

Student learning activities are primarily active and exploratory, guided by teachers. These activities are organized both within and beyond the school campus and include methods such as inquiry-based learning, problem-solving, project-based learning, case studies, practical exercises, and self-study. Emphasis is placed on hands-on experiments and real-world investigations.

3.4. Developing Natural Science Teachers Through a Competency-Based Approach

The concept of "competency" can be approached from various perspectives, depending on the scientific field (Thuy, 2020). Competency is defined as "*the ability to apply or utilize knowledge, skills, behaviors, and personal attributes to successfully perform important tasks associated with a specific function or activity in a particular role or position*" (Arup Barman, 2011). Competencies are shaped by natural aptitudes, but they are primarily developed through practice. "*Competency reflects the knowledge, skills, experiences, attitudes, or qualities necessary to fulfill a role, task, or job—representing the levels of competency required by the job. It also indicates the degree of fit and task completion of an individual in a given role*" (Quyen, 2023).

Competencies can be categorized into core competencies, managerial competencies, professional competencies, and personal/supplementary competencies. When conducting task analysis, it is essential to identify the necessary competencies for task performance, define the required proficiency levels for each competency, and describe specific behavioral indicators corresponding to each proficiency level. This analysis serves as a foundation for identifying gaps between the actual competencies of individuals and the required competency levels.

According to the U.S. Employment and Training Administration, "*a competency-based approach in human resource development standardizes and regulates the behavioral energy of teachers, creating noticeable differences in performance*" (Ennis, 2008).

The Southeast Asian Ministers of Education Organization (SEAMEO) proposes a teacher competency framework consisting of four core competencies, 12 general

competencies, 31 enabling competencies, and 136 success descriptors (Thailand, 2018). This framework has been adopted by several Southeast Asian countries as a basis for evaluating and training teachers.

Franz E. Weinert (2001) outlined nine approaches to competency:

i. **General cognitive competencies**: This approach examines competencies through three theoretical models:
   - **Intelligence model**: Represents a system integrating content, context, potential abilities, and aptitudes, which serve as prerequisites for purposeful cognitive action and success in learning and environmental interaction.
   - **Information processing model**: Views the mind as an "information processing machine" capable of acquiring specific knowledge and skills.
   - **Piaget's cognitive development model**: Describes psychological adaptation organized into developmental stages of knowledge acquisition and action.

ii. **Specialized cognitive competencies**: Focuses on the characteristics of specific disciplines, addressing prerequisite cognitive conditions necessary for excelling in particular fields. These require extensive experience, deep domain knowledge, and high-level thinking.

iii. **Competence performance model**: Emphasizes abstract rules and principles of language, cognitive components, and the ability to create, comprehend, and articulate complex ideas.

iv. **Competency-regulation-performance models**: Investigate how the relationship between competency and performance is mediated by variables such as cognition style, memory ability, task familiarity, or personal traits.

v. **Competency-motivation integration**: Understands competency as a result of effective interaction between individuals and their environment.

vi. **Objective and subjective competencies**: Objective competencies are measured through standardized tools, while subjective competencies reflect the ability to solve problems and are assessed through qualitative tools.

vii. **Action competencies**: Includes general problem-solving abilities, critical thinking skills, specific domain knowledge, confidence, and social competencies.

viii. **Key competencies**: Encompasses fundamental competencies (e.g., literacy, numeracy), methodological competencies (e.g., planning, problem-solving), community competencies (e.g., communication, presentation), and judgment competencies (e.g., critical thinking, evaluation).

ix. **Meta-competencies**: Involve enabling individuals to understand themselves better and apply their existing knowledge effectively in real-life situations.

Based on these perspectives, developing teachers through a competency-based approach involves enhancing the competencies of teachers according to specific competency indicators, as identified in teacher competency frameworks. Teacher

development in this context focuses on competency standards as both the objective and criteria for evaluating progress and achievements.

3.5. Factors Influencing the Development of Natural Science Teachers Through a Competency-Based Approach

3.5.1. External Factors

A. Scientific and Technological Factors

> "*The scientific and technological revolution has significantly increased labor productivity and economic efficiency, profoundly influencing human resource development requirements. It necessitates a workforce with advanced skills. For management levels, scientific and technological development impacts all stages of teacher development at the lower secondary level, including the application of technology in management, planning, training, professional development, and teacher evaluation.*" (Ngoc, 2019)

Teachers are the key factor in the process of educational reform and improving the quality of human resources. The development of the teaching workforce must ensure sufficient quantity, quality, and professional competence to meet the demands of enhancing educational quality through a science and technology-oriented approach (Ngoc, 2019). This requires teachers to possess scientific and technological knowledge to integrate into lesson preparation and practical teaching.

B. Mechanisms and Policies

Policies at all levels of education impact teacher development. Appropriate mechanisms and policies create motivation for teachers to enhance their professional qualifications, skills, and ethical qualities, ensuring they meet the competency standards required for the teaching profession.

C. Economic and Social Factors

Economic and social development is intrinsically linked to education. As the economy and society advance, the demand for education and training increases accordingly. Consequently, teacher development must align with the economic and social progress. The general educational level of the population and educational demands require teachers to continuously improve their qualifications and develop professionally (Ngoc, 2019).

3.5.2. Internal Factors in Schools

A. Management Personnel

School administrators significantly influence the management and development of teachers. They are responsible for implementing and promoting competency-based teacher development. To enhance teacher quality and create a supportive work environment, administrators must lead school activities, understand the institution's conditions, curricular goals, teaching content, and innovative pedagogical methods, and

serve as the central figures for unity within the school (Ngoc, 2019). The primary responsibility for teacher development lies with school administrators.

Additionally, the establishment and operation of an effective management system play a critical role in stabilizing and developing the school, including teacher development efforts.

B. Teacher Awareness and Attitude

To develop competency-based NS teachers, it is essential for teachers to understand their roles and responsibilities in education. They must be motivated to embrace change and adopt a proactive attitude toward professional development. Teachers should be willing to embrace challenges and adopt new methods to self-evaluate and improve their competencies.

C. Students

Students' interest in NS directly affects teachers' motivation. When students enjoy and understand the subject, teachers feel inspired and motivated to further develop their teaching abilities. Additionally, understanding students' needs and preferences enables teachers to tailor their methods and content, further enhancing their professional skills and knowledge.

4. Conclusion

The General Education Curriculum is designed with a competency-based approach, requiring both subject-specific teaching and educational activities within schools to maximize opportunities for students to experience and engage in learning. Experiential and creative activities represent fundamental innovations in "educating individuals," alongside subject-specific experiences aimed at improving "academic education."

The new General Education Curriculum emphasizes student-centered teaching in NS at the lower secondary level (MOET, 2018). Thus, NS teachers at this level serve as facilitators and supporters, helping students access and acquire knowledge based on their prior experiences and understanding. Teachers focus on the entire learning process and methods, as well as the outcomes students achieve daily through timely feedback and evaluation.

Developing competency-based NS teachers at the lower secondary level is essential for creating a teaching workforce that possesses the necessary qualities and competencies to effectively teach NS. This development aligns with the requirements for fundamental and comprehensive educational reform in Vietnam today.

Conflict of Interest Statement

The author declares no conflicts of interest.

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