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Original Research

Educational Status of High School Biology Teachers to Develop Living World Understanding Competency in Students: A Case Study in the Mekong Delta, Vietnam

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Abstract: Competency-based education is becoming increasingly popular in Vietnam, especially in the Mekong Delta region, which is known for its economic challenges and low-lying geography. This approach to education focuses on equipping students with specific skills and knowledge that will enable them to excel in their future careers. However, a study conducted with biology teachers in high schools in the region revealed that although the teachers pay significant attention to developing students' competencies, such as their understanding of the living world, the results of teaching these competencies are unsatisfactory and require improvement. To improve students' living world understanding competency, the study recommends that teachers use more experimental teaching methods, including organizing games and role-plays, project-based learning, and research on scientific and technical topics. Additionally, the study suggests that teachers use the STEM and STEAM approaches, which involve integrating different subjects and encouraging creative thinking, problem-solving, and innovation. Implementing these approaches can create a more engaging and interactive learning environment, leading to a better understanding of the living world. The study emphasizes the importance of developing students' competencies, particularly in low-lying areas like the Mekong Delta, where sustainable development and environmental awareness are critical for the region's future. Its recommendations offer practical guidance for teachers to enhance their teaching and improve students' living world competency, contributing to the region's economic and social development.

Keywords: *Competency, High School Students, Teachers, Living World Understanding*

Introduction

The Concept of "Capacity" and General Issues about "Teaching and Developing Capacity"

Competence is the ability of the subject to apply knowledge, skills, attitudes, experiences, values, ethical standards, and motivations to act appropriately and effectively in a context or in practice (Woodruffe 1993). According to Vietnam's 2018 General Education Program, competence is understood as "personal attributes formed and developed thanks to existing qualities and the process of learning and training, allowing people to mobilize synthesis of

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knowledge, skills and other personal attributes such as interest, belief, will,…to successfully perform a certain type of activity, achieving desired results under specific conditions" (Ministry of Education and Training 2018a, 3).

Since the beginning of the nineteenth century, educators have changed their thinking about teaching, moving from teaching to help students remember knowledge to the tendency to form problem-solving abilities in learners by fostering thinking and critical ability (Ha and Dao 1998). By the 1970s, the concept of competency-oriented teaching for learners had emerged in the United States, and for this mode of education, the teaching process becomes scientific when quantifying the level of formation of the learning in educational programs (The Social Science Education Consortium 1996). Blank (1982) lays the rationale for teaching competency development and develops a competency training program handbook that discusses the actual contents of competency-based education, introducing the learner capacity-building and development trends.

John (1995) followed that rationale, publishing competency-based education and training material. The author clarifies the views and objectives of competency-based education, provides criteria and tools for assessing competencies, and improves Blank's draft competency training program. Saterdag (2004) and Stronge (2018) believe that developing performance capacity must be the goal of teacher training because it is the teacher who lays the foundation, helping students form their abilities. The learner is a copy of the teacher's qualities, personality, and ability to perform professionally. According to the training model of the Massachusetts Institute of Technology, the development of engineering programs according to the CIDO (Conceive – Design – Implement – Operate) approach (idea, design, implementation, operation) is based on the statement of Learning Outcomes: what knowledge, skills, qualities, attitudes graduates need to have and on that basis form practical competencies to meet the needs of employers (stakeholders) (Crawley et al. 2007). According to Stronge (2018), the qualities of an effective teacher include (1) the prerequisites for becoming an effective teacher, (2) qualities of teachers, (3) classroom organization and management, (4) composing lessons and organizing teaching, and (5) tracking student progress and potential. Thus, studies on teaching capacity have been conducted relatively early in countries around the world and have shown the structure of teaching capacity and constituent concepts as well as identified the role and importance of training according to learners' ability.

Teaching Develops the Ability to Understand the Living World

According to Hoang Phe's Vietnamese dictionary, "find out" means considering, investigating, and understanding a particular issue (Phe 1997). In addition, according to the naturalist David Attenborough (1984), our world is a living world: we share the Earth with millions of other species of organisms in countless different forms, from microscopic bacteria to giant blue whales. Or, to put it briefly, the "living world" is the world with life

(Attenborough 1984). The Ministry of Education and Training of Vietnam has outlined the steps in the process of understanding students' living world, including: (1) proposing issues related to world living, (2) making judgments and developing hypotheses, planning and implementing plans, and (3) writing, presenting reports, and discussing (Ministry of Education and Training 2018b).

Exploration is an important factor playing a crucial role in teaching and developing understanding of the living world and exploring knowledge in natural sciences in general and biology in particular. This has become a source of inspiration for many scientists who believe that researching the wild and phenomena through experiments is a path related to scientific research activities of learners. The constructivist learning view may be best supported by teaching methods involving cognitive activity rather than behavioral activity, instructional instruction rather than pure exploration, and focusing on curriculum rather than unstructured exploration (Mayer 2004).

Practical teaching is also one of the suitable methods to develop the capacity to understand the living world. The modern, practical teaching of biology emerged in the twentieth century. By 1939, it appeared in Europe, with quite a few publications on the method of empirical learning for students. After World War II, the number of publications of this type increased rapidly from year to year. Stawiński (1978) has analyzed these publications and found that the objectives and functions of practical activities, experiments in teaching, and learning have been carried out at a high level with a variety of methods. Nguyen (2015) developed a problem-based learning organization process and applied that process to teach ecology using problem-based learning activities, at the Faculty of Biology, University of Education. Le and Mai (2012) proposed teaching exploratory learning in Ecology at high school level through three steps: assigning cognitive tasks and guiding exploration, organizing discussions to explore and apply problem-solving situations, and providing some illustrative examples of teaching exploratory lessons in Ecology.

Thuy and Hong (2019, 62) present "the process of building a learning project oriented to developing scientific research capacity for high school students." According to the authors, scientific research capacity belongs to one of the three groups of competencies necessary to form and develop for students in teaching Biology in high school. These are (1) The capacity to perceive the natural world, (2) The ability to understand the natural world, and (3) The ability to apply the knowledge learned into practice. Dang and Nguyen (2020) also set out the structure of teaching develops the ability to learn about the world of life, including fourteen indicators to determine capacity, and set out the process of designing and organizing experimental activities to develop the ability to understand the living world through performing hands-on experiments in Body Biology, in Biology grade 11. According to a study conducted by Ninh (2020), exploration and discovery has been known as an active and proactive activity of learners, by asking questions, collecting, investigating, analyzing data…to seek and acquire new knowledge; The development of the capacity of exploration and discovery for students through exploratory teaching according to the 5E model, the general structure of the capacity to explore includes four main component competencies, in each of which there are corresponding component competencies; Through exploration and discovery activities, students discover knowledge like a scientist through the organization of discovery according to the set orientation, under the guidance, organization, and control of teachers, students are trained in scientific research skills, develop scientific thinking, forming in students the sense and skills to apply Biology knowledge in real life, creating an interest in learning and a serious attitude in science.

According to Ha's research, the ability to understand the living world can be assessed using a four-step process: (1) engage in research planning, (2) design appropriate tools, (3) ask for expert opinion, and (4) use and perfect the tools. Assessing the ability to understand the living world involves assessing abilities (standards) such as identifying research problems from practice, asking research questions, hypothesis building (planning and implementing a plan to prove the hypothesis), comparing results with hypotheses, drawing conclusions, writing reports, and discussing reports. These abilities can be assessed by teachers or be assessed by students themselves and evaluated using comments or points. Appropriate assessment tools, such as essay questions, multiple-choice questions, situational exercises, experimental exercises, and assessment sheets (checklists, scales, rubrics based on criteria), should be used. Regardless of the form, the assessment at what time and with what tools depends on the requirements to be met, the teaching content, teaching methods, and students' learning products; it especially depends on the abilities of teachers and students, as well as other conditions (Ha et al. 2023). Therefore, in the world and in the country, there are quite a few authors who are interested in researching teaching in the direction of developing students' understanding of the living world with various aspects, levels, and fields. These specific studies have built a basic theoretical system, essential for enhancing students' knowledge of biology in Vietnam. However, there have not been many studies specifically researching the current teaching situation of teachers in terms of developing the ability to learn about the living world in students when teaching topics in high school biology. This research was conducted with the aim of bridging this gap.

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This study was carried out from September 2022 to December 2022 using a cross-sectional survey model with quantitative and qualitative research forms. It surveyed a total of sixty biology teachers from Cai Nuoc High School, Ca Mau City High School, An Khanh High School, Phan Van Tri High School, Cu Lao Dung High School, and Hoang Dieu High School.

The survey questions include both open-ended and closed-ended questions designed in a table format for easy data collection. The design of these table-format questions is based on the research method of Pham and Nguyen (2011) The survey questionnaire, after being designed, is tested before the formal survey is conducted (Dinh, Nguyen, and Tran 2011a, 2011b). The Likert scale, with an interval of $(5-1)/5 = 0.8$, was used to measure consent/satisfaction/response (Allen and Seaman 2007; Yavuz et al. 2013; Narli 2010). Accordingly, the meanings of the scale were determined as follows: $1.0 \leq M < 1.8$ (strongly disagree), $1.8 \leq M < 2.6$ (disagree), $2.6 \leq M < 3.4$ (neutral), $3.6 \leq M < 4.5$ (agree), $4.2 \leq M \leq 5.0$ (strongly agree).

Data, after collection, was qualified by SPSS v.21. The Cronbach Alpha was used to assess the reliability of the survey questionnaire (Cronbach 1951). The Mann–Whitney U test was applied to qualify the different views between male and female teachers, and the Kruskal–Wallis H was used to verify the different opinions of teachers regarding working seniority and institution with a significance level of $p < .05$. This method has been successfully used in evaluating the quality of human resources according to the requirements of enterprises in the Mekong Delta (Nhut, Hau, and Yen 2012), in lesson plan designing and application in the Mekong Delta (Vo et al. 2023), and in understanding the living world of high school students in the Mekong Delta, Vietnam (Nguyen, Nguyen, and Dang 2023).

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Questionnaire Reliability and Survey Participant Information

The Cronbach Alpha coefficient of the present questionnaire was 0.98 (>0.6), indicating that the questionnaire used in the study had very high internal consistency and was a reliable measure of the construct being studied. Sixty teachers participated in the survey, including twenty-four males and thirty-six females, with a higher proportion of female teachers. The variation in the length of teaching experience is also noteworthy, with a higher proportion of teachers having eleven to fifteen years of experience and a smaller proportion having over twenty years of experience. Specifically, teachers with eleven to fifteen and six to ten years of experience accounted for 31.7 and 25.0 percent, respectively; one to five and sixteen to twenty years accounted for 18.30 and 16.7 percent, respectively; and twenty-one to twenty-five and twenty-six to thirty years accounted for <5.00 percent. The gender and experience distribution of the sample may have important implications for the interpretation of the study findings. It is possible that male and female teachers may have different perspectives or approaches to teaching living world understanding, which could impact the study results. Similarly, teachers with varying experience levels may have additional familiarity or comfort with different teaching methods or approaches.

Educational Status in the Living World Understanding Competency Development

The Current Situation of Organizing Biology Teachers' Lessons to Develop the Ability to Explore the Living World in High School Students

Based on the survey conducted on high school teachers regarding the skills and competencies they prioritize and train their students in, it was observed that the teachers place significant emphasis on problem-solving skills. Specifically, the teachers focus on teaching students how to ask questions that are relevant to the problem (Q11, 4.43 ± 0.07 SE), effectively articulate the situation using language (Q13, 4.43 ± 0.08 SE), and analyze the problem in order to come up with a well-informed judgment (Q14, 4.20 ± 0.09 SE). Additionally, they focus on teaching students how to analyze the context in which the problem arises (Q12, 4.03 ± 0.08 SE); formulate research hypotheses (Q15, 3.88 ± 0.10 SE); develop a logical framework for research (Q16, 3.82 ± 0.09 SE); select appropriate research methods (Q17, 4.10 ± 0.09 SE); make plans to implement research activities (Q18, 3.87 ± 0.10 SE); collect and retain data (Q19, 3.67 ± 0.12 SE); evaluate results using simple statistical parameters (Q110, 3.77 ± 0.11 SE); compare results with hypotheses and explain and draw conclusions (Q111, 3.85 ± 0.11 SE); propose further research (Q112, 3.58 ± 0.11 SE); use language, drawings, diagrams, and tables to express research processes and results (Q113, 3.93 ± 0.10 SE); write research reports (Q114, 3.65 ± 0.11 SE); and work collaboratively with others respectfully and effectively (Q115, 3.90 ± 0.11 SE) (Table 1).

The evaluations of male and female teachers were found to be approximately equal and not statistically significant across all questions, including Q11, Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19, Q110, Q111, Q112, Q113, Q114, and Q115 (Table 1). Similarly, for seniority, teacher assessments for those with experience ranging from one to five, six to ten, eleven to fifteen, sixteen to twenty, twenty-first to twenty-five, and twenty-six to thirty years were not statistically significant for all these questions (Table 1). According to the survey findings, high school teachers were highly committed to teaching and enhancing students' abilities. They prioritized developing students' skills following the General Education Program's general and specific competencies outlined by the Ministry of Education and Training (2018a).

Table 1: The Skills to Enhance Living World Understanding in Students

Code	*Mean ± SE*	*Assessment Level*	*Gender*		*Mann–Whitney U*	*Seniority (Year)*						*Kruskal–Wallis H*
			Female	*Male*		*1–5*	*6–10*	*11–15*	*16–20*	*21–25*	*26–30*	
Q11	4.43 ± 0.07	Very often	4.44 ± 0.09	4.42 ± 0.10	*Z* = −0.29, *p* = .77	5.00 ± 0.00	4.45 ± 0.21	4.47 ± 0.13	4.32 ± 0.11	4.4 ± 0.16	4.67 ± 0.33	χ^2 = 4.27, *df* = 5, *p* = .51
Q12	4.03 ± 0.08	Regular	4.00 ± 0.11	4.08 ± 0.12	*Z* = −0.51, *p* = .61	4.50 ± 0.50	3.91 ± 0.21	4.00 ± 0.17	4.11 ± 0.11	4.1 ± 0.23	3.67 ± 0.33	χ^2 = 3.12, *df* = 5, *p* = .68
Q13	4.43 ± 0.08	Very often	4.36 ± 0.11	4.54 ± 0.10	*Z* = −0.88, *p* = .38	5.00 ± 0.00	4.36 ± 0.24	4.47 ± 0.13	4.37 ± 0.16	4.5 ± 0.17	4.33 ± 0.33	χ^2 = 2.21, *df* = 5, *p* = .82
Q14	4.20 ± 0.09	Very often	4.14 ± 0.11	4.29 ± 0.13	*Z* = −0.84, *p* = .4	5.00 ± 0.00	4.09 ± 0.21	4.27 ± 0.12	4.21 ± 0.18	4.20 ± 0.20	3.67 ± 0.33	χ^2 = 5.58, *df* = 5, *p* = .35
Q15	3.88 ± 0.10	Regular	3.83 ± 0.12	3.96 ± 0.16	*Z* = −0.72, *p* = .47	4.50 ± 0.50	3.82 ± 0.3	4.07 ± 0.15	3.63 ± 0.17	4.00 ± 0.15	4.00 ± 0.58	χ^2 = 4.93, *df* = 5, *p* = .42
Q16	3.82 ± 0.09	Regular	3.72 ± 0.12	3.96 ± 0.15	*Z* = −1.13, *p* = .26	4.00 ± 1.00	3.64 ± 0.2	4.13 ± 0.17	3.68 ± 0.19	3.9 ± 0.18	3.33 ± 0.33	χ^2 = 6, *df* = 5, *p* = .31
Q17	4.10 ± 0.09	Regular	4.19 ± 0.12	3.96 ± 0.14	*Z* = −1.4, *p* = .16	4.50 ± 0.50	4.00 ± 0.23	4.20 ± 0.14	3.89 ± 0.20	4.4 ± 0.22	4.00 ± 0.00	χ^2 = 4.03, *df* = 5, *p* = .55
Q18	3.87 ± 0.10	Regular	3.83 ± 0.14	3.92 ± 0.13	*Z* = −0.29, *p* = .77	4.00 ± 1.00	3.82 ± 0.18	4.00 ± 0.17	3.68 ± 0.22	4.20 ± 0.20	3.33 ± 0.33	χ^2 = 4.92, *df* = 5, *p* = .43
Q19	3.67 ± 0.12	Regular	3.61 ± 0.16	3.75 ± 0.17	*Z* = −0.59, *p* = .55	4.00 ± 1.00	3.73 ± 0.24	3.87 ± 0.19	3.37 ± 0.27	3.80 ± 0.20	3.67 ± 0.33	χ^2 = 2.57, *df* = 5, *p* = .77
Q110	3.77 ± 0.11	Regular	3.67 ± 0.15	3.92 ± 0.16	*Z* = −0.98, *p* = .33	3.50 ± 1.50	3.82 ± 0.18	3.87 ± 0.22	3.58 ± 0.25	4.10 ± 0.18	3.33 ± 0.33	χ^2 = 3.31, *df* = 5, *p* = .65
Q111	3.85 ± 0.11	Regular	3.81 ± 0.14	3.92 ± 0.16	*Z* = −0.53, *p* = .59	4.00 ± 1.00	3.82 ± 0.18	3.93 ± 0.18	3.74 ± 0.23	3.90 ± 0.28	4.00 ± 0.58	χ^2 = 0.34, *df* = 5, *p* = 1
Q112	3.58 ± 0.11	Regular	3.47 ± 0.14	3.75 ± 0.16	*Z* = −1.26, *p* = .21	3.50 ± 1.50	3.82 ± 0.18	3.73 ± 0.21	3.47 ± 0.22	3.40 ± 0.22	3.33 ± 0.33	χ^2 = 2.36, *df* = 5, *p* = .8
Q113	3.93 ± 0.10	Regular	3.86 ± 0.13	4.04 ± 0.15	*Z* = −.92, *p* = .36	4.00 ± 1.00	3.91 ± 0.16	4.27 ± 0.15	3.58 ± 0.21	4.10 ± 0.23	4.00 ± 0.58	χ^2 = 6.18, *df* = 5, *p* = .29
Q114	3.65 ± 0.11	Regular	3.67 ± 0.16	3.63 ± 0.16	*Z* = −0.64, *p* = .52	4.00 ± 1.00	3.64 ± 0.20	4.00 ± 0.17	3.32 ± 0.25	3.70 ± 0.26	3.67 ± 0.33	χ^2 = 4.57, *df* = 5, *p* = .47
Q115	3.90 ± 0.11	Regular	3.81 ± 0.15	4.04 ± 0.14	*Z* = −0.81, *p* = .42	3.50 ± 1.50	3.91 ± 0.21	4.27 ± 0.15	3.58 ± 0.23	4.00 ± 0.21	4.00 ± 0.00	χ^2 = 5.36, *df* = 5, *p* = .37

1.0 ≤ *M* < 1.8: Never; 1.8 ≤ *M* < 2.6: Rarely; 2.6 ≤ *M* < 3.4: Occasionally; 3.4 ≤ *M* < 4.2: Regular; 4.2 ≤ *M* ≤ 5.0: Very often; Q11: Ask questions related to the problem; Q12: Analyze the context in which to propose the problem; Q13: Use your language to express the proposed problem; Q14: Analyze the problem to state the judgment; Q15: Formulating and stating research hypotheses; Q16: Develop a logical framework for research content; Q17: Selection of appropriate methods (observation, experiment, investigation, interview, retrospective); Q18: Make a plan to implement research activities; Q19: Collect and retain data from overview, empirical and investigative results; Q110: Evaluate results based on analysis, process data with simple statistical parameters; Q111: Compare results with hypotheses, explain, draw conclusions, and adjust (if necessary); Q112: The proposal results or the problem for further research; Q113: Use language, drawings, diagrams, and tables to express research processes and results; Q114: Write a research report; Q115: Cooperate with partners with an attitude of active listening and respect for views and opinions given by others to actively absorb and explain, critique, and defend research results convincingly.

In response to the open-ended question, "How do you think teaching–learning biology develops the ability to understand the living world in students at the high school level?" forty-two out of sixty teachers stated that teaching should focus on developing students' ability to analyze and evaluate the living world, allowing them to make comments, judgments, and hypotheses that can be experimentally tested. These responses indicate that the surveyed high school teachers properly understand how to foster students' capacity to comprehend the living world through the teaching of biology.

According to student evaluations, textbooks and materials (4.58 ± 0.53 SE), question-and-answer lectures (4.42 ± 0.62 SE), schematic simulations and model paintings (Q33, 4.28 ± 0.56 SE), and stating and resolving situations (Q34, 4.28 ± 0.56 SE) were all organized at very open levels. Learning activities like watching videos (Q35, 4.00 ± 0.64 SE), hands-on experiments (Q36, 3.70 ± 0.72 SE), integrated teaching (Q37, 3.90 ± 0.71 SE), and creative experiential activities (Q38, 3.55 ± 0.77 SE) were organized at regular levels. On the other hand, activities such as game organization, role-playing (Q39, 3.23 ± 0.81 SE), project teaching (Q310, 3.15 ± 0.84 SE), scientific and technical research (Q311, 2.97 ± 0.92 SE), and STEM (Q312, 3.03 ± 0.84 SE) and STEAM modeling (Q313, 2.85 ± 0.90 SE) were occasionally held (Table 2). The current situation of using these teaching techniques was also found in Duong's study: "Using Teaching Methods and Techniques to Actively Organize Learning Activities in Groups of Organic Compounds with Functional Groups in the Chemistry Curriculum for Grade 11 High School" (Duong 2018).

Table 2: Organizing Activities in the Process of Teaching Biology

Code	*Mean ± SE*	*Assessment Level*	*Gender*		*Mann–Whitney U*	*Seniority (Year)*						*Kruskal–Wallis H*
			Female	*Male*		*1–5*	*6–10*	*11–15*	*16–20*	*21–25*	*26–30*	
Q31	4.58 ± 0.53	Very often	4.58 ± 0.09	4.58 ± 0.10	$Z = -0.12$, $p = .9$	5.00 ± 0.00	4.45 ± 0.21	4.47 ± 0.13	4.32 ± 0.11	4.4 ± 0.16	4.67 ± 0.33	$\chi^2 = 4.27$, $df = 5$, $p = .51$
Q32	4.42 ± 0.62	Very often	4.44 ± 0.10	4.38 ± 0.13	$Z = -0.39$, $p = .7$	4.50 ± 0.50	3.91 ± 0.21	4.00 ± 0.17	4.11 ± 0.11	4.1 ± 0.23	3.67 ± 0.33	$\chi^2 = 3.12$, $df = 5$, $p = .68$
Q33	4.28 ± 0.56	Very often	4.31 ± 0.09	4.25 ± 0.12	$Z = -0.28$, $p = .78$	5.00 ± 0.00	4.36 ± 0.24	4.47 ± 0.13	4.37 ± 0.16	4.5 ± 0.17	4.33 ± 0.33	$\chi^2 = 2.21$, $df = 5$, $p = .82$
Q34	4.00 ± 0.64	Regular	4.00 ± 0.11	4.00 ± 0.13	$Z = 0$, $p = 1$	5.00 ± 0.00	4.09 ± 0.21	4.27 ± 0.12	4.21 ± 0.18	4.20 ± 0.20	3.67 ± 0.33	$\chi^2 = 5.58$, $df = 5$, $p = .35$
Q35	3.23 ± 0.81	Occasionally	3.22 ± 0.14	3.25 ± 0.16	$Z = -0.13$, $p = .89$	4.50 ± 0.50	3.82 ± 0.3	4.07 ± 0.15	3.63 ± 0.17	4.00 ± 0.15	4.00 ± 0.58	$\chi^2 = 4.93$, $df = 5$, $p = .42$
Q36	3.70 ± 0.72	Regular	3.69 ± 0.12	3.71 ± 0.15	$Z = -.24$, $p = .81$	4.00 ± 1.00	3.64 ± 0.2	4.13 ± 0.17	3.68 ± 0.19	3.9 ± 0.18	3.33 ± 0.33	$\chi^2 = 6$, $df = 5$, $p = .31$
Q37	4.27 ± 0.58	Very often	4.28 ± 0.09	4.25 ± 0.12	$Z = -0.14$, $p = .89$	4.50 ± 0.50	4.00 ± 0.23	4.20 ± 0.14	3.89 ± 0.20	4.4 ± 0.22	4.00 ± 0.00	$\chi^2 = 4.03$, $df = 5$, $p = .55$
Q38	3.90 ± 0.71	Regular	3.92 ± 0.12	3.88 ± 0.14	$Z = -0.2$, $p = .84$	4.00 ± 1.00	3.82 ± 0.18	4.00 ± 0.17	3.68 ± 0.22	4.20 ± 0.20	3.33 ± 0.33	$\chi^2 = 4.92$, $df = 5$, $p = .43$
Q39	3.55 ± 0.77	Regular	3.53 ± 0.13	3.58 ± 0.16	$Z = -0.46$, $p =.65$	4.00 ± 1.00	3.73 ± 0.24	3.87 ± 0.19	3.37 ± 0.27	3.80 ± 0.20	3.67 ± 0.33	$\chi^2 = 2.57$, $df = 5$, $p = .77$
Q310	3.15 ± 0.84	Occasionally	3.14 ± 0.13	3.17 ± 0.19	$Z = -0.21$, $p = .83$	3.50 ± 1.50	3.82 ± 0.18	3.87 ± 0.22	3.58 ± 0.25	4.10 ± 0.18	3.33 ± 0.33	$\chi^2 = 3.31$, $df = 5$, $p = .65$
Q311	2.97 ± 0.92	Occasionally	2.83 ± 0.15	3.17 ± 0.20	$Z = -1.38$, $p = .17$	4.00 ± 1.00	3.82 ± 0.18	3.93 ± 0.18	3.74 ± 0.23	3.90 ± 0.28	4.00 ± 0.58	$\chi^2 = .34$, $df = 5$, $p = 1$
Q312	3.03 ± 0.84	Occasionally	3.00 ± 0.15	3.08 ± 0.16	$Z = -0.28$, $p = .78$	3.50 ± 1.50	3.82 ± 0.18	3.73 ± 0.21	3.47 ± 0.22	3.40 ± 0.22	3.33 ± 0.33	$\chi^2 = 2.36$, $df = 5$, $p = .8$

Q313	2.85 ± 0.90	Occasionally	2.72 ± 0.16	3.04 ± 0.15	$Z = -1.48$, $p = .14$	4.00 ± 1.00	3.91 ± 0.16	4.27 ± 0.15	3.58 ± 0.21	4.10 ± 0.23	4.00 ± 0.58	$\chi^2 = 6.18$, $df = 5$, $p = .29$

$1.0 \le M < 1.8$: Never; $1.8 \le M < 2.6$: Rarely; $2.6 \le M < 3.4$: Occasionally; $3.4 \le M < 4.2$: Regular; $4.2 \le M \le 5.0$: Very often; Q31: Organize for students to study textbooks, materials; Q32: Lectures and combined ask–answer; Q33: Simulation by diagrams, paintings, and models; Q34: Watch movies, videos; Q35: Organize games, role-play; Q36: Use experiments, practice; Q37:State and resolve the situation; Q38: Integrated teaching; Q39: Creative experiential activities; Q310: Project teaching; Q311: Research on scientific and technical topics; Q312: STEM; Q313: STEAM.

There were no statistically significant differences in the average assessment levels between male and female teachers when participating in the survey (Table 2). Similarly, in terms of seniority, there were no statistically significant differences in the average assessment levels of teachers working in the profession for periods of one to five, six to ten, eleven to fifteen, sixteen to twenty, twenty-one to twenty-five, and twenty-six to thirty years (Table 2). The shift in teaching models from content-based to competency-based can clarify the variance in assessment levels. The traditional content-based teaching model, which involves methods like textbook study, lectures, and simulations through diagrams, images, models, and problem-solving, is typically employed by teachers. However, certain activities like game organization and role-playing have limitations that do not align well with the nature of biology. Teaching activities involving research projects on science and technology, as well as teaching STEM and STEAM models, have been in use for a while. However, teachers still lack a comprehensive understanding of the organizational process of these activities, resulting in their underutilization and lack of dissemination. The basis of the organization of these teaching activities is similar to the research results on working with textbooks in teaching biology in the high school of Nguyen (2012).

The assessment regarding "the basis for designing learning activities for students" received positive responses from teachers, with a considerable percentage agreeing with the assessment facilities. The average ratings for the different aspects are as follows: goals and requirements to be achieved (Q41, 2.00 ± 0.00 SE); the logic of lesson content (Q42, 1.98 ± 0.13 SE); teacher's strengths (Q43, 1.72 ± 0.45 SE); student competencies (Q44, 1.98 ± 0.13 SE); student learning styles (Q45, 1.78 ± 0.42 SE); teaching facilities, equipment, and learning materials (Q46, 1.97 ± 0.18 SE); and local practices (Q47, 1.92 ± 0.28 SE) (Table 3). The results of the study are similar to Ngo's findings in "Teaching and Teaching Methods in Schools" (Ngo 2005) and Nguyen's in "Designing Teaching Activities to Develop Students' Cognitive Ability in Teaching Genetics, Biology 12" (Nguyen 2019).

Table 3: The Basis for Designing Learning Activities for Students

Code	*Mean ± SE*	*Gender*		*Mann–Whitney U*	*Seniority (Year)*						*Kruskal–Wallis H*
		Female	*Male*		*1–5*	*6–10*	*11–15*	*16–20*	*21–25*	*26–30*	
Q41	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	*Z* = 0.00, *p* = 1.00	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	χ^2 = 0.00, *df* = 5, *p* = 1.00
Q42	1.98 ± 0.13	1.97 ± 0.03	2.00 ± 0.00	*Z* = −0.82, *p* = .41	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	1.90 ± 0.10	2.00 ± 0.00	χ^2 = 5.00, *df* = 5, *p* = .42
Q43	1.72 ± 0.45	1.69 ± 0.08	1.75 ± 0.09	*Z* = −0.46, *p* = .64	1.50 ± 0.50	1.91 ± 0.09	1.80 ± 0.11	1.58 ± 0.12	1.70 ± 0.15	1.67 ± 0.33	χ^2 = 4.73, *df* = 5, *p* =.45
Q44	1.98 ± 0.13	2.00 ± 0.00	1.96 ± 0.04	*Z* = −1.22, *p* = .22	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	1.95 ± 0.05	2.00 ± 0.00	2.00 ± 0.00	χ^2 = 2.16, *df* = 5, *p* = .83
Q45	1.78 ± 0.42	1.78 ± 0.07	1.79 ± 0.08	*Z* = −0.13, *p* = .9	2.00 ± 0.00	1.91 ± 0.09	1.8 ± 0.11	1.74 ± 0.10	1.70 ± 0.15	1.67 ± 0.33	χ^2 = 2.45, *df* = 5, *p* = .78
Q46	1.97 ± 0.18	1.97 ± 0.03	1.96 ± 0.04	*Z* = −0.29, *p* = .77	2.00 ± 0.00	2.00 ± 0.00	2.00 ± 0.00	1.95 ± 0.05	1.90 ± 0.10	2.00 ± 0.00	χ^2 = 2.62, *df* = 5, *p* = .76
Q47	1.92 ± 0.28	1.92 ± 0.05	1.92 ± 0.06	*Z* = 0, *p* = 1.00	2.00 ± 0.00	1.91 ± 0.09	1.93 ± 0.07	1.89 ± 0.07	1.90 ± 0.10	2.00 ± 0.00	χ^2 = .66, *df* = 5, *p* = .98

1.0 ≤ *M* < 1.8: Never; 1.8 ≤ *M* < 2.6: Rarely; 2.6 ≤ *M* < 3.4: Occasionally; 3.4 ≤ *M* < 4.2: Regular; 4.2 ≤ *M* ≤ 5.0: Very often. Q41: Goals and requirements to be achieved; Q42: Lesson content logic; Q43: Teacher's forte; Q44: Student competencies; Q45: Students' learning styles; Q46: Facilities, equipment, teaching materials; Q47: Local practices.

The survey found no significant differences in the average assessment levels between male and female teachers (Table 3). Similarly, there were no statistically significant differences in the assessment levels of teachers based on their seniority (Table 3). It is worth noting that most teachers focus on setting learning goals and targets for students, which is an essential aspect of evaluating lesson effectiveness and is emphasized in the 2018 Vietnamese General Education Program.

The teachers' responses to the survey question "To what extent do teachers organize learning activities for students in different settings?" were diverse. The results showed that teachers frequently organize learning activities for their students in the classroom (Q51, 4.72 ± 0.45 SE), in laboratories (Q52, 3.42 ± 0.72 SE), and for self-study at home (Q53, 3.95 ± 0.77 SE). However, teachers only occasionally teach in school gardens (Q54, 3.95 ± 0.77 SE) and natural settings or local practices (Q55, 2.82 ± 1.02 SE). Learning activities in production facilities (Q56) and research centers (Q57) were rare, with an average of 2.32 ± 0.97 SE and 2.10 ± 0.88 SE, respectively (Table 4). The influence of study location in this study on teaching and learning to develop students' ability is similar to that in Khoa's study in the case of online education of students at Nam Can Tho University (Khoa 2022).

Table 4: The Use of Location in Organizing Teaching and Learning Activities for Students

Code	*Mean ± SE*	*Assessment Level*	*Gender*		*Mann–Whitney U*	*Seniority (Year)*						*Kruskal–Wallis H*
			Female	*Male*		*1–5*	*6–10*	*11–15*	*16–20*	*21–25*	*26–30*	
Q51	4.72 ± 0.45	Very often	4.72 ± 0.08	4.71 ± 0.09	$Z = -0.12$, $p = .91$	5.00 ± 0.00	4.82 ± 0.12	4.67 ± 0.13	4.68 ± 0.11	4.7 ± 0.15	4.67 ± 0.33	$\chi^2 = 1.65$, $df = 5$, $p = .89$
Q52	3.42 ± 0.72	Regular	3.36 ± 0.12	3.50 ± 0.15	$Z = -0.67$, $p = .50$	4.00 ± 1.00	3.27 ± 0.19	3.47 ± 0.13	3.47 ± 0.14	3.6 ± 0.27	2.33 ± 0.67	$\chi^2 = 5.12$, $df = 5$, $p = .4$
Q53	2.85 ± 0.84	Occasionally	2.83 ± 0.13	2.88 ± 0.19	$Z = -0.18$, $p = .86$	4.00 ± 1.00	2.73 ± 0.19	3.07 ± 0.18	2.63 ± 0.22	3.1 ± 0.18	2.00 ± 0.58	$\chi^2 = 9.05$, $df = 5$, $p = .11$
Q54	3.95 ± 0.77	Regular	4.06 ± 0.13	3.79 ± 0.16	$Z = -1.25$, $p = .21$	4.05 ± 0.50	4.09 ± 0.21	3.87 ± 0.22	3.79 ± 0.20	4.2 ± 0.20	3.67 ± 0.33	$\chi^2 = 3.75$, $df = 5$, $p = .59$
Q55	2.32 ± 0.97	Rarely	2.31 ± 0.16	2.33 ± 0.21	$Z = -.18$, $p = .86$	2.50 ± 0.50	2.36 ± 0.24	2.47 ± 0.29	2.00 ± 0.24	2.5 ± 0.22	2.67 ± 0.67	$\chi^2 = 4.16$, $df = 5$, $p = .53$
Q56	2.10 ± 0.88	Rarely	2.06 ± 0.14	2.17 ± 0.20	$Z = -0.30$, $p = .76$	2.05 ± 0.50	2.27 ± 0.19	2.07 ± 0.18	1.79 ± 0.25	2.6 ± 0.27	1.67 ± 0.33	$\chi^2 = 9.57$, $df = 5$, $p = .09$
Q57	2.82 ± 1.02	Occasionally	2.86 ± 0.18	2.75 ± 0.19	$Z = -0.21$, $p = .84$	2.50 ± 0.50	2.82 ± 0.30	2.80 ± 0.24	2.74 ± 0.27	3.1 ± 0.31	2.67 ± 0.67	$\chi^2 = 1.23$, $df = 5$, $p = .94$

$1.0 \leq M < 1.8$: Never; $1.8 \leq M < 2.6$: Rarely; $2.6 \leq M < 3.4$: Occasionally; $3.4 \leq M < 4.2$: Regular; $4.2 \leq M \leq 5.0$: Very often; Q51: Classes; Q52: Laboratory; Q53: School Garden; Q54: Self-study at home; Q55: Production facilities; Q56: Research centers; Q57: Nature, local practices.

In terms of gender, there is a difference in the evaluation of male and female teachers, but it is not statistically significant. The results of the Mann–Whitney U test for questions Q51 to Q57 show no significant difference in the assessment of male and female teachers (Table 4). Similarly, there is no statistically significant difference in the assessment of teachers based on their years of experience. The Kruskal–Wallis H tests for questions Q51 to Q57 show no significant difference in the assessment of teachers with one to five, six to ten, eleven to fifteen, sixteen to twenty, twenty-first to twenty-five, and twenty-six to thirty years of experience (Table 4). Classroom learning is the primary focus of the public learning environment; thus, teachers evaluate the organization of classroom activities on a "very regular" basis. All teaching and learning activities, including theoretical and practical lessons, occur within the classroom's confines. The latter requires access to facilities, teaching equipment, and laboratories, which are regularly utilized. Additionally, students engage in self-study at home to promote self-discipline and consolidate their knowledge, preparing them for upcoming lessons. However, teachers regularly organize self-study for students at home (Q54, 3.95 ± 0.77 SE) and rarely organizes teaching at production facilities (Q55, 2.32 ± 1.02 SE). The reason for this difference stems from the advantages and challenges between organizing self-study at home and organizing learning activities at production facilities. Self-study at home helps students develop independent work skills and be more proactive in exploring and accessing new knowledge. In addition, organizing self-study activities at home is less costly and easier to manage students than organizing activities at production facilities because organizing activities in production facilities and research centers are uncommon due to the requirement of permission from the school and the parents. Safety measures must be taken to avoid unfortunate risks. Therefore, teachers prioritize organizing self-study for students at home rather than studying at production facilities.

The results of the survey are positive concerning the question of how teachers typically determine the content or opening of their lessons. Specifically, teachers identified the activity of proposing problems related to the living world (Q61) as a “very regular” means of determining the opening content of their lessons, with an average score of 4.35 ± 0.58 SE. Additionally, teachers also regularly organize their lessons through activities such as making judgments and formulating hypotheses (Q62, 3.93 ± 0.66 SE), planning implementation (Q63, 3.67 ± 0.90 SE), implementing plans (Q64, 3.52 ± 0.93 SE), and writing, presenting reports, and discussing (Q65, 3.68 ± 0.85 SE) (Table 5). This similarity is also found in Le’s studies “Designing Warm-up Activities in Teaching Students to Learn in Middle School” (Le 2021) and “The Process of Designing Warm-up Activities in Teaching Mathematics in the Direction of Developing Learners’ Competencies in High Schools” (Le, Nguyen, and Le 2021).

Regarding gender, male teachers demonstrated a higher frequency of rating the organization of the opening content of the lesson through proposing issues related to living world activity with an average of 4.53 ± 0.09 SE, while female teachers rated it at a regular level with an average of 4.08 ± 0.10 SE. This difference was statistically significant (Mann–Whitney U, $Z = -2.99$, $p = .00$). However, there was no significant difference between male and female teachers for Q62, Q63, Q64, and Q65 (Table 5). No statistically significant differences were found between teachers with varying levels of experience for Q61 to Q65 (Table 5). This indicates no significant differences in responses between teachers of different experience levels. To kickstart the engagement phase, it is customary to conduct an outdoor activity that piques the student’s interest. This phase presents an opportunity for teachers to assess the student’s comprehension of the subject matter and identify any misconceptions they may have. The primary goal of the activity is to determine the problem or task that needs to be addressed during the lesson, such as the problem statement, topic, and lesson name. Therefore, creating an activity that optimizes students’ knowledge and experience while encouraging active participation in the lesson is essential. Warm-up activities should be familiar to students and avoid introducing complicated or academic questions. Therefore, most educators prefer to use real-world issues as the foundation for these activities.

Table 5: Common Activities Used to Determine Lesson Content/Opening

Code	*Mean ± SE*	*Assessment Level*	*Gender*		*Mann–Whitney U*	*Seniority (Year)*						*Kruskal–Wallis H*
			Female	*Male*		*1–5*	*6–10*	*11–15*	*16–20*	*21–25*	*26–30*	
Q61	4.35 ± 0.58	Very often	4.53 ± 0.09	4.08 ± 0.10	$Z = -2.99$, $p = .00$	5.00 ± 0.00	4.36 ± 0.2	4.53 ± 0.13	4.16 ± 0.12	4.20 ± 0.20	4.67 ± 0.33	$\chi^2 = 8.13$, $df = 5$, $p = .15$
Q62	3.93 ± 0.66	Regular	4.03 ± 0.11	3.79 ± 0.13	$Z = -1.36$, $p = .17$	4.5 ± 0.5	3.91 ± 0.21	4.27 ± 0.12	3.68 ± 0.15	3.90 ± 0.23	3.67 ± 0.33	$\chi^2 = 8.68$, $df = 5$, $p = .12$
Q63	3.67 ± 0.90	Regular	3.64 ± 0.16	3.71 ± 0.16	$Z = -0.24$, $p = .81$	4.00 ± 1.00	3.73 ± 0.24	3.87 ± 0.17	3.68 ± 0.24	3.40 ± 0.34	3.00 ± 0.00	$\chi^2 = 4.64$, $df = 5$, $p = .46$
Q64	3.52 ± 0.93	Regular	3.44 ± 0.16	3.63 ± 0.18	$Z = -0.64$, $p = .52$	4.00 ± 1.00	3.64 ± 0.28	3.73 ± 0.18	3.42 ± 0.23	3.20 ± 0.36	3.33 ± 0.33	$\chi^2 = 2.43$, $df = 5$, $p = .79$
Q65	3.68 ± 0.85	Regular	3.58 ± 0.16	3.67 ± 0.16	$Z = -0.44$, $p = .66$	4.00 ± 1.00^{a}	3.64 ± 0.28^{a}	4.07 ± 0.15^{a}	3.63 ± 0.14^{a}	3.30 ± $0.30^{a,b}$	2.00 ± 0.58^{b}	$\chi^2 = 12.59$, $df = 5$, $p = .03$

$1.0 \le M < 1.8$: Never; $1.8 \le M < 2.6$: Rarely; $2.6 \le M < 3.4$: Occasionally; $3.4 \le M < 4.2$: Regular; $4.2 \le M \le 5.0$: Very often; Q61: Propose problems related to the living world: ask questions related to the problem, analyze the context to propose the problem, use your language to express the proposed problem; Q62: Make judgments and build hypotheses: analyze problems to state judgments, formulate and state research hypotheses; Q63: Planning Implementation: building a logical framework of research content, selecting appropriate methods (observation, experiment, investigation, interview, retrospective,…), planning research activities; Q64: Implement the plan: collect and retain data from overview, empirical and investigative results; evaluate results based on analysis, process data with simple statistical parameters; compare results with hypotheses; explain, and draw conclusions; Q65: Writing, presenting reports, and discussing: using language, drawings, diagrams, and tables to express research processes and results; writing research reports; cooperating with partners with an attitude of active listening and respect for views and opinions given by others to actively absorb and explain, critique, and defend research results convincingly; Different letters in row Q65 indicate significant differences at the meaningful of 5%.

Current Status of Capacity Formation of High School Students through Activities to Learn about the Living World

The overall survey results regarding the question "Do you typically learn new information during the lesson through any of these activities?" were similar to those of the warm-up survey. The teachers who participated indicated that the beginning of the lesson is usually marked by the teacher presenting real-world problems (Q71) at a very open level, with an average score of 4.28 ± 0.64 SE. Moreover, they frequently utilize other activities such as making judgments and formulating hypotheses (Q72, 3.88 ± 0.72 SE), planning implementation (Q73, 3.75 ± 0.86 SE), implementing plans (Q74, 3.60 ± 0.94 SE), and writing, presenting reports, and engaging in discussions (Q75, 3.62 ± 1.03 SE) (Table 6). Hai's research results on methods to attract students, help students focus on lesson content (Hai 2013) and Hien's research results on "The Process of Guiding Students to Form Concepts in Teaching Lesson 9 of Biology 12" (Hien 2015) are also similar to our research results.

Table 6: Activities Commonly Used to Identify Content That Forms New Knowledge

Code	*Mean ± SE*	*Assessment Level*	*Gender*		*Mann–Whitney U*	*Seniority (Year)*						*Kruskal–Wallis H*
			Female	*Male*		*1–5*	*6–10*	*11–15*	*16–20*	*21–25*	*26–30*	
Q71	4.28 ± 0.64	Very often	4.44 ± 0.09	4.04 ± 0.14	$Z = -2.3$, $p = .02$	5.00 ± 0.00	4.36 ± 0.20	4.27 ± 0.12	4.00 ± 0.17	4.50 ± 0.17	4.67 ± 0.33	$\chi^2 = 8.73$, $df = 5$, $p = .12$
Q72	3.88 ± 0.72	Regular	3.89 ± 0.12	3.88 ± 0.15	$Z = -0.09$, $p = .93$	4.50 ± 0.50	4.00 ± 0.27	3.87 ± 0.17	3.74 ± 0.15	4.00 ± 0.26	3.67 ± 0.33	$\chi^2 = 3.6$, $df = 5$, $p = .61$
Q73	3.75 ± 0.86	Regular	3.69 ± 0.15	3.83 ± 0.16	$Z = -0.65$, $p = .52$	4.00 ± 1.00	3.82 ± 0.26	3.87 ± 0.19	3.79 ± 0.16	3.70 ± 0.37	2.67 ± 0.33	$\chi^2 = 5.02$, $df = 5$, $p = .41$
Q74	3.60 ± 0.94	Regular	3.50 ± 0.17	3.75 ± 0.16	$Z = -0.97$, $p = .33$	3.50 ± 1.50	3.73 ± 0.27	3.80 ± 0.20	3.63 ± 0.19	3.30 ± 0.42	3.00 ± 0.00	$\chi^2 = 3.02$, $df = 5$, $p = .70$
Q75	3.62 ± 1.03	Regular	3.44 ± 0.19	3.88 ± 0.16	$Z = -1.37$, $p = .17$	3.50 ± $1.50^{a,b}$	3.91 ± 0.25^{a}	4.07 ± 0.18^{a}	3.58 ± $0.23^{a,b}$	3.20 ± $0.33^{a,b}$	2.00 ± 0.58^{b}	$\chi^2 = 11.08$, $df = 5$, $p = .05$

$1.0 \le M < 1.8$: Never; $1.8 \le M < 2.6$: Rarely; $2.6 \le M < 3.4$: Occasionally; $3.4 \le M < 4.2$: Regular; $4.2 \le M \le 5.0$: Very often; Q71: Propose problems related to the living world: ask questions about the problem, analyze the context in which the problem is proposed, use your language to express the proposed problem; Q72: Make judgments and build hypotheses: analyze problems to state judgments, formulate and state research hypotheses; Q73: Planning implementation: building a logical framework of research content, selecting appropriate methods (observation, experiment, investigation, interview, retrospective,…), planning research activities; Q74: Implement the plan: collect and retain data from overview, empirical and investigative results; evaluate results based on analysis, process data with simple statistical parameters; compare the results with hypotheses, explain, draw conclusions, and adjust (if necessary); proposals are recommendations applying research results, or further research issues; Q75: Writing, presenting reports, and discussing: using language, drawings, diagrams, and tables to express research processes and results; writing research reports; cooperating with partners with an attitude of active listening and respect for views and opinions given by others to actively absorb and explain, critique, and defend research results convincingly; Different letters in row Q75 indicate significant differences at the meaningful of 5%.

The degree of organization in activities that generate new knowledge varies based on gender. Q71 shows a difference in the average rating between male and female teachers. Specifically, male teachers rated the organization of opening lesson content through proposing issues related to the real world at the "Very often" level with an average score of 4.44 ± 0.09 SE, while female teachers rated it at a lower level of "Regular" with an average score of 4.04 ± 0.14 SE. The difference in assessment levels was statistically significant (Mann-Whitney U, $Z = -2.30$, $p = .02$). However, for Q72, Q73, Q74, and Q75, there were no statistically significant differences between male and female teachers' ratings (Table 6). Regarding seniority, there were differences in the average assessment among teachers who had worked in the profession for periods of one to five, six to ten, eleven to fifteen, sixteen to twenty, twenty-first to twenty-five, and twenty-six tot thirty years, but these differences were not statistically significant for Q71 to Q75 (Table 6). This activity addresses problems or tasks and facilitates students' acquisition of fundamental knowledge and skills. This is an essential part of the teaching process, and teachers need to employ active teaching methods and techniques to design this activity effectively. Additionally, teachers should provide relevant and practical examples to help students grasp the concept easily. As each unit has distinct knowledge content, teachers regularly organize various activities to ensure that the lesson delivery is efficient and effective. The coordinated use of multiple activities is necessary to achieve this goal.

According to the survey responses, teachers routinely organize all of the activities suggested by the research team for the practice activity. The average ratings of the activities, in order, are as follows: proposing problems related to the living world (Q81, 4.15 ± 0.63 SE), making judgments and formulating hypotheses (Q82, 3.87 ± 0.70 SE), planning implementation (Q83, 3.63 ± 0.80 SE), implementing plans (Q84, 3.52 ± 0.85 SE), and writing, presenting reports, and discussing (Q85, 3.60 ± 0.92 SE) (Table 7). The research results are similar to Tra's findings in building the process of teaching physics (Tra 2009).

Regarding gender, there was a significant difference in the ratings of male and female teachers for Q83, with male teachers rating it at a "Regular" level of 3.42 ± 0.14 SE and female teachers ranking it at 3.96 ± 0.13 SE (Mann–Whitney U, $Z = -2.64$, $p = .01$) (Table 7). Similarly, for Q84, male teachers had a lower average rating (3.31 ± 0.15 SE) than female teachers (3.83 ± 0.13 SE) at both Occasional and Regular levels, and this difference was statistically significant (Mann–Whitney U, $Z = -2.27$, $p = .02$) (Table 7). However, there was no significant difference between male and female teacher ratings for Q81, Q82, and Q85 (Table 7), which have similar mean ratings. Although there were variations in the average evaluation of teachers based on their seniority, of one to five, six to ten, eleven to fifteen, sixteen to twenty, twenty-one to twenty-five, and twenty-six to thirty years of experience, these differences were not considered statistically significant (Table 7). Teachers can engage students in activities such as redrawing diagrams or summarizing lesson content to facilitate this learning and practice process. This is a natural neurophysiological process that helps students consolidate their understanding. The review process may vary depending on the knowledge being learned: each type of knowledge requires a distinct form of reinforcement and practice. As such, teachers must be adaptable and flexible when designing activities to maximize their effectiveness.

Table 7: Activities Commonly Used to Determine the Content of Training Activities

Code	*Mean ± SE*	*Assessment Level*	*Gender*		*Mann–Whitney U*	*Seniority (Year)*						*Kruskal–Wallis H*
			Female	*Male*		*1–5*	*6–10*	*11–15*	*16–20*	*21–25*	*26–30*	
Q81	4.15 ± 0.63	Regular	4.22 ± 0.11	4.04 ± 0.13	$Z = -1.1$, $p = .27$	5.00 ± 0.00	3.91 ± 0.25	4.20 ± 0.14	4.05 ± 0.12	4.4 ± 0.16	4.00 ± 0.58	$\chi^2 = 7.39$, $df = 5$, $p = .19$
Q82	3.87 ± 0.70	Regular	3.81 ± 0.12	3.96 ± 0.13	$Z = -0.8$, $p = .43$	4.50 ± 0.50	3.91 ± 0.25	3.93 ± 0.15	3.74 ± 0.17	3.9 ± 0.23	3.67 ± 0.33	$\chi^2 = 2.51$, $df = 5$, $p = .78$
Q83	3.63 ± 0.80	Regular	3.42 ± 0.14	3.96 ± 0.13	$Z = -2.64$, $p = .01$	3.50 ± 1.50	3.82 ± 0.23	3.67 ± 0.16	3.63 ± 0.21	3.6 ± 0.27	3.00 ± 0.00	$\chi^2 = 3.45$, $df = 5$, $p = .63$
Q84	3.52 ± 0.85	Regular	3.31 ± 0.15	3.83 ± 0.13	$Z = -2.27$, $p = .02$	3.50 ± 1.50	3.64 ± 0.20	3.06 ± 0.13	3.63 ± 0.21	3.2 ± 0.39	3.00 ± 0.00	$\chi^2 = 3.51$, $df = 5$, $p = .62$

Q85	3.60 ± 0.92	Regular	3.42 ± 0.17	3.88 ± 0.15	*Z* = −1.77, *p* = .08	3.50 ± 1.50	3.64 ± 0.24	3.87 ± 0.13	3.74 ± 0.21	3.2 ± 0.33	2.67 ± 0.88	χ^2 = 5.38, *df* = 5, *p* = .37

1.0 ≤ *M* < 1.8: Never; 1.8 ≤ *M* < 2.6: Rarely; 2.6 ≤ *M* < 3.4: Occasionally; 3.4 ≤ *M* < 4.2: Regular; 4.2 ≤ *M* ≤ 5.0: Very often; Q81: Propose problems related to the living world: ask questions about the problem, analyze the context in which the problem is proposed, use your language to express the proposed problem; Q82: Make judgments and build hypotheses: analyze problems to state judgments, formulate and state research hypotheses; Q83: Planning implementation: building a logical framework of research content, selecting appropriate methods (observation, experiment, investigation, interview, retrospective,…), planning research activities; Q84: Implement the plan: collect and retain data from overview, empirical and investigative results; evaluate results based on analysis, process data with simple statistical parameters; compare the results with hypotheses, explain, draw conclusions, and adjust (if necessary); proposals are recommendations applying research results, or further research issues; Q85: Writing, presenting reports, and discussing: using language, drawings, diagrams, and tables to express research processes and results; writing research reports; cooperating with partners with an attitude of active listening and respect for views and opinions given by others to actively absorb and explain, critique, and defend research results convincingly.

The results of the survey question regarding whether teachers often encourage students to apply, explore, and expand on lesson content through various activities are consistent with the findings on practice. On average, teachers frequently organize activities that involve proposing problems related to the natural world (Q91, 4.13 ± 0.70 SE), formulating hypotheses and making judgments (Q92, 3.83 ± 0.78 SE), planning implementation (Q93, 3.57 ± 0.83 SE), implementing plans (Q94, 3.50 ± 0.87 SE), and writing, presenting reports, and engaging in discussions (Q95, 3.50 ± 0.95 SE) (Table 8). A similarity is found in Hien's study, "The Process of Guiding Students to Form Concepts in Teaching Lesson 9 of Biology 12" (Hien 2015).

Table 8: Common Activities Used to Determine the Content of Exploration/Expansion Activities

Code	*Mean ± SE*	*Assessment Level*	*Gender*		*Mann–Whitney U*	*Seniority (Year)*						*Kruskal–Wallis H*
			Female	*Male*		*1–5*	*6–10*	*11–15*	*16–20*	*21–25*	*26–30*	
Q91	4.13 ± 0.70	Regular	4.17 ± 0.12	4.08 ± 0.15	*Z* = −0.45, *p* = .66	5.00 ± 0.00	4.09 ± 0.25	4.20 ± 0.14	4.00 ± 0.17	4.30 ± 0.21	3.67 ± 0.33	χ^2 = 5.97, *df* = 5, *p* = .31
Q92	3.83 ± 0.78	Regular	3.86 ± 0.13	3.79 ± 0.16	*Z* = −0.44, *p* = .66	5.00 ± 0.00	3.82 ± 0.23	4.00 ± 0.17	3.68 ± 0.19	3.80 ± 0.29	3.33 ± 0.33	χ^2 = 6.84, *df* = 5, *p* = .23
Q93	3.57 ± 0.83	Regular	3.42 ± 0.15	3.79 ± 0.13	*Z* = −1.69, *p* = .09	4.50 ± 0.50	3.64 ± 0.20	3.67 ± 0.16	3.53 ± 0.21	3.40 ± 0.37	3.00 ± 0.00	χ^2 = 5.31, *df* = 5, *p* = .38
Q94	3.50 ± 0.87	Regular	3.33 ± 0.16	3.75 ± 0.14	*Z* = −1.66, *p* = .1	3.50 ± 1.50	3.64 ± 0.20	3.60 ± 0.16	3.63 ± 0.21	3.10 ± 0.38	3.00 ± 0.00	χ^2 = 4.24, *df* = 5, *p* = .52
Q95	3.50 ± 0.95	Regular	3.33 ± 0.16	3.75 ± 0.18	*Z* = −1.7, *p* = .09	3.50 ± 1.50	3.36 ± 0.31	3.87 ± 0.13	3.68 ± 0.22	3.1 ± 0.28	2.33 ± 0.67	χ^2 = 9.45, *df* = 5, *p* = .09

1.0 ≤ *M* < 1.8: Never; 1.8 ≤ *M* < 2.6: Rarely; 2.6 ≤ *M* < 3.4: Occasionally; 3.4 ≤ *M* < 4.2: Regular; 4.2 ≤ *M* ≤ 5.0: Very often; Q91: Propose problems related to the living world: ask questions about the problem, analyze the context in which the problem is proposed, use your language to express the proposed problem; Q92:Make judgments and build hypotheses: analyze problems to state judgments, formulate and state research hypotheses; Q93: Implementation planning: building a logical framework of research content, selecting appropriate methods (observation, experiment, investigation, interview, retrospective,…), planning research activities; Q94: Implement the plan: collect and retain data from overview, empirical and investigative results; evaluate results based on analysis, process data with simple statistical parameters; compare the results with hypotheses, explain, draw conclusions, and adjust (if necessary); proposals are recommendations applying research results, or further research issues; Q95: Writing, presenting reports, and discussing: using language, drawings, diagrams, and tables to express research processes and results; writing research reports; cooperating with partners with an attitude of active listening and respect for views and opinions given by others to actively absorb and explain, critique, and defend research results convincingly.

Concerning gender, there are variations between the evaluations of male and female teachers regarding their ability to organize activities that allow students to apply, explore, and expand on the subject matter; however, these differences are not statistically significant (Table 8). Regarding seniority, the statistical analysis revealed no significant differences for Q91 to Q95 (Table 8). Organizing exploratory and expansion activities involves providing students with the necessary knowledge, skills, and opportunities to apply problem-solving strategies to enhance their abilities and qualities. Such activities are intended to serve as practical extensions of the learning process, rather than as advanced exercises, and they can be assigned as homework to reinforce the students' understanding of how the knowledge they have acquired can be useful in real-world situations.

Conclusions and Recommendations

According to a survey and interviews with biology teachers in high schools in the Mekong Delta, teachers are focused on developing their students' competencies, specifically in living world understanding, using various methods such as lectures, diagrams, and models. However, the study found that the results of teaching these competencies are unsatisfactory, and there is room for improvement. To address this, the study recommends incorporating more experimental teaching methods such as project-based learning, research, and organizing games and role-plays to enhance students' understanding of the living world. Additionally, the study suggests using STEM and STEAM approaches to teaching to create a more interactive and engaging learning environment, encouraging students to think creatively, problem-solve, and innovate. This study emphasizes the importance of developing competencies, especially in regions like the Mekong Delta, where sustainable development and environmental awareness are critical for the region's future. The recommendations provided in this study offer practical suggestions to teachers to improve their teaching and enhance students' living world understanding competency, which can contribute to the region's economic and social development.

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Conflict of Interest

The author declares that there is no conflict of interest.

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