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Developing problem-solving and creativity skills in high school students through chemistry teaching in Vietnam: Current status and solution

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Abstract
This paper provides an extensive examination of the current status of chemistry education in Vietnam. In light of contemporary education and the demands of the job market, it emphasises how important it is for high school students to develop their creative and problem-solving abilities. Using a methodological approach that includes surveys and interviews with teachers in different regions, the study evaluates students' competencies and current teaching practises. The findings show a marked underutilization of creative and active learning strategies in favour of conventional teaching methods. Students' creativity and problem-solving abilities have only performed mediocrely or poorly as a result of this traditional approach. The advocacy for educational reforms, with a focus on the implementation of more innovative and dynamic teaching strategies in high schools, concludes the paper. This adjustment is thought to be required in order to properly develop these essential skills in students and get them ready for challenges in the future.

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1. Introduction

The need to foster in students the development of critical abilities like creativity and problem-solving is critical given the dynamic nature of education. This scientific study aims to investigate this need for education in the particular setting of Vietnam's high school system [7]. This paper's introduction seeks to provide a thorough overview of the state of education today, highlight the value of chemistry as a teaching tool for developing skills, and examine the unique opportunities and challenges associated with fostering these skills in Vietnamese high schools.

The narrative surrounding education around the world has been moving more and more in the direction of incorporating 21st-century skills into the curriculum, specifically creativity and problem-solving [6, 9, 10]. This change recognises that students need to be prepared for a world that is changing faster than ever before, going beyond the traditional emphasis on theory and memorization. This global trend serves as a backdrop for this paper's examination of the Vietnamese educational system, highlighting the opportunities and difficulties associated with bringing these trends into the local setting [12]. The introduction places Vietnam in the context of the global educational landscape, highlighting the importance of skills like creativity and problem-solving while also recognising the distinctive social, cultural, and educational dynamics of the nation [14].

This paper reinterprets chemistry—traditionally thought of as a scientific discipline concerned with substances and their interactions—as a powerful instrument for educational development. The subject is perfect for promoting critical thinking, problem-solving, and creative application because it combines theoretical knowledge with real-world application [8]. This section of the introduction looks at how Vietnamese high schools can use chemistry's structured yet exploratory nature to help students acquire these crucial 21st-century skills. The paper explores how students' cognitive skills—such as hypothesis testing, data interpretation, and creative problem-solving—can be improved by the conceptual depth and experimental components of

chemistry education. The emphasis shifts to the particular context of Vietnam, providing a summary of the condition of high school education today with a particular focus on chemistry instruction [2, 13]. The traditional teaching approaches that are still widely used in Vietnamese high schools are highlighted in this section. These methods frequently place more emphasis on theoretical knowledge and rote memorization than they do on critical thinking and creativity [1]. The introduction looks at Vietnam's current educational reforms, which are meant to bring curriculum designs and teaching methods up to date. Finding the gaps between the current practises and the intended outcomes in terms of skill development is made possible in large part by this examination.

There is a substantial research vacuum regarding the best ways to foster creativity and problem-solving abilities in Vietnamese classrooms using courses like chemistry. By evaluating the current state of these abilities within the context of Vietnamese chemistry education, this paper aims to close this gap. The goals are twofold: first, to assess how well the ways that chemistry is currently taught develop these skills; second, to suggest workable, situation-specific ways to incorporate these skills into chemistry instruction more successfully.

The study presents its conclusions and suggestions as essential additions to the current discussion on Vietnamese educational reform. The results of this study should provide more dynamic, interesting, and useful chemistry instruction, improving Vietnamese high school students' educational experiences and better equipping them for challenges in the future.

2. Content from Research

2.1. The Ideas of Creativity Competence and Problem-Solving

Competence is more than knowing and understanding; it is the capacity to act, know how to act, and act effectively. Here, the activity needs to involve knowledge and abilities as well as consciousness and attitude. Competency needs to be observable or quantifiable and shown through activities that lead to results [1].

The capacity to recognise and define difficulties in learning and in life, to suggest and choose suitable solutions, to carry out and assess the problem-solving process, is known as problem-solving competency [3, 4, 7, 8, 15, 16].

The capacity for innovative task performance is known as creativity competence. It entails being skilled, continuously innovating, and possessing distinct qualities that are always applicable to reality. It entails developing original concepts while producing excellent outcomes even in the absence of prior knowledge gained via lectures, readings from documents, or tours [1, 11, 13].

The abilities to creatively address educational difficulties and, to some extent, uncover something new are problem-solving and creativity in learning. Students must encounter issues in order to develop their creativity and problem-solving skills. They must then find ways to overcome action or cognitive inconsistencies, which leads them to propose unique solutions that are fresh to them [5, 6, 13].

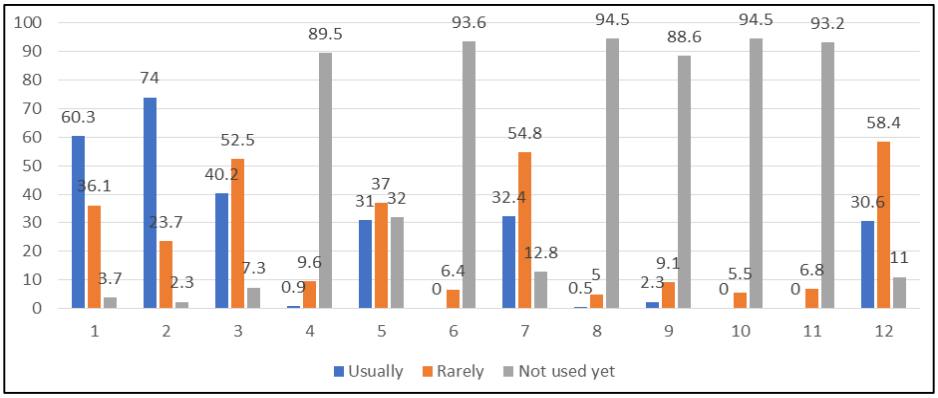
In this piece, the idea is used: "High school students' problem-solving and creativity competence is the ability to find newness, new solutions, the ability to detect and solve problems in learning, the ability to discover the unknown, and create the unknown in a unique, effective way" [5, 12].

2.2. How Some Provinces and Cities Are Currently Developing Their Capabilities in Problem-Solving and Creativity

In 29 high schools spread throughout 13 provinces and cities, including Quang Ninh, Hai Phong, Hai Duong, Bac Giang, Bac Ninh, Thai Nguyen, Son La, Yen Bai, Lang Son, Ha Noi, Thanh Hoa, Ha Tinh, Nghe An,... from September 2022 to September 2023, we polled 219 Chemistry teachers concerning their perspectives. The goal was to evaluate how Chemistry is currently taught, with an emphasis on how students are currently developing their creative and problem-solving skills, as well as how high school students are currently doing in these areas.

Following the collection and synthesis of the survey data, the following outcomes were attained:

a. Concerning the degree to which instructional strategies and active teaching techniques are used



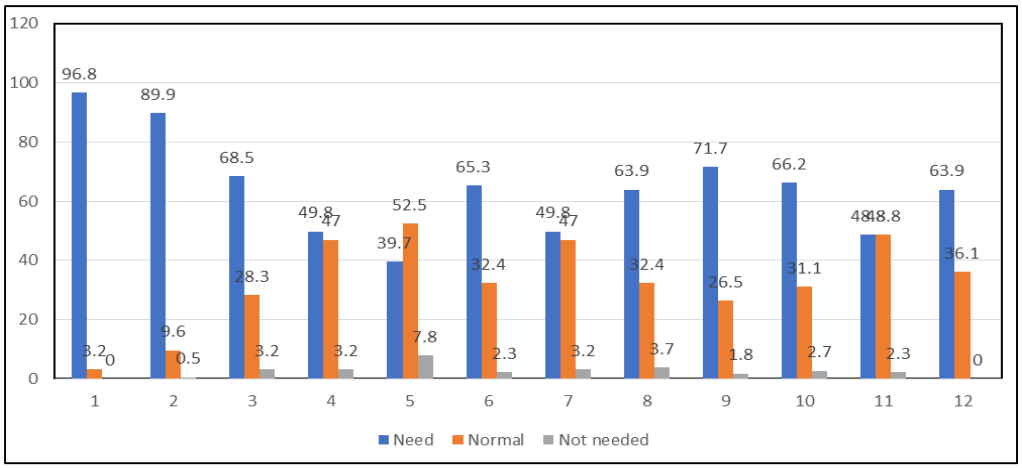
Note: The names of the corresponding criteria on the graph are respectively: 1. Verbal teaching method; 2. Presentation method; 3. Visual teaching method; 4. Project based learning; 5. Problem-solving teaching method; 6. Contract teaching method; 7. Small group cooperating teaching method; 8. "The Four Corners" teaching method; 9. 5W1H teaching techniques; 10. KWL teaching techniques; 11. "Six thinking hats" teaching technique; 12. Mind-mapping techniques

Fig 1: Usage frequency of positive teaching methods and techniques

A clear preference for traditional teaching approaches in educational settings can be shown from the study of Table 1. The most common methods used by educators are verbal and presentation, with 60.3% and 74% of them utilising them

regularly, respectively. Innovative approaches such as problem-solving techniques and project-based learning are less common than visual teaching methods, which show a more balanced usage. The low usage of contract teaching (93.6% not used) and project-based learning (89.5% not used) is particularly noticeable. According to this research, there may be a lapse in the adoption of interactive and contemporary teaching methodologies. This suggests that in order to promote the integration of varied teaching strategies in educational settings, there should be more training provided as well as more resources allocated.

b. The necessity of developing various competencies for high school students.

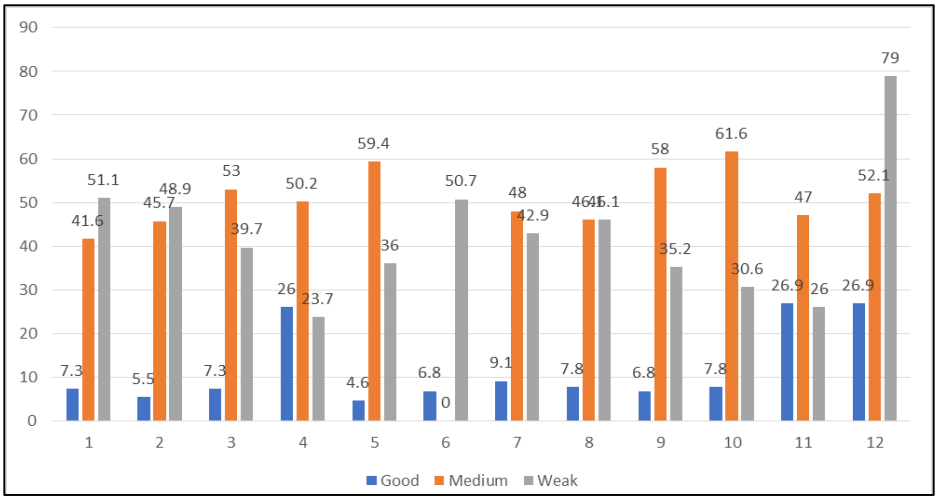


Note: The names of the corresponding criteria on the graph are respectively: 1. Communication and collaboration capacity; 2. Problem-solving and creativity capacity; 3. Self-control and self-learning competency; 4. Technological capacity; 5. Language capacity; 6. Aesthetic competence; 7. Physical competence; 8. 8. Computer competence; 9. Math competence; 10. Chemistry cognitive competence; 11. Ability to understand the natural world from a chemical perspective; 12. Ability to apply learned knowledge and skills

Fig 2: The necessity of each competency that needs to be developed for high school students

Table 2 of the document, which emphasises high school students' competency development, shows interesting trends. Communication and collaboration are most important (96.8%), followed by problem-solving and creativity (89.9%). High percentages indicate a consensus on the importance of these skills in modern education. Technological and language capacities are more divided on necessity and normal importance. This may be due to changing educational and technological trends that have changed the value of these skills. Self-control, self-learning, aesthetic, and physical competences are moderately to highly necessary, recognising the importance of holistic student development. Math and chemistry cognitive competence are also vital, but less so than communication and problem-solving. A trend in education is to balance foundational academic skills with transferable competencies. Table 2 shows that education is shifting towards a more balanced approach that values both academic skills and 21st-century competencies.

c. The current state of competencies among students in some surveyed schools.

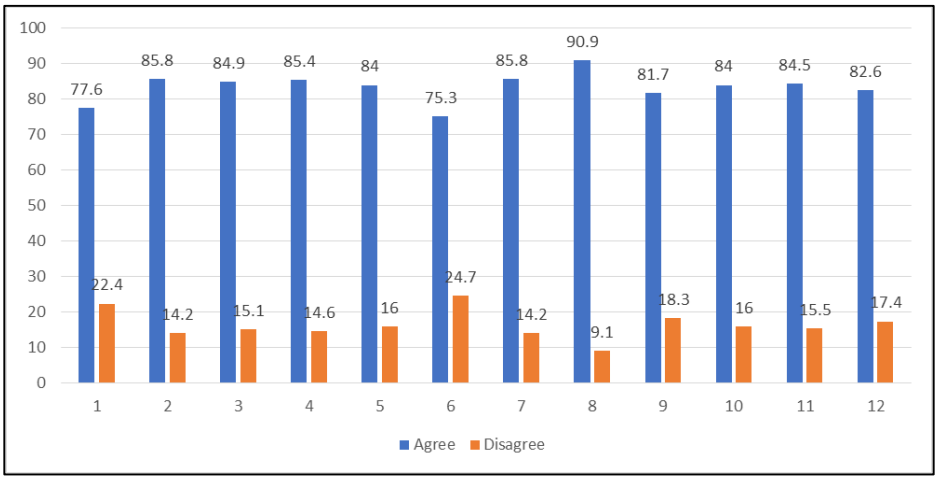


Note: The names of the corresponding criteria on the graph are respectively: 1. Communication and collaboration capacity; 2. Problem-solving and creativity capacity; 3. Self-control and self-learning competency; 4. Technological capacity; 5. Language capacity; 6. Aesthetic competence; 7. Physical competence; 8. Computer competence; 9. Math competence; 10. Chemistry cognitive competence; 11. Ability to understand the natural world from a chemical perspective; 12. Ability to apply learned knowledge and skills

Fig 3: The reality of students's abilities in some surveyed schools

An unsettling pattern in student competencies is shown by the examination of Table 3 in the scholarly study. In important 21st-century competencies including teamwork and communication, creativity, problem-solving, and technological aptitude, a sizable portion of students receive ordinary or poor ratings. This points up an important area where educational systems need to be improved. Additionally, the research suggests that in areas like maths and chemistry, there is a need for more focused education on basic academic abilities and for more effective language instruction. Overall, the findings highlight the need for improving instructional practices to help students acquire these critical abilities and make sure they are prepared for challenges in the future.

d. Manifestations of problem-solving and creative abilities in students.

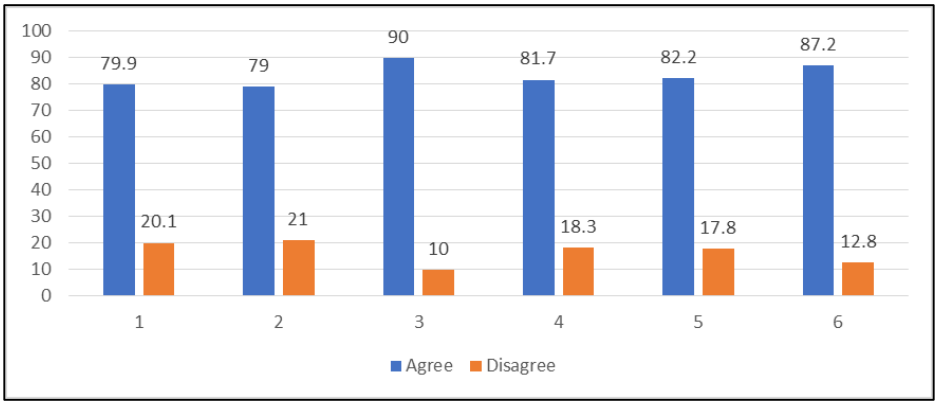


Note: The names of the corresponding criteria on the graph are respectively: 1. Identify and clarify new and complex ideas and information from different sources; 2. Detect and state problematic situations in learning and in life; 3. Analyze problematic situations in study and in life; 4. Raise many new ideas in study and in life; 5. Propose alternative solutions or change solutions to suit the new context; 6. Create new elements based on different ideas; 7. Propose solutions to solve the problem; 8. Compare solutions to the problem and choose the most suitable solution; 9. Implement problem-solving solutions; 10. Evaluate the solution to the problem; 11. Adjust and creatively apply problem-solving solutions to new contexts; 12. Be willing to consider and reevaluate the problem from different perspectives.

Fig 4: Manifestation of students' ability in problem-solving and creativity

Table 4 in the publication offers a thorough understanding of pupils' creative and problem-solving abilities. The vast majority of pupils show skill in recognising and elaborating on novel concepts (77.6%), recognising and evaluating challenging circumstances (85.8% and 84.9%, respectively), and coming up with original concepts (85.4%). In addition, 84% of respondents can suggest other solutions, and an astounding 90.9% of respondents can compare options and decide which is best. But fewer people (75.3%) are able to combine different concepts to generate new elements, suggesting that innovative thinking still has space to expand. The research highlights students' strong problem-solving skills while drawing attention to areas like the development of new ideas that need more attention in instructional tactics.

e. Causes of limitations in students' problem-solving and creative abilities.

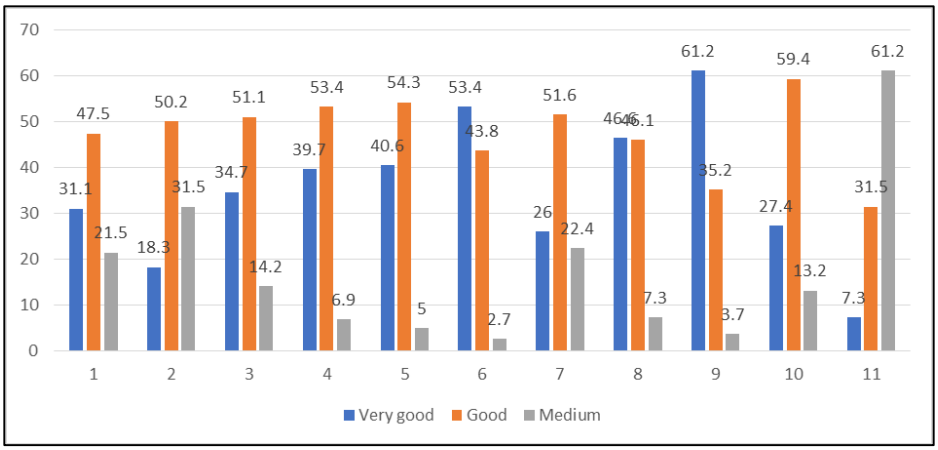


Note: The names of the corresponding criteria on the graph are respectively: 1. There is no system of exercises oriented to develop diverse problem-solving and creative abilities; 2. Teachers do not clearly understand the content and requirements of developing students' problem-solving and creative abilities; 3. Teachers have not proficiently used some active teaching methods such as: Project teaching method, problem-solving teaching method,...; 4. Students are not proactive, positive, and interested in learning; 5. Due to limited time; 6. Due to lack of equipment, machinery, tools, chemicals, etc.

Fig 5: Causes of limited problem-solving and creative abilities of students

Your document's Table 5 explores the reasons for pupils' limits in their creative and problem-solving skills. The vast majority of respondents concur that the absence of exercise programmes designed to develop these skills (79.9%), instructors' poor comprehension of the material and conditions needed to foster these abilities (79%), and their limited use of active teaching strategies like project-based and problem-solving techniques (90%) are important contributing factors. Significant contributing variables also include student initiative and motivation in learning (81.7%), time constraints (82.2%), and lack of skills and equipment (87.2%). According to this research, in order to improve students' problem-solving and creative talents, a multifaceted approach is required that includes curriculum design, teacher training, student engagement tactics, sufficient time allocation, and resource provisioning.

f. The effectiveness of using various methods to develop problem-solving and creative abilities in high school students.

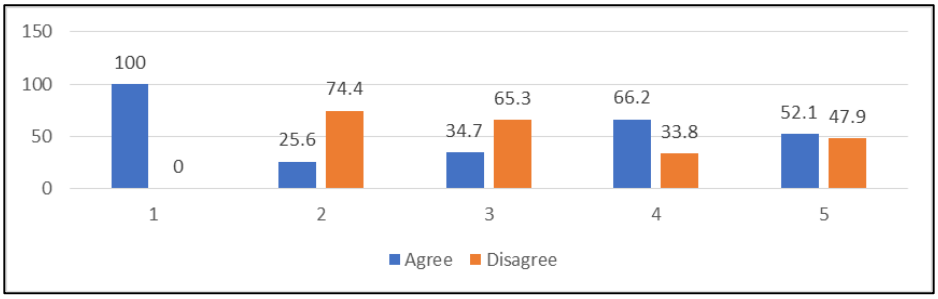


Note: The names of the corresponding criteria on the graph are respectively: 1. Encourage students to express their personal opinions; 2. Encourage students to participate in scientific research activities; 3. Encourage students to self-assess and peer-assess; 4. Encourage students to discover problems that need to be solved in lessons or in practice; 5. Use exercises with practical content and capacity-oriented exercises; 6. Use project teaching method; 7. Use exploratory conversation teaching method; 8. Use problem-solving teaching methods; 9. Use contract teaching method; 10. Use cooperative teaching methods in small groups; 11. Use "The Four Corners" teaching method.

Fig 6: Effectiveness of measures to develop problem-solving and creativity capacity for high school students

Table 6 assesses how well different interventions work to help high school pupils become more creative and adept at solving problems. The project teaching technique (high effectiveness: 53.4%), contract teaching method (61.2%), and practical content exercises (high effectiveness: 40.6%, average effectiveness: 54.3%) are the most effective methods. Though to a lesser extent, encouraging students to voice their thoughts and take part in scientific research is also thought to be useful. Less conventional techniques like "The Four Corners" are less effective, indicating the need for more creative teaching methods that better suit the learning preferences of the pupils. This information emphasises how crucial it is to use a variety of engaging instructional strategies to help students develop their critical thinking and creative skills.

g. Tools for assessing problem-solving and creative abilities in students.



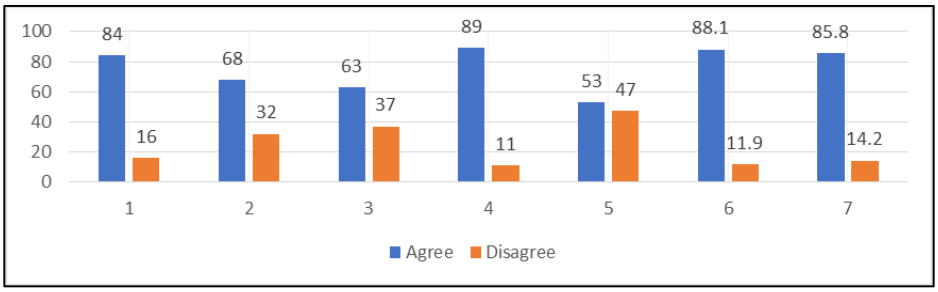
Note: The names of the corresponding criteria on the graph are respectively: 1. Assessment through test; 2. Assessment through learning records; 3. Assessment through the teacher's evaluation form; 4. Assessment through questions and answers and group discussions; 5. Students self-assess according to the criteria.

Fig 7: Tools to assess problem solving and creativity capacity for students

Table 7 examines how well different evaluation instruments measure students' capacity for creativity and problem-solving. There is broad support (100%) for test-based assessment, suggesting a strong conviction in its effectiveness. On the other hand, just 25% of respondents believe that learning records are useful, and even fewer (34.7%) are in favour of teacher evaluation forms. Student self-assessment is seen to be moderately successful (52.1%),

whereas interactive approaches such as group discussions and questions and answers perform better (66.2%). Although there is significant support for more dynamic and interactive assessment procedures, which represent a nuanced view of evaluating student competencies, the data suggests a preference for traditional testing methods.

h. Challenges in constructing competency-oriented questions and exercises.



Note: The names of the corresponding criteria on the graph are respectively: 1. Haven't been trained on how to build questions and abilites development exercises; 2. Not fully understanding the signs/expressions of each ability; 3. Not fully understanding general and specific abilities; 4. Select a problemaic situation; 5. Students' learning ability is limited; 6. Preparing questions and exercises is time-consuming; 7. Find suitable practical materials.

Fig 8: Difficulty in building ability-oriented questions and exercises

Table 8 looks at the challenges in developing exercises and questions that focus on capabilities. The vast majority (84%) concur that one of the biggest obstacles is a lack of training in question construction. Comparably, 68% of respondents found it difficult to interpret each ability's indications or expressions, and 63% have trouble differentiating between general and particular talents. 89% of respondents find it difficult to choose difficult scenarios, and 53% point to students' poor learning capacities as a hurdle. Furthermore, 85.8% of respondents report having trouble locating appropriate practical materials, and 88.1% find it time-consuming to prepare these questions and exercises. The aforementioned data emphasises the necessity of more organised instruction and resources in order to create capability-oriented educational materials.

3. Conclusion

The research paper's conclusion centres on how teaching chemistry in Vietnam fosters students' creativity and problem-solving abilities in high school. It discusses the state of education today, the efficacy of different teaching strategies, and the difficulties in improving these vital abilities. The importance of creative teaching methods and the necessity of educational reforms to better prepare students for challenges in the future are probably going to be emphasised in the conclusion. Additionally, the conclusion may highlight the need for collaboration between educators and policymakers to implement these reforms effectively. It may also suggest the integration of technology and real-world applications in chemistry education to further enhance students' creativity and problem-solving skills.

4. References

1. Nguyen Cuong. Teaching Methods of Chemistry in High Schools and Universities. Some Fundamental Issues, Vietnam Education Publishing House, Hanoi, 2007.
2. Nguyen Ngoc Duy, Nguyen Thi Suu. The Current Situation of Problem-Solving Skills Development for High School Students in Mountainous Areas in Son La Province". Journal of Science, Hanoi University of Education, 2016, 249-256.
3. Pham Thi Kieu Duyen, Bui Quoc Hung. Using Problem-Oriented Exercises to Develop Problem-Solving Skills in Teaching Chapter 11: Carbon-Silicon Chemistry to Develop Problem-Solving Skills for High School Students". Journal of Science, Hanoi University of Education, 2015; 6:66-76.
4. Pham Van Hoan, Hoang Dinh Xuan. Researching the Construction and Use of Chemistry Exercises to Develop Problem-Solving Skills for High School Students". Journal of Science, Hanoi University of Education, 2020, No. 69/2020, pp. 100-112.
5. Vu Thi Thu Huong, Nguyen Van Quang. Developing Problem-Solving and Creativity Capacity for High School Students Through Exercises with Multiple Solutions in the Inorganic Part of Chemistry Programs for 11th Grade". Journal of Educational Equipment – Special Issue, 2021, 16-18.
6. Michael D Mumford. Something Old, Something New: Revisiting Guilford's Conception of Creative Problem Solving. Creativity Research Journal. 2010; 13(3-4):267-276.
7. Ministry of Education and Training. General Education Program – Master Program, Hanoi, 2018.
8. Norman Reid, UK Mei Jung Yang. The Solving of Problems in Chemistry: the More Open-Ended Problems. Research in Science & Technological Education, 2002, 20(10.
9. PISA Results: Creative Problem Solving Students' Skills in Tackling Real-Life Problems, 2012, 5:30.
10. Qin Zhou, Giles Hirst, Helen Shipton. Promoting Creativity at Work: The Role of Problem-Solving Demand. Applied Psychology. 2011; 61(1):56-80.
11. Nguyen Van Quang. Abstract Using Inorganic Chemistry Exercises in Teaching to Develop the Creativity Capacity of High School Students. Journal of Science, Hanoi University of Education. 2016; 6A:223-232.
12. Robert L DeHaan. Teaching Creativity and Inventive Problem Solving in Science. CBE—Life Sciences Education. 2017; 8(3):172-181.
13. Nguyen Thi Suu, Nguyen Ngoc Duy. Initial Research on the Situation of Problem-Solving and Creativity Skills of High School Students in the Northwest Mountainous

Area of Vietnam and Proposed Development Measures". Proceedings of the International Scientific Conference, Hanoi University of Education, 2017, 156-163.
14. The Prime Minister of Vietnam attends the inauguration ceremony of the new facility of the National Innovation Center on October 28, 2023. Documents of Vietnamese government newspapers.
15. Cao Thi Thang. Some Issues in Developing Problem-Solving Skills for Students in Chemistry at Secondary Schools". Journal of Educational Science, 2010, 53:21.