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A Study of Problems and the Need for Innovative Teaching of Pre-service Science Teachers: A Case Study of a Rajabhat University in the North

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Abstract: This study was survey research. The purpose was to explore the problem and the need for innovative teaching of pre-service science teachers. The sample was 30 pre-service science teachers from first-year to fifth-year in General Science, Faculty of Education. The overall was 150 obtained by stratified random sampling. The instruments used were a survey of the problem and the need for innovative teaching of pre-service science teachers, using a 1-5 rating scale. The survey consisted of 5 components of innovative teaching: 1) Application of innovative thoughts in teaching science; 2) The innovative use of teaching science content; 3) The use of innovative teaching methods and teaching strategies in science; 4) The innovative use of science teaching resources and 5) Innovative evaluation. The data was collected using Google Forms and analyzed using a quantitative data analysis method. The statistical values used in the data analysis were mean and standard deviation. The quality of the tools is approved by three experts who assess the suitability of the questions. The results suggested that all items of the suitability index averaged between 4.24-4.40. The study suggested that the average from the survey is 4.48, meaning the requirement to encourage innovative teaching of pre-service science teachers, The application of innovative thoughts in teaching science and the use of innovative teaching methods and teaching strategies in science are at the highest level.

Keywords: Problems and the need, Innovative Teaching, Pre-Service Science Teachers

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1. Introduction

Innovation has a crucial role presently. It's a measure of success in the 21st century (Lee & Benza, 2015). Using previous methods or formats will be ineffective and outdated. Therefore, innovative competency is necessary for this highly competitive era (Bennett, 2012), and someone who has originality and creativity for making new things to solve problems will be successful. Education management in the 21st century needs to develop learners' innovation skills thus they can create innovation in their careers and succeed in the future. Teachers, who play a significant role in growing learners up to be physically, mentally, and intellectually complete human beings, need to be encouraged in the competency of innovative teaching since being pre-service teachers (Bellanca, 2010). Then it is possible to design instruction to attract learners' interest in learning and willingness to learn. Moreover, learners can innovate and earn essential skills in the 21st century.

Currently, Thailand has faced many challenges affecting the success of producing science teachers. One of them is the quality of curriculum. Some curricula in the production of science teachers focus on memorization and lecture methods. Also, they have outdated knowledge about how to design teaching (Faikhamta, 2018). Therefore, enhancing the quality of production of science teachers is classified as one of the keys to driving educational reforms to ensure teachers' quality meeting to the goals. Science teacher production of the fourth-year bachelor's degree may have a similar program structure in professional courses following the Teachers' Council of Thailand's professional standards (Faikhamta et al., 2018). When considering in-depth, few curricula apply innovative teaching. Moreover, the teacher construction and development process should encourage the 21st-century skills of learners by using innovative teaching in the teacher construction and development process in related subjects (Zhu et al., 2013).

It is shown that of innovative teaching competency of pre-service science teachers is important. There are two policies indicated in professional standards, the standard of learning management & classroom management and the standard of innovation & educational technology (The Teachers Council of Thailand, 2013; Suparee and Yuenyong, 2021). In addition, four aspects of the bachelor's qualification standards are mentioned. First, intellectual skills indicates that teachers should be initiative and creative and apply innovative teaching to enhance student learning and develop students as innovators. Second, interpersonal skills and responsibility identifies that pre-service teachers can a work in a team, have a responsibility, give help, and solve group problems creatively. Third, numerical analysis, communication, and technology skills tells that teachers should choose and use technology and innovation properly, such as using software packages for teaching and presentations in various formats. Forth, learning management science specified that pre-service teachers should apply the 21st-century skills to learning management for learners to practice problem-solving skills also use technology in their teaching (Ministry of Education, 2018).

Phibunsongkhram Rajabhat is a university for developing the locality in higher education and has seen the importance of educational innovation. So, we set guidelines to develop our university into an innovative university and defined Phibunsongkhram Rajabhat University Strategies. In Strategy 2, Teacher construction and Development, the purpose is to improve lecturers to know curriculum development strategies and Faculty of Education, which is a pre-service development institution, to be expert in their profession (Pibulsongkram Rajabhat University, 2021). Therefore, the defined vision responses to our intent focus on curriculum development and learning management competencies of professors and pre-service teachers to develop teaching innovation and to practice their students becoming potential innovators.

According to internal educational quality assessment data, Academic Year 2020, of Faculty of Education in Pibulsongkram Rajabhat University, it is reported that the

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innovation perspective has the lowest average. As a result, Faculty of Education imposed a policy, effective on 1st December 2021, that professors and all pre-service teachers can integrate the learning process into innovative development. Another policy aims to support innovative teaching in all courses to apply authentic teaching. Moreover, the pre-service teachers can innovate and take advantage of its products, e.g., teaching innovation, teaching materials, teaching methods, or integrating technology with teaching. All of the above are essential skills for being a 21st-century teacher (Faculty of Education Pibulsongkram Rajabhat University, 2020).

As mentioned previously, innovative learning management is a significant issue for Thai education that ought to be improved right away. Researcher, who works for the teacher construction and development, agreed that science pre-service teachers should receive preparation for teaching profession first-- by exploring the problems and needs for innovative teaching and then solving.

2. Objectives

To explore the problems and needs for innovative teaching of science pre-service teachers.

2. Methodology

2.1 Population and Sample

The population is 300 first-year to fifth-year pre-service teachers in general science, Faculty of Education.

The sample group is 150 first-year to fifth-year pre-service teachers in general science, Faculty of Education, obtained by stratified random sampling. They are the representatives of each year's class (30 participants) who answered surveys about the problem and the need for innovative teaching.

2.2 Research Instrument

The survey of problems and the need for innovative teaching of science pre-service teachers characterizes as a five-level rating scale in Google Forms. The total number of questions was 12, consisting of 5 components of innovative teaching with three questions on each aspect covering all domains: cognitive, psychomotor, and affective; 1) Application of innovative thoughts in teaching science, 2) The innovative use of teaching science content, 3) The use of innovative teaching methods and teaching strategies in science, 4) The innovative use of science teaching resources, and 5) Innovative evaluation. The quality of the tools is approved by three experts who assess the suitability of the questions. The results suggested that all items of the suitability index averaged between 4.24-4.40.

2.3 Data Collection

1. Create a problem survey and the need for innovative teaching of science pre-service teachers, applied from the definition of innovative teaching of pre-service teachers applied from Zhu et al., 2013, which consists of four components of innovative teaching as shown in Table 1.

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Table 1: presenting the definition of innovative teaching of pre-service teachers applied from Zhu et al., 2013

Components of Innovative Teaching	Learning objectives	definition
1) Application of innovative thoughts in teaching science	Attitude Knowledge Skill	1. I actively learn new things related to science teaching concepts, new methods, etc. 2. As a teacher, I know how to learn to improve my science teaching. 3. I am capable of learning science independently.
2) The innovative use of teaching science content	Attitude Knowledge Skill	1. I am willing to integrate modern multimedia technology into science teaching. 2. I know the recent development of science teaching technology. 3. I am proficient in using modern multimedia teaching technologies in science.
3) The use of innovative teaching methods and teaching strategies in science	Attitude Knowledge Skill	1. I am willing to share science teaching problems with others. 2. I have the knowledge on how to cooperate with others. 3. I can maintain a dynamic interaction with my students.
4) The innovative use of science teaching resources	Attitude Knowledge Skill	1. I am willing to spend more time on teaching science in various issues. 2. I have sufficient knowledge about science. 3. I am capable of mobilising students' learning enthusiasm and interests in the class.
5) Innovative evaluation	Attitude Knowledge Skill	1. I handle failure or mistakes in a positive manner to help students realise their errors and meet acceptable standards in a supportive atmosphere. 2. I uses a variety of evaluation methods and assessment, not to judge the students but to help them to understand better. 3. I established a safe climate in the classroom in which the students feel free to find their innovative potential for teaching.

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2. The three specialists, who are professors of the Education Faculty and skilled in educational research and evaluation, Curriculum and Instruction, and Educational Technology and Computer Education, evaluated the survey of problems and the need for innovative teaching of pre-service science teachers about the appropriateness of the 5-level rating scale questions. The results suggested that all items of the suitability index averaged between 4.24-4.40. The researcher then took the experts' advice until the survey was complete.

3. The participants answered a survey about the problem and the need for innovative teaching of science pre-service teachers via Google Forms.

2.4 Data Analysis

Analyze quantitative data of the survey results and interpret according to Srisa-ard, 2010. The statistical values used in the data analysis were mean and standard deviation. criteria as follows:

- mean during 4.51-5.00 was analyzed as problems and needs at the highest level.
- mean during 3.51-4.50 was analyzed as problems and needs at a high level
- mean during 2.51-3.50 was analyzed as problems and needs at a moderate level
- mean during 1.51-2.50 was analyzed as problems and needs at a low level
- mean during 1.01-1.50 was analyzed as problems and needs at the lowest level

3. Finding

The results of a study of problems and the need for innovative teaching of science pre-service teachers are shown in Table 2.

Table 2: shows the results of a study of problems and the need for innovative teaching of science pre-service teachers.

Components of Innovative Teaching	Mean	standard deviation (SD)	Level of problems and needs
1. Application of innovative thoughts in teaching science	4.77	0.22	highest
2. The innovative use of teaching science content	4.43	0.37	high
3. The use of innovative teaching methods and teaching strategies in science	4.53	0.31	highest
4. The innovative use of science teaching resources	4.31	0.39	high
5. Innovative evaluation	4.35	0.39	high
Total	**4.48**	**0.07**	**high**

To summarize the findings, that the overall mean was 4.48 or the high level of problems and needs. When considering each aspect, Application of innovative thoughts in teaching science and the use of innovative teaching methods and teaching strategies in science were averaged at 4.77 and 4.53 respectively, or problems and needs at the highest level. In terms of the innovative use of teaching science content, Innovative evaluation, and the innovative use of science teaching resources, the mean was 4.43, 4.35, and 4.31 respectively, or at the high level of problems and needs. The survey results also show that innovative teaching of science pre-service teachers should be encouraged as stated in the

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professional qualification standard framework for teachers and national education standards.

4. Conclusion

As the results of a study of problems and the need for innovative teaching of science pre-service teachers, the overall mean was at the high level. When considering each aspect, there are problems and the need for Application of innovative thoughts in teaching science and the use of innovative teaching methods and teaching strategies in science at the highest level; The innovative use of teaching science content, Innovative evaluation, and The innovative use of science teaching resources at a high level. Consistent with Office of National Education Standards and Quality Assessment, 2016, the teachers have to improve in terms of learning environment management supporting innovative teaching because there was neither chance to use innovative teaching in class nor apply innovative teaching covering all 5 elements. In consequence, we have to promote their collaboration in developing innovation through collaborative learning (Barkley et al., 2014), their creation of innovation via project-based learning (Bender, 2012), their experience in learning management (Experiential Learning) for developing innovations (Kolb, 2015), their application of new educational technology in teaching, and their selection of various assessment (Edwards, 2012). Providing a safe environment in the classroom allows learners to independently explore their innovative potential (Ellis & Barrs, 2008). On the topic of Innovative Evaluation, the professors have to train the pre-service teachers to recognize, accept and deal with failure in a positive manner (Beghetto, 2005; Runco, 2003).

Furthermore, the result of this study shows that science pre-service teachers need innovative teaching development as stated in Qualification Standard, Teaching Professional Standards, and National Education Standards. There are 4 areas in The Bachelor's Degree Qualification Standard consistent with the innovative teaching. Firstly, Intellectual Skills, pre-service teachers should be initiative, develop their work creatively, apply innovative teaching knowledge, and change students into innovators. Secondly, Interpersonal Skills and Responsibilities, pre-service teachers can collaborate with others, be responsible and helpful, and solve the group problems creatively. Thirdly, Numerical Analysis Skills, Communication and Technology Use, pre-service teachers can use information technology (IT) properly such as selecting suitable software packages for various work and presentations. Finally, Learning Management Science, the teachers should apply the 21st-century skills and technology in teaching to practice students' problem-solving skills (Ministry of Education, 2018). In terms of Teaching Professional Standards, there are 2 standards related to innovative teaching. To begin with Learning Management, the teachers are literate about principles, concepts, and processes of learning plans, learning management, theory, and teaching models to enhance students' analytical thinking process. Next, Innovation and Educational Information Technology, pre-service teachers know about the principles, concepts, design, application, and innovation evaluation (The Teachers Council of Thailand, 2013). On the topic of National Education Standards, there are 2 aspects of desirable outcomes. One, Learners, students in higher education should have lifelong learning skills, be aware of changes and flexible, and be able to adapt and face changes in the digital world and future. Moreover, they should have leadership, knowledge in various fields, intelligence, and working skills. Two,

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Co-innovators, the students in higher education should be able to solve social problems, do cross-disciplinarity, and create innovation for increasing chance and value for self, society, and the country (Office of the Education Council, 2018). National Education Standards defined learner goals related to innovative teaching of pre-service teachers that learners should have innovative thoughts (Office of the Education Council, 2017). The 15-year long-term higher education plan, No.2 (2008-2022), set goals for producing graduates to develop innovations (Office of The Higher Education Commission, 2007). Thailand 4.0 model stated that leading Thailand towards sustainability must be advanced and be driven the economy through innovation (Office of National Education Standards and Quality Assessment, 2017).

As all above, it's such an urgent matter to promote innovative learning management for the science teacher to achieve the goals in the future.

5. Recommendations

Recommendations for applying the research results

1. A professor can apply all five components of innovative teaching to design innovative learning and teaching to encourage innovative teaching of pre-service teachers.
2. Faculty of Education should write a policy promoting the competence of innovative teaching for pre-service teachers according to Qualification Standard, Teaching Professional Standards, and National Education Standards.

6. Suggestions for future research

1. In compliance with the study results, science pre-service teachers need support in innovative teaching, as seen in all averages being at the highest level. Therefore, learning management should be developed.
2. A researcher should study problems and needs for innovative teaching of other disciplines as a guideline for professors to design learning and further promote the competence of innovative teaching of pre-service teachers.

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