Emotional, Attitude and Classroom Action Research Competency Conduction of Undergraduate Students Through STEM Education

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Abstract

The purposes of this research were: 1) to develop lesson plans for STEM education for undergraduate students with the efficiency of the processing performances and the performance results (E_1/E_2) at the determining criteria as 75/75, 2) to compare emotional, attitude towards research, and classroom action research competency of undergraduate students before and after implementing STEM education. The sample was one class of the teaching profession program in Chemistry. The experimental group was selected by simple random sampling. The research instrument was lesson plans for STEM education management and practical skill development, a test of research knowledge, a research skill assessment form, an observation form, and a questionnaire. The statistics used were the percentage, mean, standard deviation, and Multivariate Paired Hotelling's T-Square. The research results showed that 1) the efficiency of the STEM lesson plans for undergraduate students' processing performances was 87.12 percent, and the performance results were 74.17 percent (87.12/74.17), meeting the set criteria of 75/75, 2) students had emotional, attitude towards research and classroom action research competency conduction after implementing the lesson plans of STEM education was significantly higher than before at the .05 level of statistics.

Keywords: attitude, emotional quotient, research conduction, STEM, undergraduate students

1. Introduction

Education in the 21st century has changed the classroom to be a bigger learning community and qualities of the students to be self-directed learners, independent learning, and collaborative learning through simple learning processes for developing skills and attitude (Nuangchalerm, 2017; Prachagool & Nuangchalerm, 2021). The learning activities emphasize thinking skill, problem-solving skill and team work skill development of the students by practicing and collaborating in the multicultural society (Arphattananon, 2018). The learning processes are consistent with the 12th Economic and Social Plan Development of Thailand (2017−2021), which focuses on five major areas of human resource development: positive attitude and standard norm of society, skills, knowledge and competencies, standard educational management, and long live learning by self-study (Nakornthap, 2018).

The target group is is on the emotional quotient with the typical indications of childhood and adolescence. The ability of emotion in creative and tranquil living is referred to as the emotional quotient (Schonert-Reichl, 2017; Taylor et al., 2017). During Thailand's 12th National Economic and Social Development Plan (2017−2021), the Department of Mental Health has a strategic plan that includes indicators for 70 percent of Thai adolescents to have an EQ score of not less than the standard (Department of Mental Health, 2017). The emotional quotient provides the students with self-emotional management, positive thinking skills, sympathy skills and good relationship with other people (Perryman & Bowers, 2018). The skills are necessary for self-control of the students when they are facing various problems. Additionally, the skills help them improve creative thinking and decrease their stress (Prasertsuk, 1999). However, Thailand still encounters problems with the quality of education and research on the quality of education and school-age children with emotional intelligence (EQ) problems. In 2014, this group of children had an average EQ of 45.12 in 2011, which was lower than the score range of 50−100 points" (Office of the National Economic and Social Development Council, 2016).

Classroom action research competency is essential for the students of teaching profession program regarding the National Act of Education in 1999 Part 4 Section 30. The major aim of the national act is to improve an instructional process and teacher competency development in both basic education and higher education

institutions. Moreover, Teacher's Council of Thailand emphasizes research for educational development, one of eleven educational standards of the Teacher Council of Thailand, which is one of the educational developments (Prachagool et al., 2016).

Therefore, the teaching profession program has assigned a core course of research for learning development and the research skill is one of the major indicators for the students of the teaching profession program when they do practical training experiences. The previous study showed that most of the students of the teaching profession program have no knowledge and skills of classroom action research; consequently, the students have copied other research on the teaching profession when they did practical training experience. The researchers trust the data analyzed by the statistical procedure more than analysis of the problems for appropriate and efficient solutions (Slessarev et al., 2015).

Attitude towards research conduction is one major factor for the achievement, satisfaction and trends of research conduction and happy learning. It is related closely, which the aptitude is similar to motivation for driving to do something. Developing teaching methodologies is an important process for educational management in the 21st century. The teachers are key people to design appropriate learning activities and teaching materials by self-study, facilitate, transfer, and access knowledge through modern technology in the classroom (Dostal et al., 2017; Nuangchalerm et al., 2020). Teaching methodologies are important for intellectual and thinking skill development of the students. Therefore, the teachers should employ appropriate teaching methodologies and strategies for the mental and physical development of the students based on problems and needs of learners for self-study through student-centered instruction.

STEM Education is currently a useful teaching methodology through interdisciplinary integration with Science (S), Technology (T), Engineering (E) and Mathematics (M). The strength of STEM education is an appropriate integration of four main areas for learning management and problem solutions at present (Baharin et al., 2018; Holmlund et al., 2018; National Academies of Sciences, Engineering, and Medicine, 2018). The students are able to apply the knowledge for making a decision and solving problems in their daily life (Tomovic et al., 2017). Additionally, STEM education management provides the students with intellectual, skill and required quality improvement. It is obvious that the students get and apply the knowledge appropriately for specific purposes (McComas & Burgin, 2020; Suebsing & Nuangchalerm, 2021).

The learning management of research courses for learner development enhances them to have the knowledge, research competency, and a good research attitude; it also needs to develop students' emotional intelligence to be able to happily live with their peers and others in society. Therefore, in this research, the researcher has conducted a study on the development of emotional, attitude, and classroom action research competency conduction through STEM education of undergraduate students in order to develop students to master characteristics that are consistent with education management in the 21st century.

2. Method

2.1 Sample

The sample group included undergraduate students, Maha Sarakham Rajabhat University, who enrolled in research courses for learning development in the second semester of the academic year 2017. One group included 24 students in Chemistry, selected by a Simple Random Sampling from 9 groups of students. All groups of students have never studied this subject before, and their research competency is not significantly different.

2.2 Research Instrument

1) Four lesson plans of STEM education and four skill practice of research skills for 56 hours of 14 weeks, 4 hours a week, focusing on four areas: research design, instrument construction and quality assessment, analysis and conclusion of classroom action research and research writing. The researcher examined the appropriateness of the lesson plans and skill practice by proposing 3 experts for consideration. It was found that the appropriateness was at a high level.

2) Two sets of forty items of an achievement test consisting of thirty-five (5)-multiple-choice of subjective test and four (4) items of objective test

3) A 5-point-rating-scale assessment form of classroom action research competency of Likert consisting of four areas: eight items of research design, six items of instrument construction and quality assessment, six items of analysis and conclusion of classroom action research, seven items of research writing based on 0.44–0.75 discrimination indices and a 0.92 reliability index of Cronbach.

4) Thirty-five items of A 5-point-rating-scale assessment form of Likert for emotional quotient consisting of five areas: 1) Self-awareness, 2) emotional control, 3) motivation, 4) awareness of other emotions and 5) social skills based on 0.36–0.71 discrimination indices and a .94 reliability index of Cronbach.

5) Fifteen items of A 5-point-rating-scale assessment form of Likert for attitude toward research conduction based on 0.51–0.82 discrimination indices and a .95 reliability index of Cronbach at the .05 level of statistical significance.

2.3 Data Collection

1) The author explained a course description and teaching guidelines of "Research for Learning Development".

2) According to the planned learning management plan, the researcher conducted STEM education, four plans for research courses for learning development, and four sets of skill practice exercises, lasting 14 weeks and 4 hours each. The total hours were 56 hours, as shown in Table 1.

Table 1. Learning detailed plan of STEM education

Weeks	skill practice	Subject	Hours
1–4	1	Research Design	16
5–8	2	Instrument Construction and Quality Assessment	16
9–11	3	Analysis and Conclusion of Classroom Action Research	12
12–14	4	Research Writing	12

3) The achievement test was used to assess the classroom action research competency of the experimental students after implementing the lesson plans

4) The assessment form was used to assess the emotional quotient and attitude toward research conduction of the students.

2.4 Data Analysis

1) the efficiency of lesson plans for STEM education of the processing performances (E_1) and the performance results (E_2) by percentage, mean and standard deviation.

2) Compare emotional, attitude, and classroom action research competency conduction of undergraduate students before and after implementing STEM education by Hotelling T^2. The statistical tool employed is a multivariate method that is the multivariate counterpart of Student's t, which also forms the basis for certain multivariate control charts based on Hotelling's T^2 distribution (Hotelling, 1947).

3. Results & Discussion

1) The efficiency of the STEM lesson plans for undergraduate students' processing performances was 87.12 percent, and the performance results were 74.17 percent (87.12/74.17), meeting the set criteria of 75/75 as showed in Table 2.

Table 2. The efficiency of the lesson plans for STEM education management

Statistic	Processing Performance					Performance Results
	research design (50)	instrument construction and quality assessment (60)	analysis and conclusion of classroom action research (55)	research writing (60)	Total (225)	Post test (40)
Mean	38.53	57.71	45.96	53.83	196.03	29.67
SD	3.04	4.05	2.46	2.73	6.48	5.32
Percentage	77.06	96.18	83.56	89.72	87.12	74.17

The research results showed that the efficiency of the lesson plans for STEM education management was 87.12/74.17. The efficiency of the lesson plans was indicated by 87.12% of the on-going assessment score (E1) and 74.17% of the post-test score (E2) of the students. The post-test score was less than the on-going assessment score about .83%. The efficiency of the lesson plans was in the standardized criteria based on ±2.5% of the criteria. The results asserted that the lesson plans for STEM education management was practical and appropriate for learning management of the students of the teaching profession program. The findings revealed that knowledge, intellectual skills and interrelationship skills and responsibility, analytical skills of numbers,

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communication and technology application were appropriate practical application for the students of the teaching profession program. Moreover, the body of knowledge was created through the learning process of STEM education (Theobald & Freeman, 2014; Tekerek & Karakaya, 2018; Uğraş & Genç, 2018).

2) The emotional quotient and attitude of the students towards research conduction after implementing the lesson plans of STEM education was significantly higher than before implementing the lesson plans at the .05 level as showed in Table 3.

Table 3. Comparison of classroom action research competency, emotional quotient and attitude toward research conduction

variables	Pre-test		Post-test		Hotelling's Trace				
	$\overline{X}$	S.D.	$\overline{X}$	S.D.	Value	F	Hypothesis df	Error df	Sig.
classroom action research competency	2.80	0.53	4.28	0.28	3.31	48.59	3.00	44.00	.00
attitude toward research	3.36	0.38	4.11	0.37					
emotional quotient	3.76	0.31	4.15	0.36					

The emotional, attitude toward research and classroom action research competency conduction after implementing the lesson plans for STEM education management were significantly higher than before implementing the lesson plans at the .05 level. The results were presented and discussed as follows. The classroom action research competency of the students was higher than before implementing the lesson plans. The results may be caused by the various learning activities and exercises designed by the author for practical application of classroom action research of the students. Prasertsang and Nuangchalerm (2018) stated that the learning activities of STEM education management should be various and the activities should provide the opportunities the learners to share learning experiences and find problem solution especially through project-based learning management in particularly. Additionally, the exercises focused on applying theories to action.

The results were consistent with the concepts of the Institute for the Promotion of Teaching Science and Technology (2014, pp. 17−20), which suggests that the examples of exercises or assignments should be proposed and concerned with their daily life, and the students should be provided the opportunity to practice and solve the problems by using their advance thinking skills. It was obvious that the principles of STEM education focused on applying their knowledge to solve the problems. As a result, the classroom action research competency of the students was higher than before implementing the lesson plans. The average level of the emotional quotient of the students was higher than before implementing the lesson plans of STEM education management. The results were identified by self-awareness, consciousness, cause identification, change of self-emotion, emotional management, emotional condition, self-habit, providing benefits for all, motivation for creation, interpersonal relations, empathy and maintaining of emotional balance (Rice et al., 2019).

The STEM education management provided the students with both individual work and group work on classroom action research. As a result, the collaborative learning of STEM education improved interpersonal relations and stimulated the students to acquire and test knowledge by using logical skills, study skills and teamwork skills (Hussin et al., 2019).

Additionally, STEM education improved social skills, multicultural understanding, efficiency and responsibility and leadership. STEM education management based on social constructivism theory focused on getting knowledge through social interaction and interpersonal interaction by using learning activities or worksheets (Changtong et al., 2020). STEM education, also, provided the students with mental development, experiences relating to their daily life, life skill development, acquisition of knowledge, thinking skills, knowledge management, creating new knowledge and work skills (Daugherty & Carter, 2018). Therefore, the emotional quotient of the students was higher than before implementing the lesson plans of STEM education.

The average level of the attitude of the students toward research conduction was higher significantly than before implementing the lesson plans of STEM education. The results may be caused by the clear steps of individual and group works on classroom action research and on-going learning activities which focused on practicing and interpersonal assistance. It can be dicussed that STEM education can fullfil the students' competencies and related necessary learning skilss.

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4. Suggestions

4.1 Suggestions for Practical Application

1) Learning activities of STEM education with exercises were designed appropriately for the students to practice and develop research skills of the students. However, the useful advice, questions and rewards are important for the students.

2) The classroom action research competency test should focus the application of their knowledge of Bloom rather than memorization.

4.2 Suggestions for Further Study

1) STEM education management should be employed for other subjects.

2) Research of STEM education should focus other variables such as problem-solving competency and teamwork skills.

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