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EFFECTIVENESS OF MICRO TEACHING: DEVELOPING STEM TEACHING ORGANIZING SKILLS FOR PRE-SERVICE CHEMISTRY TEACHERS

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Abstract. The research aims to determine the effectiveness of micro teaching in developing STEM teaching organizing skills for pre-service Chemistry teachers (teaching organizing skills for pre-service Chemistry teachers - TOSfPCT). This approach was evaluated through the constructivism and experiential learning theories. This research was conducted within a course for six weeks period during the 2nd semester of the 2020-21 academic year at a Chemistry faculty, Hue University of Education. The article presents the micro-teaching process combined with the application of information technology in developing STEM TOSfPCT, pre-/post-test quasi-experimental design with control group was applied. The experiment involved applying micro teaching to the experimental group (EG) while the courses were carried out using traditional lectures in the control group (CG). Mann Whitney U Test and Wilcoxon Sign Test were used in the analysis of the quantitative data. The results obtained from Mann Whitney U Test and Wilcoxon Sign Test suggest that there is no significant difference between the pre-test scores of the experimental and the control groups. Descriptive data also demonstrated that the use of the micro teaching in the curriculum had significantly increased the skill levels of the experimental group pre-service Chemistry teachers.

***Keywords*:** micro teaching, STEM teaching organizing skills, pre-service Chemistry teacher, quasi-experimental, information technology.

1. Introduction

Micro teaching is considered a method that is mostly employed by teacher training institutions and is also included among the group teaching methods. Micro teaching was first invented at Stanford University in 1960 as a part of an experimental curriculum that aimed to increase quality in teacher training [1] is based on Bandura's (1982) social learning theory. Micro-teaching, a strategy widely used across teacher training programs, combines both reflective practice and situated learning approaches. Micro-teaching is a condensed lesson plan used to practice, rehearse and reflect on action [2]. It is often delivered within a role-playing context for real-time feedback and reflection. Micro-teaching provides a platform for both mastery experiences and vicarious experiences [3]. Besides micro teaching combined with the application of information technology, so it is supported by constructivist learning theory and it provides opportunities for experiential learning and therefore can be used in informal and outdoor education settings as well. Pre-service teachers like micro teaching implementations with the help of which they acquire information regarding teaching skills. Self confidence levels

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and teaching skills of teacher candidates were observed to increase as well [4]. The teaching objective of microteaching is to develop teaching skills in a trainee teacher and to enable them to build their confidence as a teacher [5]. If teachers can model and control the elements of observations, social learning theory will support their practices. Cooper & Allen (1971) and Mohan (2007) define micro-teaching as a teaching situation made up in limited time and with few numbers of students, between 5 until 20 minutes with 3 up to 10 students, and followed by assessment or feedback given by the supervisor or lecturer. Karckay and Sanli (2009) state that micro-teaching is a technique which can be used for various professional development. Micro-teaching is aimed at developing teaching skills. As specified by Steiner et al (2009), there are several steps in conducting micro-teaching such as (a) preparation, (b) presentation, (c) video watching, (d) discussion and analysis, and (e) feedback. Moreover, Kumar (2008) states that six stages of conducting micro teaching are: (1) planning, (2) teaching, (3) giving feedback, (4) revising the plan based on the feedback, (5) teaching, and (6) giving feedback [6]. Many researchers are referring to the micro-teaching process, but in general, the process can be presented as follows: Teacher candidates were taught about the micro teaching process and teaching skills. The micro teaching videos of previous studies were watched and discussed with them. After this, which teaching skills would be focused on microteaching sessions in the study were decided by the lecturers and were notified to the participants. Subsequently, each teacher candidate was asked to prepare a lesson plan in which was taken into consideration these selected teaching skills (questioning, associating the topics with daily life, measurement and evaluation, and content knowledge). After evaluating the lesson plans by the researchers, one of the teacher candidates in each group was randomly selected as the teacher of the micro-teaching group (called StTeacher), the rest of the teacher candidates in each group have been assigned as the audience (students). It was formed according to the success of preparing lesson plans while forming student groups. Care was taken to ensure that being students prepared good, intermediate, and bad lesson plans in each group. Each micro-teaching group met three times in total, with a researcher as their mentor at regular intervals for twelve weeks to watch and criticize the micro-teaching sessions. That is, micro-teaching sessions have also been made three times and each session, which has landed 15 - 20 minutes was recorded to video. StTeacher and the students of each micro-teaching group were asked to fill structured diaries before and after each micro-teaching session. Moreover, each group watched and criticized microteaching videos of their own groups step by step with their mentors. Thanks to all these works, the teacher candidates were provided rich opportunities to make written and oral reflections about both themselves and their peers' teaching practices [7]. According to Gürol teach-reteach cycle is very important in micro teaching. Micro teaching is a recorded and practical implementation system that applies. The teaching process in controlled conditions and that focuses on specific teaching skills of the teacher training model based on a systematic approach undertaken with the help of teaching tools.

One of the most important links of the micro teaching process is the re-teaching process that will be developed through the thinking style and potentially provided to the teacher candidate at the start and end of the teaching experiment and the feedback provided. This method is also known to encourage teacher candidates to establish better work. In this context, micro teaching: Develops teaching skills by examining and assessing personal teaching techniques. Contributes to learning through examining and analyzing the teaching methods of others. In order to simplify the teaching environment, micro teaching limits the number of students, teaching skills, and duration of teaching. In addition to experimenting with teaching skills in micro teaching, it is imperative to re-try the areas that involve errors after correcting them.

In 2018, a Vietnamese New General Education Curriculum was issued, in which STEM education has shown its position. To successfully and synchronously implement STEM

education, the teacher has a decisive role. In addition to the main components such as teachers need to have an understanding of STEM educational reasoning, be able to design teaching plans, build content and materials for STEM teaching, build tools to evaluate STEM lesson plans, skills STEM teaching organization is also an extremely important component. A STEM lesson is usually quite long, can be done in many lessons, many weeks of study while the duration of modules for prospective teachers is limited. Therefore, micro-teaching is an effective measure to be applied to develop the skills of organizing STEM teaching for pre-service chemistry teachers when there is no separate module related to STEM teaching in the curriculum. In micro teaching, future teachers will practice teaching in small groups, so students will be self-disciplined, actively complete tasks. They will have more time to interact, share and practice more. When dividing STEM topics into individual activities and skills, the formation and development of specific teaching skills for each individual becomes more convenient and effective. The prolonged pandemic situation makes it difficult to practice STEM teaching organization skills due to pre-service teachers can't go to training places. To handle this issue, the research combined with the application of information technology (Technology pedagogical content knowledge-TPCK) in developing STEM teaching organization skills for prospective Chemistry teachers through both teachers and students use some applications to organize classes such as google meet, zoom, padlet, etc and some games as kahoot, quizze, wordwall, etc to implement engaging activities for students. The literature review process shows that there are many researches in Vietnam on the application of micro-teaching in the development of teaching skills [8-10], but none have mentioned the application of micro-teaching in the development of STEM TOSfPCT.

2. Content

2.1. Research purpose and questions and participants

The present study aimed to determine the effectiveness of micro teaching approach by comparing STEM TOSfPCT between a micro teaching implementation and traditional teaching. In other words, the objective of this study was to investigate whether micro teaching results in increased skills and knowledge attainment (learning outcomes) in a teacher training program. To this end, the problem statements of the study were worded as follows:

Research question 1: Is there a significant difference in STEM TOSfPCT taught with micro teaching and traditional teaching methods?

The sub-problems of the study are following:

- Is there a significant difference between the pre-test scores of the pre-service teachers in EG taught by the micro teaching and the pre-service teachers in CG taught only traditional teaching methods?

- Is there a significant difference between the post-test scores of the pre-service teachers in the EG taught by the micro teaching and the pre-service teachers in the CG taught only traditional teaching method?

- Is there a significant difference between the pre-test and post-test scores of the pre-service teachers in the EG taught by the micro teaching?

This research was conducted in the last six weeks of the second semester of the academic year 2020-21 at the Chemistry faculty, Hue University of Education. The participants were 26 pre-service teachers (12 EG; 14 CG), enrolled in some modules of the 182012 course.

2.2. Assessment tools

The assessment tool used is a rubric of STEM teaching organization skills, including 6 component skills, 25 items and each item divided 5 levels (1 = “poor expression”, 2 = “at first

there was skill", 3 = "unprofessional", 4 = "professional", 5 = "expert"). This tool has been presented by the author in another article in the process of being published in the Journal of the Vietnam National Institute of Educational Sciences [11].

Table 1. The rubric of STEM teaching organization skills

Order number	**Stem teaching organization skills**	**Level**				
		1	***2***	***3***	***4***	***5***
1	***Identify problem/learning task/opening skills***					
1.1	Transfer STEM tasks (such as giving situational or practical assignments, questions, assignments, experiments, practices, etc) so that students identify problems to be solved/learning tasks to be performed and propose problem-solving solutions or how to perform tasks.					
1.2	Organize students to conduct exploring experiments, encouraging brainstorming students to propose problems and solutions to STEM problems.					
1.3	Student organizations discuss/question STEM product specifications.					
1.4	Organize students to agree on the criteria for evaluating related products in STEM topics.					
1.5	Provide and guide students in using learning materials, academic diaries, and assessment slips throughout stem topics.					
1.6	Link the problem from operation 1 to the research/contact of background knowledge in operation 2.					
2	***Skills of organizing for students to form knowledge, propose solutions***					
2.1	Guide/guide students to learn the background knowledge themselves or mobilize the learned knowledge, linking knowledge to the solution.					
2.2	Encourage/orient/guide students to propose solutions.					
2.3	Monitoring, supporting students in the process of self-study, solution design.					
2.4	Create opportunities for students to develop teamwork skills, ask questions.					
3	***Skills of organizational for students to share knowledge, design solutions***					
3.1	Organizing students to report/protect design solutions, asking students to clarify the design basis, scientific concepts, and principles used to solve the problem of creating products.					
3.2	Orient/suggest/guide students on equipment, processing, techniques associated with specific solutions for students to choose and implement the right product ideas.					

3.3	Track and evaluate students through design diaries, team activities, etc.					
4	***Skills of organizing for students manufacturing testing and adjusting product creation***					
4.1	Orientation/guidance/support students to test and manufacture products.					
4.2	Create opportunities for students to discuss and ask questions during the process of making, testing, evaluating, adjusting products.					
4.3	Evaluate students through test fabrication logs, product adjustments, progress, etc.					
5	***Skills of organizing students to report products, summary, evaluation***					
5.1	Notice of how, content, time, requirements for product presentation, criteria for evaluation of product reports.					
5.2	Use a variety of forms of reporting organization such as exhibition exhibitions, contest organizers, etc.					
5.3	Create conditions for students to present and debate about: product creation process, difficulties, experience, adjustment, product development orientation, etc.					
5.4	Organize for students to self-evaluate, peer evaluation.					
5.5	Ask critical questions, evaluate, standardize, and supplement students' knowledge.					
6	***Skills using teaching methods, teaching techniques, teaching facilities, assessment tools, situational handling***					
6.1	Use, reasonable combination, variety of teaching methods, teaching techniques in the direction of positive chemistry of students.					
6.2	Prepare and use effectively and rationally the means of teaching.					
6.3	Effective and reasonable use of testing and evaluation tools for students.					
6.4	Handle situations that arise well throughout the STEM topic.					

2.3. Implementation

CG implements traditional teaching practices, EG performs a micro-teaching process that includes as follows:

- Phase 1. Practice each teaching skill individually;
- Phase 2. Combining 2-3 teaching skills.

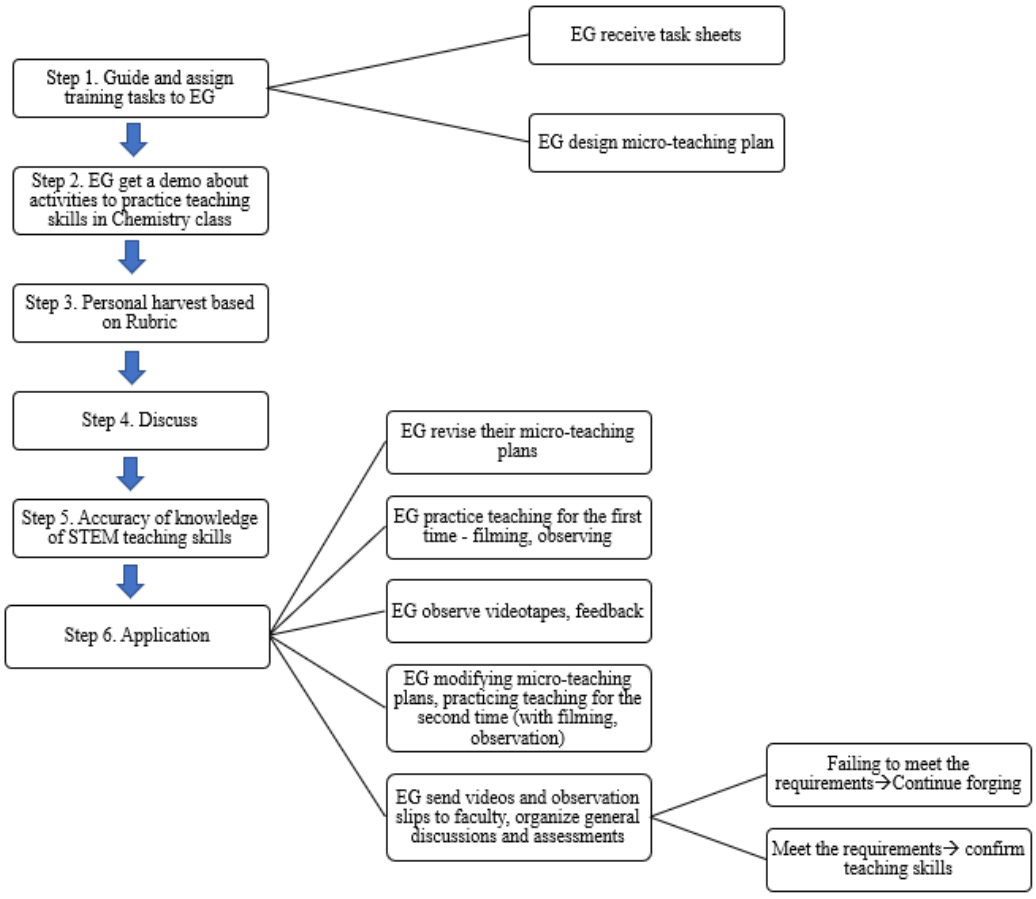

Figure 1. Micro teaching process of in developing STEM TOSfPCT

2.4. Analysis

Both EG and CG took the pre-test in order to assess learners' initial STEM teaching skills. After the course, both groups were carried out the post-test to evaluate and compare the effectiveness of the skills development between the microteaching and the traditional teaching methods. Learners' skills scores were scored on a 5-point scale of Rubric. Due to the sample size being small and the data did not meet the assumptions of the parametric test, the scores from the tests were compared by quantitative analysis, using the Mann Whitney U nonparametric test and the Wilcoxon signed rank test [12]. The Mann-Whitney U test was implemented to detect the difference between before and after the course of the experimental and control groups. Wilcoxon signed rank test was applied to examine changes in the learning outcome of the skills developed within each group separately.

2.5. Findings and discussion

We analyzed the scores of the pre-test, using Mann Whitney U Test. The results shown in Table 2 showed that the mean score of the test before the impact of the experimental and the control groups was scored on a very low 5-point scale of 2.27 and 2.18, respectively. The pre-test scores for both groups did not show statistical difference ($U = 788.00$; $p = 0.520 > 0.05$). These results proved that the STEM TOSfPCT before teaching in the micro teaching and the

traditional method was very low. And there was no difference in these skills between learners in the EG and CG before the course.

Table 2. Analysis of the pre-test score of the experimental and the control groups

Groups	N	Mean	Mean Rank	Sum of Ranks	U-value	Z-value	P-value
EG	12	2.27	43.57	2012.00	788.00	-0.391	0.520
CG	14	2.18	41.39	1784.00			

We used the Wilcoxon Signed-Ranks Test to analyze the difference in the post-test scores compared with the pre-test scores of both the experimental and control groups. The results shown in Table 3 showed that the EG has affected by the micro teaching, there was a statistically significant difference in the mean score of the post- and pre-test ($Z = -6{,}027$; $p = 2.03\times10^{-4} < 0.05$). STEM TOSfPCT improved significantly, specifically the mean score increased from 2.27 in the pre- to 4.15 in the post-test. The significant increase in STEM TOSfPCT was not coincidental, it was due to the impact of the micro teaching. This result was similar to the CG affected by the traditional methods, in which the mean score of the post-test increased significantly compared to the pre-test (from 2.18 to 3.67), this development also did not happen by chance ($Z = -5.679$; $p = 1.95\times10^{-5} < 0.05$).

Table 3. Analysis of the difference between the post- and pre-test scores of the experimental and the control groups

Groups		N	Mean	Mean Rank	Sum of Ranks	Z-value	P-value
EG	pre-test scores	12	2.27	22.00	1024.00	-6.027	2.03×10^{-4}
	post-test scores		4.15				
CG	pre-test scores	14	2.18	20.00	859.00	-5.679	1.95×10^{-5}
	post-test scores		3.67				

We further analyzed the post-test scores, using the Mann Whitney U Test. The results shown in Table 4 showed that there was a statistically significant difference in the mean score of the post-test between the experimental and the control groups ($U = 359.00$; $p = 1.06\times10^{-5} < 0.05$), in which the mean score of the post-test of the experimental was 0.48 higher than that of the CG (4.15; 3.67). This proved that the STEM TOSfPCT of the experiment affected by the micro teaching is higher than the CG taught by the traditional method.

Table 4. Analyze the post-test score of experimental and control groups

Groups	N	Mean	Mean Rank	Sum of Ranks	U-value	Z-value	P-value
EG	12	4.15	53.20	2420.00	359.00	-4.869	1.06×10^{-5}
CG	14	3.67	31.19	1293.00			

In line with the findings of the study, it was identified that STEM TOSfPCT improved as observed in the average means of the post-test. ($p < 0.05$). This result shows that the micro teaching technique positively affects EG skills regarding STEM teaching skills. The finding is parallel to the results of many other studies in the field [13-17].

We can confirm that the use of micro teaching implementations helped pre-service teachers to overcome their reservations, make them more relaxed during lesson presentations, solve problems faced during lesson presentations, develop classroom mastery skills, be more cautious about their sentences and tones of their voices, be more aware of the need for attracting student attention and interest, be less reserved to try out implementations, be patient toward students in the class, to have ease in communicating and not to experience any problems while ending the class. The findings of the current study are similar to those of [13, 15, 18].

Some studies show that micro teaching helps the teacher to overcome problems related to getting ready for class and presenting the lesson; it gives positive results related to professional adaptation of teachers, preparation of lesson plans and acquiring classroom management skills; it is effective in relaxing teachers, helping them to overcome their reservations and making them grasp the need to use different methods according to lesson presentation. Kazu (1997) and Ceyhun (2003) identified that teacher candidates had positive views and responses towards the micro teaching course and listed negative aspects of micro teaching as the brevity of duration, inability to present the class to real students, and the inability to present the lesson in a real classroom environment.

3. Conclusions

Based on the data analysis and previous discussion, some conclusions can be drawn as follows: presented the micro-teaching process in phase 1 including 6 steps to develop STEM teaching organization skills for pre-service Chemistry teachers; the STEM TOSfPCT of the experiment affected by the micro teaching is higher than the CG taught by the traditional method, specifically the following skills as identify problem/learning task/opening; organizational for students to share knowledge, design solutions; organizing students to report products, summary, evaluation.

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