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LEARNING MANAGEMENT WITH THE STEM EDUCATION METHOD FOR ENCOURAGING SCIENCE PROCESS SKILLS AND LEARNING ACHIEVEMENTS OF SECONDARY STUDENTS AT THE 10TH GRADE LEVEL IN PHYSICS CLASS

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Abstract:
The aims of this research study focused on administrating the innovative instructional management model with the STEM Education in physics class on the Projectile Motion issue of secondary students at the 10th grade level to evaluate the efficiency of the process and the efficiency of the results (E1/E2) of the innovative instructional lesson plan with the efficiency at the determining criteria as 75/75, students' scientific process skills and the 75-percent criterion with the STEM Education method were compared, students' learning achievements of their post and their standardized assessments of the 75-percent criterion level were examined, association between students' scientific process skills and their post learning achievements were assessed. Research administrations, which a sample consisted of 33 secondary students in Watsratong Municipal School, in Roi-Et Province in the second semester of the academic year 2016 with the purposive sampling technique were selected. Assessments an innovative instructional lesson plan in the form of the STEM Education method in the field of physics on projectile motion issue was integrated. Research instruments were assessed with the 20-item Scientific Process Skill Test (SPST) that it was the 4-option multiple choice and the discriminative value (r) was ranged from 0.31 to 0.94, and with the confidence of both the 0.90 test achievement of four characters. Selecting the 30-item Learning Achievement Test (LAT) that it was the 4-option multiple choices, which deals of the discriminative value (r) was ranged from 0.27 to 0.80 and a confidence score of 0.92. The results of these findings have found and followed as: The E1/E2 efficiency was

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77.07/76.97, which is higher than the standard set of 75/75 performance criteria. Comparisons between students of their SPST and the 75-percent criterion was 77.10 (= 15.42, = 1.35) and the differences between mean score of SPST and the 75-percent was differentiated at .05 levels, significantly. Comparisons between students' learning achievements of their post LAT was 76.96 (= 23.09, = 1.91), and differences indicated at the .05 level, significantly. Associations between students' encouragements of their SPST and their post LAT, the coefficient predictive value indicated that 31% that was contributed to enhance the science process skills and the achievements and had a statistically significant at the .05 level (R2 = 0.3121, p<.05), relatively. The results reflect that learning management with the STEM education method for encouraging science process skills and learning achievements of secondary students at the 10th grade level in physics class are successful at a certain level in the context of this research framework.

Keywords: learning management, STEM education method, encouragement, science process skills, learning achievements, secondary students, physics class

1. Introduction

Thailand is a constitutional monarchy, with a bicameral parliament. King Rama IX has been head of state since 1946 and is responsible for appointing half of the members of the Senate (the other half are elected) on recommendation from the Senate Selection Commission, made up of both elected and appointed officials, and the Prime Minister who acts as the head of government. The lower house is democratically elected and is the primary legislative branch of the Thai government (World Education News & Reviews, 2014). Education in Thailand is provided mainly by the Thai government through the Ministry of Education from pre-school to upper secondary school. A free basic education of twelve years is guaranteed by the constitution, and a minimum of nine years' school attendance is mandatory. In 2009, the Ministry of Education announced the extension of a free, mandatory education to fifteen years (UNICEF, 2016). Formal education consists of at least twelve years of basic education, and higher education. Basic education is divided into six years of elementary education and six years of secondary education, the latter being further divided into three years of lower- and upper-secondary levels. Kindergarten levels of pre-elementary education, also part of the basic education level, span 2–3 years depending on the locale, and are variably provided. Non-formal education is also supported by the state. Independent schools contribute significantly to the general education infrastructure. Administration and control of public and private universities are carried out by the Office of Higher

Education Commission, a department of the Ministry of Education (Dumrongkiat, 2016).

The school structure is divided into four key stages: the first three years in elementary school, Prathom 1–3, are for age groups 7–9; the second level, Prathom 4 through 6 are for age groups 10–12; the third level, Matthayom 1–3, is for age groups 13–15. The upper secondary level of schooling consists of Matthayom 4–6 for age groups 16–18 and is divided into academic and vocational streams. There are academic upper secondary schools, vocational upper secondary schools and comprehensive schools offering academic and vocational tracks. Students who choose the academic stream usually intend to enter a university. Vocational schools offer programs that prepare students for employment or further studies. The academic year has traditionally run from May to March in the school sector and June to March in the tertiary sector, with two semesters per year (Ministry of Education, 2014).

Admission to an upper secondary school is through an entrance exam. On the completion of each level, students need to pass the NET (National Educational Test) to graduate. Children are required to attend six years of elementary school and at least the first three years of high school. Those who graduate from the sixth year of high school are candidates for two decisive tests: O-NET (Ordinary National Educational Test) and A-NET (Advanced National Educational Test). The school year is divided into two semesters. The general curriculum, which private schools must also follow, covers five main subject areas: Thai and foreign languages, science and mathematics, social studies, arts, vocational education. The general education curriculum includes five subject areas: Thai and foreign languages, science (chemistry, biology, and physics), mathematics, social studies, character development (health and physical education, arts and crafts), work and occupational education.

The O-NET is now weighted at 30 percent of the total score, while two new tests, the General Aptitude Test (GAT) – testing reasoning ability and English proficiency – and the Professional Aptitude Test (PAT) – similar to the subject-specific A-NET tests, account for 50 percent of the final admissions score. The remaining 20 percent is based on student GPA scores. Students take the O-NET one time, after they graduate upper secondary, but can take the GAT and PAT as many times as they like, beginning in the first year of upper secondary and with the highest score counting for admissions. The examinations are offered three times a year. According to a recent report from the British Council there were 128 collaborative degree programs' with international partners in 2011, relatively low compared to other countries in the region, and far fewer than large transnational education (TNE) hosts such as Malaysia and Singapore. The top five TNE partner countries in 2011 were China, USA, Germany, Australia and Canada, according to the British Council (World Education News & Reviews, 2014). The important thing to take into account is that Thai literacy scores from PISA scores on analytical reading were at a very low level. Moreover, the average in schools outside of Bangkok has stilled at level 0, especially the one that contains more than one paragraph, it is assumed of many students have reading problems affect other grades because students can't read the proposition to understand. Therefore, the Institute for the Promotion of Teaching Science and Technology (IPST) encourages science teachers to teach language skills and readings to students. Especially, reading the analytical proposition, but still failed of the problem, it all ties together. The course focuses on many subjects, lesser school hours exams focused on content, these are the conditions that make the teacher teach this, not the instructor, students do not want to be a good instructor but this is the context that directs the instructor to teach like this (Office of Social Promotion for Learning and Quality of Youth, 2012).

In terms of 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).

The National STEM Education Center is an agency under the supervision of the Institute for the Promotion of Teaching Science and Technology (IPST) which is operated by the board of directors headed by the director of IPST. There are 5 working groups in this center, which include 1) STEM awareness promotion 2) STEM education networking 3) Teacher capacity development for STEM integrated learning 4) STEM learning activity development and 5) STEM learning performance monitoring and supporting, that work together to drive STEM education and give support to the Regional STEM Education Center and school network. The support which is given by IPST consists of the media and exhibition to raise awareness and provide knowledge about STEM education, development curriculum for administrators, teachers, and provincial educational officers, trainer development and mentor network, and monitoring and evaluation system. The STEM education network in Thailand includes National STEM Education Center, Regional STEM Education Center, and STEM school network, which are main operational agencies. Apart from that, there are academic mentor network in universities, educational supervisor network, academic teaching mentor network, STEM ambassador network, STEM system, and STEM Hall of Fame that team up to support and drive STEM teaching and learning in schools throughout the Thailand country (The Promotion of Teaching Science and Technology (IPST) (2016).

In this current research study was to design in the instructional model for provide all the tools and strategies of this research study' plan to need to design integrated, interdisciplinary STEM lessons and units that are relevant and exciting to the target group students. With clear definitions of both STEM and STEM literacy, the authors argue that STEM in itself is not a curriculum, but rather a way of organizing and delivering instruction by weaving the four disciplines together in intentional ways. Rather than adding two new subjects to the curriculum, the engineering and technology practices can instead be blended into existing mathematics and science lessons in ways that engage students and help them master 21st century skills. STEM Innovative Lesson Plans of the essentials was built how to begin the STEM integration journey with: five guiding principles for effective STEM instruction, physics laboratory classroom environments were responded of what these principles look like in action of students' perceptions, sample activities that put all four STEM fields into practice, and lesson planning templates for STEM units were assessed by the professional expert educators were checked of their efficiency quality

Science and teaching students about science means more than scientific knowledge. There are three dimensions of science that are all important. The first of these is the content of science, the basic concepts, and our scientific knowledge. This is the dimension of science that most people first think about, and it is certainly very important. The other two important dimensions of science in addition to science knowledge are processes of doing science and scientific attitudes. The processes of doing science are the science process skills that scientists use in the process of doing science. Since science is about asking questions and finding answers to questions, these are actually the same skills that researcher team all use in our daily lives as teachers try to figure out everyday questions (Vitti, & Torres, 2006). When teachers teach students to use these skills in science, we are also teaching them skills that they will use in the future in every area of their lives. The third dimension of science focuses on the characteristic attitudes and dispositions of science. These include such things as being curious and imaginative, as well as being enthusiastic about asking questions and solving problems. Another desirable scientific attitude is a respect for the methods and values of science. These scientific methods and values include seeking to answer questions using some kind of evidence, recognizing the importance of rechecking data, and understanding that scientific knowledge and theories change over time as more information is gathered. The science process skills form the foundation for scientific methods. There are six basic science process skills: *Observation, Communication, Classification, Measurement, Inference*, and *Prediction* skills. These basic skills are integrated together when scientists design and carry out experiments or in everyday life when we all carry out fair test experiments. All the six basic skills are important individually as well as when they are integrated together (Rezba, Sprague, Fiel, Funk, Okey, & Jaus, 1995). This research study was modified of the *Teaching the Science Process Skills* from the Longwood University (2015) to the 20-item *Scientific Process Skill Test* (SPST) on six skills.

Moreover, problems regarding learners' ability to acquire essential knowledge, skills, capacities and desired characteristics were quite disconcerting (Bureau of Academic Affairs and Educational Standards, 2008). Furthermore, the new curriculum; the Basic Core Curriculum B.E. 2551 (A.D. 2008) and the Basic Core Curriculum B.E. 2558 (A.D. 2015) (Draft) has prescribed a structure of minimum time to be allotted to each subject area for each grade level. Schools are given opportunities to increase learning time allotment, depending on their readiness and priorities. Improvement has been made to the process of measuring and evaluating learners' performance as well as criteria for graduation at each educational level. Adjustment has also been made for streamlining certification which correlates with learning standards, thus facilitating application of certifying documents. 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 core, 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 at the Strand 4: Forces and Motion Standard SC4.1 and Standard SC4.2, and Strand 5: Energy Standard SC5.1. In this research, study was selected on the Strand 4: Forces and Motion Standard SC4.1 on Projectile Motion Issue with the instructional management between STEM education method was instructional design for secondary students at the 10^{th} grade level in this research study.

2. Research Methodology

Generally, the process by 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), is the analysis of learning needs and systematic development of instruction. Effective instructional designers are also familiar with a wide range of educational technology that can be used for delivering learning experiences. Instructional design models 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 upper secondary school classrooms 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 were assessed, students' performances of their posttest assessment and their science process skills were associated. The research methodology was following as:

3. Research Objectives

1. To evaluate the efficiency of the process and the efficiency of the results (E1 / E2) of the innovative instructional lesson plan in the form of the STEM Education method in the field of physics of secondary students at the 10^{th} grade level in physics class.
2. To compare between students' scientific process skills and the 75-percent criterion by using the innovative instructional management model with the STEM Education in physics course on the projectile motion issue of secondary students at the 10th grade level.
3. To compare between students' post learning achievements and the 75-percent criterion by using the innovative instructional management model with the STEM Education in physics course on the projectile motion issue of secondary students at the 10th grade level.
4. To associated between students' scientific process skills and their post learning achievements by using the innovative instructional management model with the

STEM Education in physics course on the projectile motion issue of secondary students at the 10th grade level.

4. Research Procedures

To develop the innovative instructional strategies combined with the STEM education for enhancing students' learning achievements and scientific process skills in physics class at the 10th grade level. Research team has been designed in five steps of research procedures that followed as:

Step I: Created the Lesson Plan of the Instructional Innovation with the STEMe
The innovative instructional strategies combined with the STEM education (STEMe) was created and designed on 1 main lesson instructional plan to 5 learning activities in 12 hours; *Principles of Knowledge, Meaning and Projectile Motion, Volume Statement Related to the Projectile Motion, Designing the STEMe Learning Activities on Tennis Ball Design*, and *Tennis Ball Shooting Machine* on STEM education instructional was created with the definition of the content, analysis of curriculum course description determine the purpose of learning, and creating a learning management plan.

Step II: Creating the Steps of Learning Activities with the STEMe
The processes of implementing activities according to the learning management plan that focuses on teaching and learning activities with the STEMe; construct a STEMe learning management plan with the content analysis projectile motion by dividing the learning activities into 5 learning activities that composed as: Select Central Standards, Align with a Problem, Support Central Standards with Supplemental Standards, Instruct STEMe Standards, Engage Student Participation, Troubleshoot the Designs, Evaluate the Designs, and Present Completed Projects steps.

Step III: the Quality of an Instructional Innovation of the STEMe was Checked
Using the instructional innovation with the STEMe was checked by the advisors and the professional experts with the *Index of Item Objective Congruence* (IOC*)*. Researcher team was selected the STEMe that it had the high quality of appropriability, only.

Step IV: 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 Projectile Motion Issue was created by the researcher team of

30 optional items in 4 multiple choice options was assessed in the forth step of research procedures.

Step V: Selected the Scientific Process Skill Test (SPST)

The 20-item *Scientific Process Skill Test* (SPST) was modified from the conceptual thinking from the *Teaching the Science Process Skills* of Longwood University (2015), there are six basic science process skills: *Observation, Communication, Classification, Measurement, Inference*, and *Prediction* skills was assessed students' science process skills in five skills that composed of Identifying and controlling variables, Formulating hypotheses, Defining variables operationally, Experimental skills (Experimenting), and Interpretation skills and conclusions. (Interpreting data and making conclusion) was assessed students' scientific process skills in physics classes in the five step of research methodology.

5. Using the Popular Instructional Method in 21st-Century: STEM Education

First of all, STEM is not a new concept, despite the forceful rhetoric of those claiming otherwise. The practice of integrating content subjects such as math and science (in order to help provide useful contexts for what is being learned) is not a new idea either. In fact, STEM is not even a new acronym. The idea of content integration was originally explored more than a century ago by the Committee of Ten at Harvard (Eliot, et. al., 2001), as a way to standardize the agrarian school system of the late 1800's. Today, STEM education continues to be defined differently by various groups and individuals, with many definitions evolving into a series of one-size-fits-all perceptions. Definitions exist that span a full spectrum of philosophies ranging from STEM simply consisting of additional course offerings of the traditional topics in mathematics and science to STEM being conceived as a non-exclusive meta-discipline; in essence, as a way to provide meaning for each individual subject by contextualizing it within the others. This is certainly important at the collegiate level as well. Specialization in a content discipline comes after we understand the contributions of other ways of visualizing or extending ideas. This way of looking at STEM not only helps define the scope of STEM at each educational level, but also helps to define the most effective methods of instruction and the intellectual performances that are reasonable at each level (Ostler, 2012). Rather than adding two new subjects to the curriculum, the engineering and technology practices can instead be blended into existing mathematics and science lessons in ways that engage students and help them master 21st century skills. STEM Innovative Lesson Plans of the essentials was built how to begin the STEM integration journey with: five guiding principles for effective STEM instruction, science classes were responded of what these principles look like in action of students' perceptions, sample activities that put all four STEM fields into practice, and lesson planning templates for STEM units were assessed by the professional expert educators were checked of their efficiency quality.

5.1 Sample Size

Administration of this research study was the upper secondary educational school students who sat at the 10^{th} grade level which sample size of 33 students in physics class in the second semester of academic year 2016 at Watsratong Municipal School under Roi-Et Municipality, and Ministry of the Interior in Thailand that it provides kindergarten, elementary and secondary school education with the purposive sampling technique.

5.2 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 and ANOVA results (eta^2). Associations between students' learning achievements of their posttest outcomes and their scientific process skills to their perceptions in physics class with simple and multiple correlations, standardized regression weight abilities and the coefficient predictive value (R^2) were used.

6. Results

Education reformists and special interest groups appear to be positioning themselves to be recognized as STEMe experts, some even going so far as to claim credit for contributing to the STEMe acronym. As the education profession develops programs to address the evolving STEM teaching and learning needs, a central factor that must be understood is that STEM content and STEM education are not the same. 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 10^{th} grade level in the three main topics that followed as:

6.1 Validity of Research Instruments

6.1.1 The IOC Value of the STEM Education Innovative Instructional Lesson Plan

The STEMe 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 be 5.00. It appears that the research plan developed by the researcher has an average of 4.80, which the IOC was 4.80; it means as in the most appropriate the highest quality level.

6.1.2 Validations of the Leaning Achievement Test (LAT)

The 30-item *Leaning Achievement Test* (LAT) on Projectile Motion 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 0.20 to 0.65, and 0.31 to 0.94, evidently. The LAT tests came to the full confidence level, by calculating the Lovett formula, the total confidence value was 0.93.

6.1.3 Validity of the Scientific Process Skill Test (SPST)

Using the 20-item *Scientific Process Skill Test* (SPST) that it has 5 optional components in 4 multiple choice options was assessed students' critical thinking abilities were assessed with the SPST. The reliability coefficient (Lovett) was calculated as 0.94.

6.2 The Effectiveness of the STEMe 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 classe 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)	70	53.95	2.44	77.07
Efficiency Performance Results (E2)	30	1.90	1.90	76.97
The Lessoning Effectiveness (E1/E2) = 77.07/76.97				

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 77.07 and the performance effectiveness (E2) indicate that of 76.97, so the lessoning effectiveness (E1/E2) evidences of 77.07/76.97 over the threshold setting is 75/75.

6.3 Comparisons between Students' Scientific Process Skills and the Criteria Learning Outcomes at 75% with the STEM Education Instructional Method

Using the average mean scores of students' scientific process skills with the 20-item *Scientific Process Skill Test* (SPST) was assessed and the criteria learning outcomes at 75%. Students' responses of their scientific process skill test indicated that an average mean score ($\overline{X}$) = 15.42, Standard deviation S.D. = 1.34, and Percentage of average score = 77.27. The organizing learning activities in STEM education with a criterion of 75 percent threshold were compared. Table 2 reports of the relationships between students' scientific process skills and the criterion of 75 percent 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*)
33	20	15.00	15.42	1.34	32	1.81*	.034*

In Table 2 reported that the comparisons of mean scores on students' scientific process skills that the organizing learning activities in STEM education with a criterion of 75 percent threshold were compared at the 10^{th} grade level with 75% of the 33 students when analyzing the difference using t-test statistics (One-Way ANOVA), it was found that the *t*-test indicated that was 1.81 and statistically significant at the level of .05, differently.

6.4 Comparisons between Students' Leaning Achievements and the Criteria Learning Outcomes at 75% with the STEM Education Instructional Method

Using the average mean scores of students' scientific process skills with the 30-item *Learning Achievement Test* (LAT) was assessed and the criteria learning outcomes at 75%. Students' responses of their leaning achievement test indicated that an average mean score ($\overline{X}$) = 23.09, Standard deviation S.D. = 1.91. The organizing learning activities in STEM education with a criterion of 75 percent threshold were compared. Table 3 reports of the relationships between students' leaning achievements and the criterion of 75 percent threshold.

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

Students' Number	Total Score	Criteria Score 75%	Mean	S.D.	df	t-test	Sig. (p)
33	30	22.50	23.09	1.91	32	1.78*	.041*

In Table 3 reported that the comparisons of mean scores on students' students' learning achievements that the organizing learning activities in STEM education with a criterion of 75 percent threshold were compared at the 10th grade level with 75% of the 33 students when analyzing the difference using *t*-test statistics (One-Way ANOVA), it was found that the *t*-test indicated that was 1.78 and statistically significant at the level of .05, differently.

6.5 Associations between Students' Learning Achievements of their Posttest Assessment and their Scientific Process Skills Creative Thinking Abilities with 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 SPST 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)	15.42	1.35	0.39**	0.55**	0.5509*	0.3132*
SPST	23.09	1.91				

*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 SPST science process skills among four scales were relative significantly, when using a simple correlation analysis (r) and standardized regression validity (β). The multiple correlations (R) was 0.5509 and the predictive efficiency (R^2) value indicated that 31% of the variances in students' science process skills to their physics class was attributable to their post learning achievement in their physics. 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 (SPST). 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.

7. Conclusions

This paper was reported of the designing instructional innovation of the popular teaching and learning method in the 21st century with the STEM Education Method to investigate and examine of the activity-based on learning approaching management through the STEM education instructional method for encouraging science process skills and learning achievements of secondary students at the 10th grade level in physics class of secondary students at the 10th grade level for the target group that was the upper secondary educational school which a sample size of 33 students in class in the second semester of academic year 2016 at Watsratong Municipal School under Roi-Et Municipality, and Ministry of the Interior in Thailand that it provides kindergarten, elementary and secondary school education with the purposive sampling technique. The context of the content that it composes of the Projectile Motion Issue from the Strand 4: Forces and Motion that focused on the Standard SC4.2 from the Basic Education Core Curriculum B.E. 2551 was aimed at the full development of learners in all respects - morality, wisdom, happiness, and potentiality for further education was selected of the context of the strand and learning standard in science learning area in terms of students' performances of their learning environment and their science process skills in physics class are provided.

This section summarizes the research study, describes the STEMe 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 STEM education innovative instructional lesson plan was checked the quality by professional experts with the effectiveness of lessons during the learning process (E1) and the performance effectiveness (E2) at 75/75 standardized criteria. Students' learning achievements was defined factors that impact a student's ability to achieve and explains what research shows about successful student achievement with the 5-sub lesson plans were assessed with the 20-item Learning Achievement Test (LAT), students' scientific process skills were assessed with the 20-item *Scientific Process Skill Test* (SPST) were also used in this study. Comparison between students' learning achievements and their scientific process skills of the *Criteria Learning Outcomes at 75%* with the STEM Education Instructional Method were compared. Associations between students' learning achievements with the LAT and the SPST with the STEM Education Instructional Method were assessed. The conclusions of main findings are provided in this remark that it follows as below.

It appears that the research plan developed by the researcher has an average of 5.00, which the IOC was 4.80; it means as in the most appropriate the highest quality level. The 30-item *Leaning Achievement Test* (LAT) on Projectile Motion 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 0.20 to 0.65, and 0.31 to 0.94, evidently. The LAT tests came to the full confidence level, by calculating the Lovett formula, the total confidence value was 0.93. The 20-item *Scientific Process Skill Test* (SPST) that it has 5 optional components in 4 multiple choice options was assessed students' critical thinking abilities were assessed with the SPST. The reliability coefficient (Lovett) was calculated as 0.94. These results suggest that the research instruments display satisfactory internal consistency, thus, the innovative instructional lesson plan, the LAT, and the SPST are valid and reliable instruments for used in this research study.

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 77.07 and the performance effectiveness (E2) indicate that of 76.97, so the lessoning effectiveness (E1/E2) evidences of 77.07/76.97 over the threshold setting is 75/75.

In terms of comparisons of mean scores on students' scientific process skills that the organizing learning activities in STEM education with a criterion of 75 percent threshold were compared at the 10^{th} grade level with 75% of the 33 students when analyzing the difference using t-test statistics (One-Way ANOVA), it was found that the *t*-test indicated that was 1.81. Similarly, the mean scores on students' learning achievements that the organizing learning activities in STEM education with a criterion of 75 percent threshold, it was found that the *t*-test indicated that was 1.78 and statistically significant at the level of .05, differently.

To investigate of associations between students' learning achievements of their posttest assessment and their scientific process skills creative thinking abilities with the innovative STEM education instructional method. The 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 SPST science process skills among four scales were relative significantly, when using a simple correlation analysis (r) and standardized regression validity (β). The multiple correlations (R) was 0.5509 and the predictive efficiency (R^2) value indicated that 31% of the variances in students' science process skills to their physics class was attributable to their post learning achievement in their physics. 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 (SPST). 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. Overall, this upper 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 process skills and learning achievements of secondary students at the 10^{th} grade level in physics class of their own class has a moderately centralized education system and a different context from the other countries.

8. Discussions

This study has limitations and therefore its findings should be generalized with caution of a municipal school. The limitations of the study include with the research instruments were adapted to suit the context of this study, although the sample size is too small target group; the finding cannot be generalized to other groups in government schools, private schools, religious affairs schools and demonstration schools for the universities, which are under the Ministry of Education of Thailand.

Because of 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 K-12 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 K-12 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.

From the findings as above, the description then the physical and mental fatigue can affect learning and achievement so that students learn best not to happen should avoid fatigue in the study as spinelessness body. So it is necessary to arrange the conditions that are free from such spiritual exhaustion that means thinking about problems without a break, doing something because it had not in accordance with the interest and attention. This is all a huge influence on student learning achievement. In order for students as students should not occur with both physical and psychological exhaustion. According to the factors of teacher and teach an important factor, how the attitude and personality of teachers , the level of knowledge possessed by teachers , and how teachers teach that knowledge to the children helped students determine learning outcomes to be achieved by students. Meanwhile, according to teaching is essentially a process, which is a process set up, organize the environment surrounding the students, so it can grow and encourage students to make the learning process in physics class in this research study.

The science process skills are part of and central to other disciplines. Research indicates that the integration of science with The STEM education method has produced positive effects on student learning. In this research finding, integrating the science process skills with classroom lessons and field investigations will make the learning experiences richer and more meaningful for students. Students will be learning the skills of science as well as science content. The students will be actively engaged with the science they are learning and thus reach a deeper understanding of the content. Finally, active engagements with science will likely lead students to become more interested and have more positive attitudes towards science, successfully. Research team has demonstrated that a variety of STEM experiences toward physics can facilitate the transition of students from one level of cognitive development to the next. A relationship between STEM education instructional method and their science process skills is suggested by the fact that one's achievement in physics is related to cognitive development are provided, significantly.

References

1. Dumrongkiat, L. (2016). *Ex-WTO chief decries Thai education.* Bangkok Post. Retrieved on 3 March 2016 from http://www.bangkokpost.com/archive/ex-wto-chief-decries-thai-education/883780
2. Elliott, B., Oty, K., McArthur, J., & Clark, B. (2001). The effect of an interdisciplinary algebra/science course on students' problem solving skills, critical thinking skills and attitudes toward mathematics. *International Journal of Mathematical Education in Science and Technology. 32*, 811-816.
3. Longwood University. (2015). *Teaching the science process skills*. Retrieved from http://www.longwood.edu/cleanva/images/sec6.processskills.pdf
4. Ministry of Education. (2012). *Education in Thailand*. Retrieved on 17 June 2014 from https://en.wikipedia.org/wiki/Education_in_Thailand
5. Ministry of Education. (2015). *Basic education curriculum core B.E.2551 (A.D. 2008).* Retrieved from file:///C:/Users/User/Downloads/Basic%20Education%20Core%20Curriculum%20B.E.%202551%20(1).pdf
6. Office of Social Promotion for Learning and Quality of Youth. (2012). *Development of a science-based brainstorming activity model in conjunction with group activities to improve science process skills*. Retrieved from http://www.qlf.or.th/Home/Contents/499
7. Ostler, E. (2012). 21st century STEM education: A tactical model for long-range success. *International Journal of Applied Science and Technology Vol. 2 No. 1*; January 2012. Retrieved from http://www.ijastnet.com/journals/Vol_2_No_1_January_2012/3.pdf
8. Rezba, R. J., Sprague, C. S., Fiel, R. L., Funk, H. J., Okey, J. R., & Jaus, H. H. (3rd Ed.). (1995). Learning and Assessing Science Process Skills. Dubuque, IA: Kendall/Hunt Publishing Company.
9. The Promotion of Teaching Science and Technology (IPST). (2016). *STEM education: Preparing a workforce for the future.* Retrieved from http://eng.ipst.ac.th/

10. UNICEF. (2016). *Thailand education overview*. Retrieved on 18 June 2016 from https://www.unicef.org/thailand/education_303.html
11. Vitti, D. and Torres, A. (2006). *Teaching the science process skills*. Retrieved from http://www.longwood.edu/cleanva/images/sec6.processskills.pdf
12. Wai, J., Lubinski, D., Benbow, C. P., & Steiger, J. H. (2010). Accomplishment in Science, Technology, Engineering, and Mathematics (STEM) and Its Relation to STEM Educational Dose: A 25-Year Longitudinal Study. *Journal of Educational Psychology, 102*(4), 860-871. Retrieved from EBSCOhost.
13. World Education News & Reviews. (2014). *Education in Thailand*. Retrieved on 3 March 2014 from http://wenr.wes.org/2014/03/education-in-thailand