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Research Article

RESEARCH ON TEACHING HOW TO CONDUCT EXPERIMENTS IN SCIENCE FOR GRADES 4 AND 5 (2018 GENERAL EDUCATION CURRICULUM) IN HO CHI MINH CITY

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ABSTRACT

This study explores how teaching was delivered for experiment lessons in science subjects in Grades 4 and 5 in Ho Chi Minh City. The study surveyed 912 teachers and administrators. The results show that teachers were good at using experiments and active teaching methods, guiding students to ask questions effectively, adjusting teaching plans based on assessment results, integrating information technology, and promoting student autonomy through self-testing and peer review. Evaluations of teachers and administrators are consistent with positive trends of innovative teaching methods, emphasizing teachers' proficiency in adjusting teaching plans based on evaluation results and information technology integration. This study provides data for enhancing teaching practices in science subjects in elementary schools per the educational goals stated in the Vietnam 2018 General Education Curriculum.

Keywords: primary education; science education; teacher; teaching practices for experiment lessons

1. Introduction

Socio-economic development poses new requirements for education. Therefore, education has become a decisive factor and is a solid foundation for the sustainable development of each country (Agbedahin, 2019; Brodowski et al., 2019). In Vietnam, in the context of a socialist-oriented market economy and international integration, the goals of innovation and development of education and human resource training are also emphasized. Specifically, Resolution No. 29-NQ/TW on fundamental and comprehensive innovation of education and training clearly states that "*Education and training are top national policies. Investing in education is a development investment, given priority in socio-economic*

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development programs and plans" (Communist Party of Vietnam, 2013). In addition, primary education is an essential level in the national education system with the goal of "*helping students form and develop the basic elements that lay the foundation for harmonious physical and mental development, qualities and abilities that mainly guide education about personal values, family, community and necessary habits and routines in learning and living*" (Ministry of Education and Training, 2018a). At the same time, the general education curriculum issued with Circular No. 32/2018/TT-BGDDT of the MOET emphasizes the shift to a continuing orientation. The approach to developing learner competencies has raised requirements for innovation in teaching methods (MOET, 2018b).

In the elementary school curriculum, science is a mandatory subject in Grades 4 and 5 and is built on the essential, initial foundation of natural science and health and environmental education. This subject plays a vital role in helping students study natural sciences at the middle school level and Physics, Chemistry, and Biology at the high school level, focusing on arousing curiosity. Scientific exploration initially allows students to learn and explore the natural world, apply knowledge and skills learned into practice, and learn how to maintain health and behave appropriately with the surrounding living environment. The Science Curriculum clearly states the educational view of "*increasing students' active participation in the learning process. Students learn science through inquiry, discovery, observation, experimentation, practice, and teamwork*" (MOET, 2018c).

Teaching scientific practices (TSP) is required to shift from content teaching to the development of qualities and competencies. This shift is demonstrated to be effective in the educational process in general and in teaching and learning science in particular and is widely applied in many countries around the world (Demirbaş & Pektaş, 2010; Hofstein & Lunetta, 2004; Hofstein et al., 2008; Koç & Böyük, 2012; Yeşilyurt et al., 2021). TSP is an active teaching method that helps students proactively and actively participate in the learning process, thereby developing their thinking, problem solving, creativity, and cooperation abilities. In particular, TSP promotes students' positivity, initiative, and creativity (Le, 2010). In addition, TSP also brings significant positive changes to students' motivation and academic success in science (Başdaş, 2007). In addition, experimental teaching capacity is an integral part of teaching capacity, which needs to be developed for primary school teachers to meet the general education curriculum (Ly, 2020). Science is a subject with the orientation of developing natural scientific cognition, the capacity to learn about the surrounding natural environment, and the capacity to apply learned knowledge and skills. Therefore, improving experimental teaching quality for teachers is crucial to ensure the quality of education and training in general and TSP in particular.

Previous research in Vietnam on teaching scientific practices is limited. Therefore, the research was conducted to survey teaching scientific practices in science subjects Grades 4 and 5 per the 2018 general education curriculum (2018 GEC) in Ho Chi Minh City followed

by suggestions to improve teaching scientific practices for teachers in primary schools in Ho Chi Minh City. At the same time, it is necessary to create criteria for evaluating the teaching scientific practices of elementary school teachers and data for reviewing intitial teacher curriculum for primary teachers on teaching scientific practices.

2. Research design

2.1. Research aim

The primary objective of this study is to evaluate teaching scientific practices and teachers' current compentency levels in science subjects for Grades 4 and 5 in alignment with the 2018 General Education Curriculum. The focus will be on primary teachers in Ho Chi Minh City, aiming to provide insights into the effectiveness of teaching practices and identify potential areas for improvement in science education at these grades.

2.2. Research question

- ***Research question 1:*** How do teachers practice experimental teaching in science subjects for Grades 4, 5 according to the 2018 GEC in Ho Chi Minh city?
- ***Research question 2:*** How do they self-assess their competencies in TSP?

2.3. Survey methods

The research surveyed teachers and administrators for two primary purposes: (i) the current practices of TSP and (ii) their self-assessment of TSP competency in science subjects for Grades 4 and 5. The questionnaire, adapted from previous studies by Cao and Ly (2017), Le (2016), Ly et al. (2018), Le and Vo (2022), Le (2022), and Nguyen (2014), aimed to explore various dimensions of TSP and teacher competency comprehensively. The participants werr 912 teachers and administrators (Table 1).

Table 1. *Demographic characteristics of the paticipants in this study*

Individuals characteristics	Frequency (n)	Percentage (%)
Sex		
Male	198	21.7
Female	716	78.3
Academic level		
College	13	1.4
Undergraduate education	806	88.2
Postgraduate education	95	10.4
Others	0	0.0
Professional seniority		
Under 5 years	214	23.4
From 5 to 10 years	75	8.2
From 11 to 15 years	196	21.4
Over 15 years	429	46.9
Position		
Principal	15	1.6
Vice-principal	19	2.1
Chief specialist	28	3.1
Teacher	852	93.2

Items were adapted from validated questionnaires to ensure the instrument's reliability and validity with Likert scales (Table 2).

Table 2. *Likert scale interpretation*

Scale	Interpretation
Likert 5-point scales	
Frequency	Never/ Rarely/ Sometimes/ Often/ Always
Effectiveness	Not effective/ Less effective/ Normal/ Effective/ Very effective
Likert 7-point scale	
Competency	Not applicable/ Undeveloped/ Underdeveloped/ Normal/ Competent/ Strong competent/ Outstanding competent

2.4. Statistical analysis

The unsatisfactory answers were scanned after data collection, and subsequent valid data were encoded and analyzed using SPSS software for descriptive statistical techniques (mean, standard deviation, and minimum and maximum values).

3. Result and discussion

3.1. TSP in science subjects by teachers

3.1.1. Science teaching methods

Teachers assessed their teaching methods used in teaching science subjects in Grades 4 and 5 are presented in Tables 3 and 4.

Table 3. *Frequency of using surveyed science teaching methods for Grades 4 and 5*

No.	Items	Percentage (%)					Mean/SD	Rate
		1	2	3	4	5		
1	Visual learning	1.10	1.10	3.90	50.20	43.70	4.34 ± 0.71	2
2	Cooperative learning	0.20	1.10	4.80	50.80	43.10	4.35 ± 0.65	1
3	Practice-based learning	0.20	2.60	10.90	50.00	36.20	4.19 ± 0.75	3
4	Problem-based learning	0.70	1.00	12.60	53.70	32.10	4.16 ± 0.72	4
5	Investigative case-based learning	0.90	6.90	52.10	18.80	21.30	3.53 ± 0.93	7
6	Hands-on activities	0.40	5.40	46.50	30.90	16.80	3.58 ± 0.85	6
7	Scientific practice	0.40	6.20	32.70	46.90	13.70	3.67 ± 0.80	5

Research results show that Investigative Case-Based Learning (3.53 ± 0.93), Hands-On Activities (3.58 ± 0.85), and Scientific Practice (3.67 ± 0.80) are the methods were least used by teachers (Table 3) and the lowest mean is for Investigative Case-Based Learning.

This suggests that teachers used it less frequent and could be less effective. Possible reasons could be there is a lack of engagement or challenges connecting the presented cases to their understanding of scientific concepts (Etherington, 2011). While hands-on activities are valuable for practical skill development, with a slightly higher mean than investigative case-based learning, may indicate that teachers find these activities more engaging but still see room for improvement (Carlson & Sullivan, 1999). Similar to hands-on activities, scientific practice received a moderate mean from the survey. Some aspects of the scientific method or practice-based approaches need adjustment to better align with students' preferences or expectations.

Cooperative learning and visual learning emerged as the most frequent teaching methods, receiving mean scores of 4.35 ± 0.65 and 4.34 ± 0.71, respectively. Cooperative learning involves students working on tasks, fostering collaboration, and communication skills (Tran, 2013). Visual learning utilizes visual aids to enhance understanding, catering to diverse learning styles (Pashler et al., 2008). The high means for these methods highlight their frequency in engaging students and facilitating a deeper understanding of scientific concepts.

Table 4. *Effectiveness of using science teaching methods for Grades 4 and 5*

No.	Variables	Efficiency (%)					Mean	Rate
		1	2	3	4	5		
1	Visual learning	0.20	2.10	4.30	49.50	44.00	4.35 ± 0.68	2
2	Cooperative learning	0.00	0.40	3.70	53.10	42.80	4.38 ± 0.58	1
3	Practice-based learning	0.20	1.00	5.70	57.30	35.80	4.27 ± 0.63	3
4	Problem-based learning	0.20	1.00	16.60	52.00	30.20	4.11 ± 0.72	5
5	Investigative case-based learning	0.20	3.80	35.90	35.30	24.70	3.81 ± 0.86	7
6	Hands - on activities	0.00	2.70	25.70	44.90	26.70	3.96 ± 0.80	6
7	Scientific practice	0.20	1.90	14.10	44.50	39.30	4.21 ± 0.77	4

Results on the effectiveness of teaching methods in science subjects show that cooperative learning received the highest mean (4.38 ± 0.58), indicating that teachers highly value this method. The collaborative nature of the method likely fosters more profound understanding and engagement among students (Johnson et al., 2000; Gillies, 2014). This positive perception aligns with the frequency result, emphasizing the effectiveness of cooperative learning in science education.

Hands-on activities received a moderate mean (3.96 ± 0.80), a slightly higher score than investigative case-based learning, suggests that teachers found them more engaging. This alignment with the frequency result indicates that hands-on activities, while valued, may require adjustments to enhance their impact on science education further (Schwarz et al., 2008). Investigative case-based learning received the lowest mean (3.81 ± 0.86), suggesting that teachers perceived it as less effective than other methods. The challenges associated with investigative case-based learning align with the frequency result, highlighting the need to improve its effectiveness in the science classroom.

Scientific practice demonstrates a higher mean (4.21 ± 0.77), suggesting its effectiveness in science education. Although not used frequently (Table 3), more focus on applying the scientific method and engaging in scientific practices will likely contribute to a more comprehensive understanding of scientific concepts (Rouse, 2018).

3.1.2. Effectiveness of teaching scientific practice in science subjects

The results of teachers' assessment of the effectiveness of teaching scientific practice in science subjects for Grades 4, 5 are presented in Table 5.

Table 5. *Effectiveness of teaching scientific practice in science subjects for Grades 4, 5*

No.	Items	Effectiveness in TSP (%)					Mean	Rate
		1	2	3	4	5		
1	Using TSP when studying new lessons.	0.90	3.00	7.00	48.10	41.00	4.25 ± 0.78	1
2	Using TSP when practicing exercises.	0.30	2.60	15.50	50.20	31.30	4.10 ± 0.77	3
3	Using TSP in practice hours.	0.00	1.90	14.20	50.20	33.70	4.16 ± 0.73	2
4	Using TSP when reviewing lessons.	0.80	7.10	18.20	52.20	21.80	3.87 ± 0.86	4

The results show that teaching scientific practice when studying new lessons has the highest score (4.25 ± 0.78). This suggests that participating teachers actively utilized this method to enhance students' understanding of new scientific concepts, fostering an environment that encourages inquiry and critical thinking (Kim et al., 2007; Vieira & Tenreiro-Vieira, 2016). The mean score for teaching scientific practice during exercise is also positive (4.10 ± 0.77). This indicates that teachers are integrating practical application and problem-solving components into exercises, aligning with the principles of scientific practice. The score, while slightly lower than the introduction of new lessons, still reflects a strong emphasis on practical application during exercise sessions.

The mean for teaching scientific practice during practice hours (4.16 ± 0.73) demonstrates a consistent effort to integrate practical and hands-on activities into the curriculum. This suggests that teachers seemed not to allow students much to apply scientific principles during practice periods, contributing to a more immersive learning experience. The mean for teaching scientific practice during lesson reviews is slightly lower than in

others (3.87 ± 0.86). This may suggest improvement in incorporating practical applications and active engagement strategies during lesson reviews.

3.2. Teachers' self-assessments on TSP competencies in science subjects

3.2.1. Understanding of TSP in science subjects

The results of teachers' self-assessment of their understanding of TSP in science subjects are presented in Table 6.

Table 6. *Teachers' understanding of TSP in science subjects for Grades 4 and 5*

No.	Items	Understanding (%)							Mean	Rate
		1	2	3	4	5	6	7		
1	Scientific expertise	0.70	1.80	10.20	27.20	24.40	17.90	17.50	4.97 ± 1.35	3
2	Knowledge of TSP theory and methods	0.20	2.80	10.70	27.70	22.60	15.80	20.10	4.97 ± 1.40	2
3	Compliance with internal regulations, safety rules, and experimental techniques	0.00	2.10	6.60	24.70	24.90	20.40	21.30	5.19 ± 1.31	1

The results show that Compliance with Internal Regulations, Safety Rules, and Experimental Techniques has the highest score (5.19 ± 1.31). The highest mean among the three aspects indicates that teachers can comply with internal regulations, safety rules, and experimental techniques. Grades 4 and 5 teachers are conscientious about adhering to safety protocols and guidelines while conducting scientific experiments, contributing to a secure and controlled learning environment.

The mean for Knowledge of TSP Theory and Methods (4.97 ± 1.40) aligns closely with scientific expertise. Teachers believed that they possess foundational scientific knowledge and exhibit a reasonable understanding of the theoretical aspects and methodologies associated with Teaching Scientific Practice.

The mean of Scientific Expertise (4.97 ± 1.35) indicates a moderately high perception of teachers' scientific expertise. Grades 4 and 5 teachers possess a solid foundation of scientific knowledge, allowing them to engage with and understand the principles introduced through TSP in science subjects.

3.2.2. Teachers' selfassessment of their competence of TSP in science subjects

The results of teachers' self-assessment of TSP competence in science subjects are presented in Table 7.

Table 7. *Teachers' self-reported competence of TSP in science subject*

No.	Items	Percentage (%)							Mean	Rate
		1	2	3	4	5	6	7		
1	Plan to carry out scientific experiments.	0.40	1.10	10.80	28.10	23.10	18.50	17.90	5.00 ± 1.34	4
2	Select tools and chemicals to to conduct experiments.	0.20	0.70	11.60	25.60	16.40	24.20	21.30	5.15 ± 1.37	3
3	Conduct experiments safely, operate reasonably, and phenomena are clear and observable.	0.00	1.30	7.70	22.80	16.60	30.70	20.90	5.31 ± 1.31	1
4	Describe experimental phenomenon, apply theoreties to explain the experimental phenomenon.	0.20	1.60	5.90	26.40	14.00	30.50	21.30	5.29 ± 1.33	2

Table 7 shows that Conduct Experiments Safely, Operate Reasonably, and Phenomena are Clear and Observable received the highest mean (5.31 ± 1.31), indicating a relatively strong self-reported competence among grades 4 and 5 teachers in conducting experiments safely, operating equipment reasonably, and ensuring clear and observable phenomena. This also shows teachers' solid understanding of safety protocols and proficiency in conducting experiments.

Describe Experimental Phenomenon and Apply Theoreties to Explain Experimental Phenomenon also received a high mean (5.29 ± 1.33), suggesting that teachers can effectively describe experimental phenomena and apply theoreties to explain them. This indicates a high level of competence in articulating observations and connecting them to theoretical concepts.

Select Tools and Chemicals to Conduct Experiments received a moderately high mean (5.15 ± 1.37), indicating a solid level of competence among teachers in selecting appropriate tools and chemicals for experiments. This foundational skill is crucial for successful experimentation.

Plan to Carry out Scientific Experiments has an average score of 5.00 ± 1.34, a slightly lower mean. While teachers possess a solid ability to strategize and organize experiment plans, there may be opportunities for improvement in developing more detailed and comprehensive plans.

3.2.3. Competency to organize TSP in science subjects

The results of teachers' assessment of the competency to organize TSP are presented in Table 8.

Table 8. *Competency to organize TSP*

No.	Items	Competency to organize TSP (%)							Mean	Rate
		1	2	3	4	5	6	7		
1	Choose experiments suitable to teaching goals and students.	1.10	1.50	10.10	35.00	13.70	13.10	25.50	5.00 ± 1.49	4
2	Use a combination of experiments and active teaching methods.	0.00	0.70	7.10	24.40	24.40	19.40	24.10	5.27 ± 1.29	1
3	Ask questions to guide students in observing the phenomenon to draw conclusions.	0.00	2.20	9.40	25.20	16.60	22.10	24.50	5.21 ± 1.41	3
4	Handle situations and guide students to practice experiments.	0.20	1.10	10.30	25.60	14.10	24.60	24.10	5.22 ± 1.40	2

The results suggest an overall positive self-reported competencies to organize TSP of Grades 4 and 5 teachers. Teachers demonstrate strengths in using a combination of experiments and active teaching methods, employing effective questioning techniques, and handling various situations during experiments.

Table 8 show that Use a Combination of Experiments and Active Teaching Methods has the highest mean (5.27 ± 1.29), suggesting a relatively high level of competence among Grades 4 and 5 teachers in this competency. The use of a combination of experiments and active teaching methods is crucial for creating dynamic and engaging learning environments (Shepherdson, 2001). This trend aligns with contemporary pedagogical approaches emphasizing active learning strategies to enhance student understanding and retention of scientific concepts.

Additionally, the effective use of questioning techniques and the competency in handling situations during experiments reflect teachers' abilities to foster critical thinking skills and maintain a supportive learning environment. Continuous professional development efforts can further enhance these competencies, ensuring a consistent and high-competencies in TSP.

While Choose Experiments Suitable to Teaching Goals and Students received a moderately high mean (5.00 ± 1.49), this suggests an opportunity for improvement. Collaborative initiatives and sharing best practices among teachers can contribute to a more

standardized and practical approach to experiment selection, ensuring the alignment with teaching goals and student needs.

3.2.4. Teachers' assessment competencies of TSP

The results of teachers' self-report in assessment competencies of TSP are presented in Table 9.

Table 9. *Teachers' assessment competencies of TSP in science subjects*

No.	Items	Self-reported competencies in student assessment (%)							Mean	Rate
		1	2	3	4	5	6	7		
1	Applying positive testing and evaluation methods.	1.10	1.50	8.60	28.60	22.00	18.30	19.90	5.03 ± 1.39	5
2	Building a testing framework and evaluate experimental results.	0.00	0.70	10.40	29.00	22.40	17.70	19.80	5.06 ± 1.32	4
3	Organizing students to self-assess and peer-evaluate.	0.00	2.50	4.70	28.80	25.50	22.20	16.30	5.09 ± 1.25	3
4	Applying information technology in in testing and evaluating experimental results.	0.20	1.10	9.70	26.30	21.30	22.10	19.30	5.11 ± 1.33	2
5	Using testing and evaluation results to adjust teaching plans.	0.20	1.50	9.70	25.80	15.90	26.90	19.90	5.16 ± 1.36	1

The results suggest an overall high level of competence of Grades 4 and 5 teachers in TSP. teachers demonstrate strengths in using testing and evaluation results to adjust teaching plans, applying information technology in assessment, and organizing students for self-assess and peer assessment.

Using Test and Evaluation Results to Adjust Teaching Plans has the highest mean (5.16 ± 1.36), reflecting teachers' ability to use assessment data to inform and adjust teaching plans (Table 9). This aligns with best practices in education, emphasizing the importance of formative assessment to guide instructional decisions and meet the diverse needs of students. Teachers exhibit strengths in adjusting teaching plans based on assessment data, incorporating technology in assessments, fostering student autonomy, and designing testing frameworks. The results in applying positive testing and evaluation methods presents an

opportunity for professional development for teachers to ensure a more standardized and practical approach in assessment (Gupta & Lee, 2020; Gelsel et al., 2021).

The mean of Building a Testing Framework and Evaluating Experimental Results (5.06 ± 1.32) suggests a moderately high level of competence in building and evaluating experimental results (Table 9). This competency is fundamental for designing practical assessments that align with instructional goals and accurately measure student understanding. While still indicating a moderately high level of competence, Applying Positive Testing and Evaluation Methods has a slightly lower mean (5.03 ± 1.39), suggesting there may be some room for improvement of positive testing and evaluation methods among teachers. Continuous professional development and collaborative efforts can enhance their competency in assessment strategies.

4. Conclusion

The findings reveal an overall positive practices of Teaching Scientific Practice of Grades 4 and 5 teachers. Teachers self-reported their strengths in various aspects, such as using a combination of experiments and active teaching methods, asking questions to guide students, and adapting teaching plans based on assessment results. The study identified a positive self-reported competencies in integrating information technology and fostering student autonomy in self-assess and peer assessment. With certain competencies with lower levels, such as choosing experiments and planning, there may be opportunities for improvement, especially in standardizing testing and evaluation methods. Teachers displayed proficiency in using test and evaluation results to adjust teaching plans, applying information technology in assessments, and organizing students for self-assess and peer assessment.

By addressing the identified areas for improvement and building on existing strengths, teachers and educational authorities can collectively contribute to the enhancement of science education in primary schools, aligning with the goals of the 2018 General Education Curriculum.

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NGHIÊN CỨU THỰC TRẠNG DẠY HỌC THỰC HÀNH THÍ NGHIỆM TRONG MÔN KHOA HỌC LỚP 4, 5 THEO CHƯƠNG TRÌNH GIÁO DỤC PHỔ THÔNG 2018 Ở CÁC TRƯỜNG TIỂU HỌC TRÊN ĐỊA BÀN THÀNH PHỐ HỒ CHÍ MINH

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TÓM TẮT

Nghiên cứu này tìm hiểu thực trạng giảng dạy thực hành thí nghiệm (THTN) trong các môn Khoa học lớp 4 và 5 tại Thành phố Hồ Chí Minh. Nghiên cứu sử dụng phương pháp phân tích dữ liệu định lượng với cỡ mẫu gồm 912 giáo viên và quản lí. Kết quả cho thấy giáo viên thể hiện thế mạnh trong việc tận dụng sự kết hợp giữa thí nghiệm và phương pháp giảng dạy tích cực, hướng dẫn học sinh đặt câu hỏi hiệu quả và điều chỉnh kế hoạch giảng dạy dựa trên kết quả đánh giá. Việc tích hợp công nghệ thông tin và thúc đẩy quyền tự chủ của học sinh thông qua việc tự kiểm tra và đánh giá ngang hàng. Đánh giá của giáo viên và cán bộ quản lí phù hợp với những xu hướng tích cực của việc đổi mới phương pháp dạy học, nhấn mạnh sự thành thạo của của giáo viên trong việc điều chỉnh kế hoạch giảng dạy dựa trên kết quả đánh giá và tích hợp công nghệ thông tin. Nghiên cứu này cung cấp cơ sở lí luận nhằm tăng cường dạy học THTN trong môn Khoa học ở trường tiểu học, phù hợp với các mục tiêu giáo dục được nêu trong CT GDPT 2018.

Từ khóa: thực trạng; tiểu học; khoa học; giáo viên; dạy học thực hành thí nghiệm