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ENCOURAGEMENT OF STUDENTS' LEARNING ACHIEVEMENTS AND THEIR ATTITUDES TOWARDS SCIENCE THROUGH THE STEM EDUCATION INSTRUCTIONAL METHOD IN SCIENCE CLASS AT THE 9TH GRADE LEVEL

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Abstract:
To investigate the encouragement of students' learning achievements and their attitudes towards science through the STEM education instructional method in science classes at the 9th grade level was to develop learning management with the STEM education instructional method on *Electrical Circuit Connection and Ohm's Law Issue* in science class of secondary students at the 9th grade level to be effective process and result (E1/E2) according to criteria effectiveness of 75/75, students' learning achievements of their posttest assessment of their attitudes towards science and the 75-percent criterion with the STEM Education instructional method were compared, which were the main of research objectives with a sample of 35 secondary students in Watsratong Municipal School under Roi-Et Municipality Province in the second semester of the academic year 2016 with the purposive sampling technique were selected. Using the *Innovative Instructional Lesson Plan* (IILP) through the STEM education instructional method obtained at the Strand 8: Nature of Science and Technology, Standard SC 8.1: Electric and Electronics was administered. Students' learning achievements were assessed with the 30-item *Learning Achievement Test* (LAT) that it had the discriminative value ranged from 0.60 to 1.00, with a 0.88 confidence interval. Students' perceptions of their attitudes toward science were assessed with the Test Of Scène-Related Attitude (TOSRA) that obtained of 8 items and the Cronbach

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alpha reliability of the TOSRA was 0.82. The results of these findings have found that: The E1/E2 efficiency was 77.55/76.19, which is higher than the standard set of 75/75 performance criteria. Comparisons between students' learning achievements of their post LAT and the 75-percent criterion was 76.19% ($\bar{X}$ = 22.85, $S.D.$= 2.01) and the mean scores of LAT and the 75-percent was differentiated at .05 levels, significantly. Students' perceptions of their attitudes towards science with the TOSRA indicated that a highest level ($\bar{X}$ = 4.51, $S.D.$= 0.56) and associations between students' learning achievements and their attitudes toward science revealed that are positive relatively, significantly.

Keywords: encouragement, students' learning achievements, science attitudes, stem education, instructional method, science class

1. Introduction

Assessment itself is not value- free and many of the assessment processes that are used in schools actually support ways of assessing understanding that students do (Hildebrand, 1996). Especially in subjects such as Science fields of knowledge can be distorted by generating a catalogue of facts for students to recall and presenting science as if it is possible to produce absolutely objective truths, pretending that a scientific method exists when most real scientists are funded by politically driven sources, and teaching with the expectation that only a super intelligent elite can ever understand science's concepts (Kellaghan & Greaney, 1996). Monitoring learning achievement means assessing the knowledge, skills, and attitudes/ values students have gained. Testing the success and validity of didactic programs at the pre-college and college levels is an important and promising line of research in science education. Through the comparison between pre-test and post-test performances, we can detect learning achievements of students after the didactic interventions, by specifically measuring students' knowledge acquisition, possible changes in their attitude, as well as the degree of correction of previous misinformation (Ingram & Nelson, 2006; Murray et al., 1996). Such an approach is particularly needed when new and original educational projects – in particular when implying extracurricular scientific subjects and novel teaching strategies – are to be promoted (Falchetti, 2012; Quitadamo et al., 2008; Ryu & Sandoval, 2012; Smith & Reiser, 2005).

Student encouragement, described as the tendency to be behaviorally, emotionally, and cognitively involved in academic activities, is a key construct in encouragement research (Thijs & Verkuyten, 2009). Consequently, compared to less engaged peers, encouraged students demonstrate more effort, experience more positive emotions and pay more attention in the classroom (Fredricks, Blumenfeld, & Paris, 2004). Further, encouragement has also been associated with positive student outcomes,

including higher grades and decreased dropouts (Connell, Spencer, & Aber, 1994). Teachers play a vital role in their students' encouragement (Hill & Rowe, 1996). Although much is intrinsic to the student, research has found that teacher's play a vital role on their students' encouragement. Specifically, Martin (2006) found that a teacher's enjoyment and confidence in teaching, pedagogical efficacy, and affective orientations in the classroom have a positive impact on students' encouragement of their learning achievements. Teacher creates educational experiences for students that are challenging and enriching and that extend their academic abilities. Easy learning activities and assignments are not as effective at engaging students as activities and assignments that challenge them. When students are reflecting, questioning, conjecturing, evaluating, and making connections between ideas, they are encouraged. Teachers must create rich educational experiences that challenge students' ideas and stretch them as far as they can go (Zepke & Leach, 2010). Keeping up with the educational research through involvement in professional development activities is a key for teachers to remain current in the field using effective, research-based strategies, and techniques. Teacher who as research team was designed the enjoyment and confidence in teaching have been shown to positively impact their affective orientation towards their students; resulting in increased students' encouragement of their learning achievements and have found that students who believe their teacher is caring also believe they learn more. Further, positive relationships with teachers predict enhanced social, cognitive, and language development in younger children to encourage of students' learning achievements in science class with the STEM education instructional method was designed of their learning activities.

The investigation of students' attitudes towards studying science has been a substantive feature of the work of the science education research community for the past 30–40 years. Its current importance is emphasized by the now mounting evidence of a decline in the interest of young people in pursuing scientific careers (Department for Education 1994). Consequently, the promotion of favourable attitudes towards science, scientists and learning science, which has always been a component of science education, is increasingly a matter of concern. However, the concept of an attitude towards science is somewhat nebulous, often poorly articulated and not well understood. This research study offers, therefore, a review of current knowledge about attitudes towards science, what influences there are on their formation, and their impact on subject choice. Using the short version of the *Test of Science Related Attitudes* (TOSRA) (Fraser, 1981; Santiboon and Fisher, 2005) that it used to assesses science-related attitudes along seven dimensions: social implications of science, normality of scientists, attitude toward scientific inquiry, adoption of scientific attitudes, enjoyment of science lessons, leisure interest in science, & career interest in science (Fraser, 1981). Fraser developed the survey to measure seven science related attitudes among secondary

school students. Fraser based his design on the early work of Klopfer (1971). In his classification system, Klopfer's first scale was called "*Manifestation of favorable attitudes towards science and scientists."* The TOSRA was used to associate student outcomes and the classroom-learning environment, particularly to add the measure of students' attitudes towards science and achievement. This research study references the extensive of Santiboon and Fisher's work that it was shown high reliability results for modifying version from the origin was all measured to assess changes in students' attitudes toward science and science related physics content issues**,** because of participating in physics classes with the instructional management between STEM education method were associated.

Focused on Science, Technology, Engineering and Mathematics or STEM is vital for manpower development and technology and innovation enhancement, which can elevate economic status of Thailand from middle income group to higher level. Thus, encouraging young generation to pay attention on STEM is considered very essential. STEM education is a learning approach focusing on an integration of science, technology, engineering, and mathematics knowledge. It emphasizes real life problem solving with an aim to enhance students' experience, skill, creativity, and preparedness to apply scientific, mathematical, and technological know-how, which leads to innovative development in the future. Its teaching styles are fun and beneficial for future career. STEM education helps develop manpower with problem solving skill, creativity, and ability to invent innovation. Therefore, it is the key foundation of innovative skill development and important mechanics of national economic enhancement. It can also contribute to knowledge linkage between work and life (The Promotion of Teaching Science and Technology (IPST) (2016).

Schools do not have enough science classroom/labs. For some strange reason the number of science rooms is typically based on an enrollment that almost never incorporates an adequate number of science rooms. One problem is that most of the current science classroom/labs are too small. One thing science teachers can do is to clean up and organize the science materials already in the science room and science storerooms. Free up space by clearing out the shelves and drawers of items that can be collected from students each year such as plastic jugs, toilet paper rolls, etc. Another thing would be to schedule an appointment with principal for a tour of a science room and science storerooms. Well-designed science learning spaces must include enough room to perform laboratory experiments, investigations, and sense making, but they also must include enough room to safely store all of the laboratory equipment and consumables, as "*Form must follow function. The design of the science facilities can either enhance or impede effective science instruction*." (Johnson, 2014).

From the context of this basic core, curriculum problem of learning management in science classroom in physics course is integrated. The problem of achievement of

learning management at source has been achieved as low. The Institute the Promotion of Teaching Science and Technology (IPST) has been trying to solve the problems of learning management model with the integration of science education, this is just the beginning. Although there are eight centers, eight centers are located in different parts of the country (Ministry of Education, 2015). In terms of the *Learning Standards and Indicators* in science learning area, the learning standards serve as the goals in developing learners' quality, monitoring for internal quality assurance is essential, as it indicates the extent of success in achieving the quality as prescribed in the pertinent standards. Indicators specify what learners should know and be able to perform as well as their characteristics for each grade level, indicators reflect the learning standards with the eights strands with the thirteen science standards. In the context of physics contents, they are obtained in the Strand 8: Nature of Science and Technology, SC8.1 was selected in this research study that composed on was selected on *Electrical Circuit and Ohm's Law Issue* with the instructional management between STEM education method was instructional design for secondary students at the 9th grade level.

This research study was checked by education experts maintain that one of the most effective ways to make a lesson stick is to involve the students directly. This is why research team often sees student skits or mock trials. These hands-on activities can help transform a lesson into an experience. Based on the above-mentioned concept, the researchers adopted a STEM Education teaching model to provide academic capacity for learning and promoting scientific creativity in science laboratories of the enable learners to be productive and skilled in their thinking processes. As a result, students learning achievement with the instructional management between STEM education method is designed of the innovative lesson plan. Thus, the model of STEM Education teaching and learning was integrated into the model of science experiment of the upper secondary students at the 9th grade level at Watsratong Municipal School under Roi-Et Municipality, and Ministry of the Interior in Thailand is the context of research limitation in this study.

2. Methodology

The processes of ๓ research methodology, which instruction is improved through the analysis of learning needs and systematic development of learning experiences; the instructional designers often use technology and multimedia as tools to enhance instruction. It is designed to provide information about *instructional design* principles and how they relate to teaching and learning. Instructional design or instructional systems design that is the analysis of learning needs and systematic development of instruction was created. The effective instructional designers are also familiar with a wide range of educational technology that can be used for delivering learning

experiences. Instructional design model provide a method, that if followed will facilitate the transfer of knowledge, skills and attitude to the learner. Presenting content in a simple, meaningful way is the art of good instructional design. Researcher team was increasingly seeing an emphasis on STEM integration in lower secondary science school classroom such that students would learn and apply relevant math and science content while simultaneously developing engineering habits of mind. However, research in both science education and engineering education suggests that this goal of truly integrating STEM is rife with challenges. To compare between students' learning achievements and their attitude toward science were assessed, students' performances of their posttest assessment and their criteria standardized value science were compared. The research methodology was following as:

2.1 Research Aims

1. To develop learning management in the form of the STEM education instructional method on electrical circuit and Ohm's law issue in science class of secondary students at the 9th grade level on the efficiency of the process and results (E1/E2) with the standardized criteria value to be effectiveness at the level of 75/75.
2. To compare between students' learning achievements of their posttest assessment and the standardized level with a 75% threshold using the learning management through the STEM education instructional method in science class on electrical circuits and Ohm's law of secondary students at the 9th grade level.
3. To associate between students' attitudes toward science and the standardized level with a 75% threshold using the learning management through the STEM education instructional method in science class on electrical circuits and Ohm's law of secondary students at the 9th grade level.

2.3 Target Group

The target group consisted of 35 lower secondary students at the 9th grade level in science class from Watsratong Municipal School under Roi-Et Municipality, and Ministry of the Interior in Thailand with the purposive sampling technique.

2.4 Research Instruments

The aims of this research study were to develop the instructional innovation for encouraging students' learning achievements and their attitudes towards science through the STEM education instructional method in science class at the 9th grade level**.** Research team was created the research instruments were assessed students' learning achievements and their attitudes toward science that list name research instruments included as:

A. The Instructional Innovative Lesson Plan (IILP)

Selected the Strand 8: Nature of Science and Technology, and SC8.1: was selected in this research study that composed on was selected on *Electrical Circuit and Ohm's Law Issue* with the instructional management STEM education method was instructional design for secondary students at the 9th grade level. The *Instructional Innovative Lesson Plan* (IILP) was obtained of an one main IILP in 7 topics, such as; Identify the problems of learning management, learning about electrical circuits and Ohm's law, Ohm's law, Electrical Power and Energy, Electrical Circuit, Light emitting diode: LED, planning and development, and evaluation.

B. The Learning Achievement Test (LAT)

Investigations of curriculum, content, objectives, expected learning outcomes, and lesson plans were created the *Learning Achievement Test* (LAT) were assessed students' learning achievements of their pretest and posttest designs. The LAT was tried out with another sample group and proved by the professional experts. The 30-item *Leaning Achievement Test* (LAT) on *Electrical Circuit and Ohm's Law Issue* Projectile was created by the researcher team of 30 optional items in 4 multiple choice options was assessed.

C. The Test of Science-Related Attitudes (TOSRA)

The original of the *Test of Science-Related Attitudes* (TOSRA) was assessed science-related attitudes along seven dimensions: social implications of science, normality of scientists, attitude toward scientific inquiry, adoption of scientific attitudes, enjoyment of science lessons, leisure interest in science, & career interest in science and obtained of 70 items (Fraser, 1981). The term "attitude" is very common and popular in daily life. Everyone has given it its own meanings, concepts and definitions. An aim of this study was to explore the psychometric attitudes of the *Test of Science-Related Attitude* (TOSRA) to adapt to the Thai version that it obtained of 21 items (Santiboon & Fisher, 2005) was assessed students' perceptions of their attitudes toward science.

2.5 Research Procedures

To encourage of students' learning achievements and their attitudes towards science through the STEM education instructional method in science class at the 9th grade level. Researcher team had designed in four steps of research procedures that followed as:

Step I: Created the Lesson Plan of the Instructional Innovation with the STEM Education

The innovative instructional strategies combined with the STEM education was created and designed on 1 main lesson instructional plan to 5 learning activities in 12 hours. *Identify the problems of learning management, learning about electrical circuits and Ohm's law, Ohm's law, Electrical Power and Energy, Electrical Circuit, Light emitting diode: LED, planning and development, and evaluation* were designed.

Step II: the Quality of an Instructional Innovation of the STEM Education was Checked

Using the instructional innovation with the STEM education was checked by the advisors and the professional experts with the *Index of Item Objective Congruence* (IOC*)*. Researcher team was selected the STEM education that it had the high quality of appropriability, only.

Step III: Created the Learning Achievement Test (LAT)

Investigations of curriculum, content, objectives, expected learning outcomes, and lesson plans were created the *Learning Achievement Test* (LAT) were assessed students' learning achievements of their pretest and posttest designs. The LAT was tried out with another sample group and proved by the professional experts. The 30-item *Leaning Achievement Test* (LAT) on Electrical Circuits and Ohm's Law Issue was created by the researcher team of 30 optional items in 4 multiple choice options was assessed.

Step IV: Modified the Test of Science-Related Attitude (TOSRA)

An aim of this study was to explore the psychometric attitudes of the short version of the *Test of Science-Related Attitude* (TOSRA) to adapt to the Thai version that it obtained of 8 items (Santiboon and Fisher, 2005) was assessed students' perceptions of their attitudes toward science in science class.

2.6 Data Analysis

The foundational statistic with percentage, mean, standard deviation for analyzing the basically data was examined. The validity and reliability of research instruments were assessed with internal consistency Cronbach alpha reliability. Statistically significant was differentiated data to compare with the independent variable t-test. Associations between students' learning achievements of their posttest outcomes to their attitudes toward science and the threshold set at 75% with simple and multiple correlations, standardized regression weight abilities and the coefficient predictive value (R^2) were used.

3. Results

This research study focused on the encouragement of students' learning achievements and their attitudes towards science through the STEM education instructional method in science class at the 9th grade level. Because STEM instruction and outcomes are going to look different at the secondary level than they do at the collegiate level, and not just in the expectations and depth of knowledge**.** The focused on this research study was assessed students' critical thinking abilities and their attitudes toward science for

enhancing their learning achievements through the instructional approaching management with the STEM education instructional method of secondary students at the 9th grade level in the three main topics that followed as:

3.1 Validity of Research Instruments

A. The IOC Value of the STEM Education Innovative Instructional Lesson Plan

The STEM education innovative instructional lesson plan was created learning plan offers the counselor to verify the content validity for students' learning activities, teaching materials, and evaluation in the learning management plan was corrected as suggested by the advisors and the 5-professional experts with the were reviewed and assessed the validity of content, purpose learning with the IOC value (*Index of Item Objective Congruence*), the acceptable accuracy must have scoring scale ranged from 0.50 to 1.00. It appears that the research plan developed by the researcher has an average of 4.81, and the total confidence validity value was 0.88; it means as in the most appropriate the highest quality level.

B. Validations of the Leaning Achievement Test (LAT)

The 30-item *Leaning Achievement Test* (LAT) on Electrical Circuits and Ohm's Law Issue was created by the researcher team of 30 optional items in 4 multiple choice options was assessed of student' learning achievements of their pretest and posttest assessments. Use the LAT scores to analyze the difficulty (p) and the discriminant power (r), and select the difficult test ranged from 3.60 to 4.80, evidently. The LAT tests came to the full confidence level; the total confidence validated value was 0.88.

C. Validity of the Test of Science-Related Attitude (TOSRA)

Internal consistency (Cronbach alpha coefficient) and the mean correlation were obtained for sample in this present study as indicates of scale reliability for the 8-item *Test of Science-Related Attitude* (TOSRA) that it has 5 optional components and the five response alternatives are: *Almost Never, Seldom, Sometimes, Often* and *Very Often*. The Cronbach alpha reliability indicated was 0.82 and students' responses of their perceptions with the TOSRA revealed at a high level ($\overline{X}$ = 4.51, S.D. = 0.56).

D. The Effectiveness of the STEM Education Innovative Instructional Lesson Plan

To analyze the effectiveness of the innovative instructional lesson plans based on the model of learning management in the STEM Education Method of secondary students at the 10th grade level in physics class with the processing and performance resulting effectiveness at 75/75 criteria. Table 1 reports of the effectiveness of the innovative instructional lesson plan.

Table 1: Score Total, Mean, Standard Deviation, and Percentage for the Effectiveness Innovative Instructional Lesson Plans for the STEM Education Method

Efficiency Type	Total Score	$\overline{X}$	S.D.	Percentage
Efficiency Performance Processes (E1)	90	69.80	2.77	77.55
Efficiency Performance Results (E2)	30	22.85	2.01	76.19
The Lessoning Effectiveness (E1/E2) = 77.55/76.19				

Table I shows the result for the effectiveness of the innovative instructional lesson plans based on the model of learning management in a STEM Education Method. Effectiveness of lessons during the learning process (E1) reveals of 77.55 and the performance effectiveness (E2) indicate that of 76.19, so the lessoning effectiveness (E1/E2) evidences of 77.55/76.19 over the threshold setting is 75/75.

3.2 Comparisons between Students' Posttest Learning Achievements and the Criteria Learning Outcomes at the Level of 75% with the STEM Education Instructional Method

Students' learning outcomes of their posttest assessments, the average mean scores of the LAT with the 30-item *Leaning Achievement Test* (LAT) was assessed and the criteria learning outcomes at 75% were compared. Students' responses of their scientific process skill test indicated that an average mean score ($\overline{X}$) = 22.85, Standard deviation S.D. = 2.01, and Percentage of average score = 76.19. The organizing learning activities in STEM education with a criterion of 75% threshold were compared. Table 2 reports of the relationships between students' scientific process skills and the criterion of 75% threshold.

Table 2: The Mean, Standard Deviation, Total Score, the Criteria Score of 75%, Mean Different, and Independent Variable t-test for the STEM Education Method

Students' Number	Total Score	Criteria Score 75%	Mean	S.D.	df	t-test	Sig. (p)
35	30	22.50	22.85	2.01	34	0.41***	.000***

In Table 2 reported that the comparisons of mean scores on students' learning outcomes of their posttest assessments that organizing learning activities in STEM education with a criterion of 75 percent threshold were compared at the 9th grade level with 75% of the 35 students when analyzing the difference using t-test statistics (One-Way ANOVA), it was found that the *t*-test indicated that was 0.41 and statistically significant at the level of .001, differently.

3.3 Comparisons between Students' Perceptions of their Attitudes toward Science and the Criteria Learning Outcomes at 75% with the STEM Education Instructional Method

Using the average means scores of students' perceptions of their attitudes toward science with the TOSRA and the criteria learning outcomes at 75% were compared. Students' responses of their perceptions of their attitudes toward science indicated that an average mean score ($\overline{X}$) = 4.51, Standard deviation S.D. = 0.56. The organizing learning activities in STEM education with a criterion of 75% threshold were compared. Table 3 reports of the relationships between students' perceptions of their attitudes toward science and the criterion of 75% threshold.

Table 3: The Mean, Standard Deviation, Total Score, the Criteria Score of 75%, Mean Different, and Independent Variable t-test for the STEM Education Method

Students' Number	Total Score	Criteria Score 75%	Mean	S.D.	df	t-test	Sig. (p)
35	5.00	3.75	4.51	0.56	34	1.98***	.000***

In Table 3 reported that the comparisons of mean scores on students' perceptions of their attitudes toward science with the TOSRA and the criteria learning outcomes at 75% were compared in STEM education with a criterion of 75% threshold were compared at the 9th grade level with 75% of the 35 students when analyzing the difference using *t*-test statistics (One-Way ANOVA), it was found that the *t*-test indicated that was 1.98 and statistically significant at the level of .001, differently.

3.4 Associations between Students' Learning Achievements of their Posttest Assessment (LAT) and their Perceptions of their Attitudes toward Science with the TOSRA in the Innovative STEM Education Instructional Method

Given the potential for students' learning achievements of their posttest assessment to their scientific process skills with the innovative instructional lesson plans based on the model of learning management in the STEM Education Method in physics class. Correlation's studies identified significant relationships were also considered important to investigate associations that involved simple correlation and multiple regression analyses of relationships as a whole reported in Table 4.

Table 4: Associations between Students' Posttest Achievements for the LAT and their TOSRA in Term of Simple Correlation (r), Multiple Correlations (R) and Standardized Regression Coefficient (β)

Variables	Mean ($\overline{X}$)	S.D.	Simple Correlation (r)	Standardized Regression Validity (β)	Multiple Correlation (R)	Efficiency Predictive Value (R^2)
Posttest Assessment (LAT)	22.85	2.01	0.45***	0.61***	0.7812***	0.6102***
TOSRA	4.51	0.56				

*N = 33, *ρ < 0.05, **ρ < 0.01, ***ρ < 0.001*

Simple correlation and multiple regressions analyses were conducted to examine whether associations exists between students' learning achievements of their posttest assessment to their perceptions of their creative thinking abilities with the innovative instructional lesson plans based on the model of learning management in a STEM Education Method. Table 4 shows the correlations between posttest assessment (LAT) and towards physics. The TOSRA attitudes toward science were relative significantly, when using a simple correlation analysis (r) and standardized regression validity (β). The multiple correlations (R) was 0.7812 and the predictive efficiency (R^2) value indicated that 61% of the variances in students' attitudes toward science to their science class was attributable to their post learning achievement in their science. The coefficient of determination denoted R^2 is a number that indicates the proportion of the variance in the dependent variable (LAT) that is predictable from the independent variable (TOSRA). It provides a measure of how well observed outcomes are replicated by the STEM education method, based on the proportion of total variation of students' learning outcomes explained by the STEM Education instructional method.

4. Conclusions

This research study was to encourage of students' learning achievements and their attitudes towards science through the STEM education instructional method in science class at the 9th grade level investigated to develop learning management with the STEM education instructional method on *Electrical Circuit Connection and Ohm's Law Issue* in science class of secondary students at the 9th grade level to be effective process and result (E1/E2) according to criteria effectiveness of 75/75, students' learning achievements of their posttest assessment of their attitudes towards science and the 75-percent criterion with the STEM Education instructional method were compared, which were the main of research objectives with a sample of 35 secondary students in Watsratong Municipal School under Roi-Et Municipality Province in the second

semester of the academic year 2016 with the purposive sampling technique were selected. Using the *Innovative Instructional Lesson Plan* (IILP) through the STEM education instructional method obtained at the Strand 8: Nature of Science and Technology, Standard SC 8.1: Electric and Electronics was administered. Students' learning achievements were assessed with the 30-item *Learning Achievement Test* (LAT). Students' perceptions of their attitudes toward science were assessed with the Test Of Scène-Related Attitude (TOSRA).

In terms of the validity of the research instruments, the IOC value of the STEM education innovative instructional lesson plan to verify the content validity for students' learning activities, teaching materials, and evaluation in the learning management plan was corrected as suggested by the advisors and the 5-professional experts with the were reviewed and assessed the validity of content, purpose learning with the IOC value (*Index of Item Objective Congruence*), the acceptable accuracy must have scoring scale ranged from 0.50 to 1.00. It appears that the research plan developed by the researcher has an average of 4.81, and the total confidence validity value was 0.88; it means as in the most appropriate the highest quality level. The 30-item *Leaning Achievement Test* (LAT) scores to analyze the difficulty (p) and the discriminant power (r), and select the difficult test ranged from 3.60 to 4.80, evidently. The LAT tests came to the full confidence level; the total confidence validated value was 0.88. Internal consistency (Cronbach alpha coefficient) and the mean correlation were obtained for sample in this present study as indicates of scale reliability for the *Test of Science-Related Attitude* (TOSRA). The Cronbach alpha reliability indicated was 0.82 and students' responses of their perceptions with the TOSRA revealed at a high level ($\overline{X}$ = 4.51, S.D. = 0.56).

The effectiveness of the innovative instructional lesson plans based on the model of learning management in a STEM Education Method. Effectiveness of lessons during the learning process (E1) reveals of 77.55 and the performance effectiveness (E2) indicate that of 76.19, so the lessoning effectiveness (E1/E2) evidences of 77.55/76.19 over the threshold setting is 75/75.

Comparisons of mean scores between students' learning outcomes of their posttest assessments that organizing learning activities in STEM education with a criterion of 75 percent threshold were compared at the 9th grade level with 75% of the 35 students when analyzing the difference using t-test statistics (One-Way ANOVA), it was found that the *t*-test indicated that was 0.41 and statistically significant at the level of .001, differently.

Comparisons of mean scores on students' perceptions of their attitudes toward science with the TOSRA and the criteria learning outcomes at 75% were compared in STEM education with a criterion of 75% threshold were compared at the 9th grade level with 75% of the 35 students when analyzing the difference using *t*-test statistics (One-

Way ANOVA), it was found that the *t*-test indicated that was 1.98 and statistically significant at the level of .001, differently.

Associations between students' learning achievements of their posttest assessment (LAT) and their perceptions of their attitudes toward science with the TOSRA in the innovative STEM education instructional method were assessed. Simple correlation and multiple regressions analyses were conducted to examine whether associations exists between students' learning achievements of their posttest assessment to their perceptions of their creative thinking abilities with the innovative instructional lesson plans based on the model of learning management in a STEM Education Method. Table 4 shows the correlations between posttest assessment (LAT) and towards physics. The TOSRA attitudes toward science were relative significantly, when using a simple correlation analysis (r) and standardized regression validity (β). The multiple correlation (R) was 0.7812 and the predictive efficiency (R^2) value indicated that 61% of the variances in students' attitudes toward science to their science class was attributable to their post learning achievement in their science. The coefficient of determination denoted R^2 is a number that indicates the proportion of the variance in the dependent variable (LAT) that is predictable from the independent variable (TOSRA). It provides a measure of how well observed outcomes are replicated by the STEM education method, based on the proportion of total variation of students' learning outcomes explained by the STEM Education instructional method.

Suggestions that, the results of this research findings, overall, this lower secondary municipal school students show relatively favorable of their learning performances and activities with their learning management with the STEM education method for encouraging science attitudes and learning achievements of secondary students at the 9th grade level in science class of their own class has a moderately centralized education system and a context from the other countries, similarly.

5. Discussions

One of three research aim of this research study were to assess students' critical thinking abilities and science attitudes for enhancing their learning achievements through the instructional approaching management with the STEM education instructional method of secondary students at the 10th grade level. One way was to find the efficiency of teaching innovation based on the E1/E2 criteria set. The innovation is complete all whole of steps. The average percentage score obtained from the whole group's learning process is close to the average score obtained from the post-test. It should not have a value difference of more than 5%, generally. In this recent study, the innovative instructional lesson plans based on the model of learning management for the STEM Education Method. Effectiveness of lessons during the learning process (E1)

and the performance effectiveness (E2) revealed of 77.55/76.19. The results shows the finding of the E1/E2 indicates that of less than a value difference of *5*% from the set of standardized criteria of 75/75, significantly.

Science, Technology, Engineering, and Mathematics (STEM) education has emerged as one of the most sought after curriculum designs for integrating science, technology, engineering, and mathematics into secondary education. It first became popular as a means of serving the needs of mathematically gifted students, providing opportunities to both accelerate learning and increase the rigor and depth of learning. This combination afforded opportunities for motivated students to advance into special classes, including taking college classes in high school and receiving college credit for advanced classes taught during secondary school (Wai, Lubinski, Benbow, & Steiger, 2010). Empirical studies have concluded that course acceleration in itself is not a strong enough factor to improve individual learning; however, learning activities where students practice using integrated skills to solve problems allow for deeper and more meaningful student learning (Wai et al., 2010). Originally, STEM education was directed at highly talented students (especially in Mathematics) and highly motivated students who were interested in exploring and learning a greater depth of material at a faster pace to practice strong reasoning skills and to develop and strengthen learning. STEM education attracted a concentrated population until practices and methods were integrated into mainstream secondary education and seen as opportunities to provide equity for motivated but disadvantaged students from a variety of backgrounds. Thus, this research study has been established the resurgence for the science, technology, engineering, and mathematics (STEM) movement in education system in municipal school in Thailand. However, improvement of the emergence of STEM curriculum in the government public secondary educational system provides opportunities for all level learners to master skills and content important for 21st Century learning that responding to the government policy of education in the 4.0 era of the Thai government as well.

This research article describes various forms of the 30-item *Learning Achievement Test* (LAT) were assessed of their learning outcomes, and students' perceptions of their attitudes toward science were assessed with the 8-item *Test Of Science-Related Attitude* (TOSRA). These instruments are validated and reliability for using the future in this research study and report its use in this research; and examines associations between students' learning of their posttest outcomes and their perceptions of their perceptions of their attitudes toward science as assessed by the LAT and student attitude with the TOSRA. This study has confirmed the reliability and validity of the research instruments; the LAT and TOSRA when used in science class.

Comparisons of mean scores on students' learning achievements of their posttest assessments to their perceptions of their attitudes toward science with the LAT, TOSRA

and the criteria learning outcomes at 75% were compared in STEM education with a criterion of 75% threshold were compared at the 9th grade level with 75% of the 35 students when analyzing the difference using *t*-test statistics (One-Way ANOVA), it was found that the *t*-test indicated that was 1.98 and statistically significant at the level of .001, differently. Suggestions that, the predictive efficiency (R^2) value indicated that 61% of the variances in students' attitudes toward science to their science class was attributable to their post learning achievement in their science were relatively. The coefficient of determination denoted R^2 is a number that indicates the proportion of the variance in the dependent variable (LAT) that is predictable from the independent variable (TOSRA). It provides a measure of how well observed outcomes are replicated by the STEM education method, based on the proportion of total variation of students' learning outcomes explained by the STEM Education instructional method are encouraged of students' learning achievements and their attitudes towards science, significantly.

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