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LEARNING MANAGEMENT ACCORDING TO THE CONCEPT OF THE STEM EDUCATION METHOD FOR ENHANCING STUDENTS' LEARNING ACHIEVEMENTS AND THEIR SOLVING PROBLEM THINKING SKILLS IN BIOLOGY COURSE AT THE 10TH GRADE LEVEL

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Abstract:
The purposes of this research study were to develop the instructional lesson plan with the learning management according to the concept of the STEM education method for processing performances and the performance results efficiency (E_1/E_2) at the determining criteria as 80/80, to assess students' post learning achievements with the learning management according to the concept of the STEM education method and the criteria learning outcomes at 80%, to compare between students' solving problem thinking skills to their pre and post STEM education instructional method, to analyze of associations between students' post learning achievements and their perceptions of their solving problem skills. The target group consisted of 33 secondary students at the 10th grade level from Borabu Wittayakhan under the Maha Sarakham Secondary Educational Service Area Office 26 with the purposive sampling random technique was selected in the secondary semester in 2016. Using a instructional lesson plan with the learning management according to the concept of the STEM education method in 4 weeks of 12 hours was administered, students' learning achievements were assessed

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with the 30-item *Learning Achievement Test* (LAT), students' solving problems were assessed with the *Solving Problem Thinking Skill Assessment* (SPTSA) which total score of 40. Data analysis was evaluated with percentage, mean, standard deviation, t-test, simple and multiple correlation, standardized regression weight validity, and coefficient predictive value (R^2). The results of these findings have found that: the efficiency with the learning management according to the concept of the STEM education method of the processing performances and the performance results (E_1/E_2) indicated that evidence of 82.42/81.67, which was higher than with the criteria of 80/80. Students' learning achievements of their posttest assessment ($\overline{X}$ = 24.67, S.D. = 1.89) and the criteria level of 75% indicated that at the level of .01, differently. Students' responses of their post solving problem thinking skills ($\overline{X}$ = 32.67, S.D. = 2.41) and the criteria level of 75% on digestion of microorganism issue were differentiated of statistically significant at the level of 0.01. Associations between students' post learning achievements and their solving problem thinking skills were positive relative (r = 0.33, ρ<.01), the relationships between two variables with the standardized regression weigh validity were found (β = 0.33, ρ<.01), the multiple correlation value indicated that of 0.8026 (R = 0.80, ρ<.01), and the coefficient predictive value was evidence at 0.6442 (R^2 = 0.64, ρ<.01) and indicated that 64% of SPTSA of the variances in for the LAT. students in their achievement group has implications for thinking skills in solving problems that have been learned in the field of biology.

Keywords: learning management, STEM education method, enhancement, association, learning achievement, solving problem thinking skill, biology course

1. Introduction

1.1 Learning Management

Learning management is the capacity to design pedagogic strategies that achieve learning outcomes for students. The learning management concept was developed by Richard Smith of Central Queensland University (Australia) and is derived from architectural design (an artful arrangement of resources for definite ends) and is best rendered as design with intent (Smith and Lynch, 2010). Learning management then means an emphasis on 'the design and implementation of pedagogical strategies that achieve learning outcomes. That is, in the balance between and emphasis on curriculum development and pedagogy, the emphasis is definitely on pedagogical strategies. Underpinning the learning management premise is a new set of knowledge and skills, collectively referred to as a futures orientation and which attempt to prepare the mindsets and skill sets of teaching graduates for conditions of social change that

pervade local and global societies in the 2000s. The practitioner of learning management is referred to as a learning manager (Lynch, 2012). Adjunct to the theory and practice of learning management is the Learning Management Design Process (LMDP). The LMDP is a curriculum planning process comprising 8 'learning design based' questions. The process was developed by Professor David Lynch of Central Queensland University in 1998 and is used primarily as a tool to train teachers to teach (Whitney, 2015). These 'eight questions' when answered in sequence focus the teacher to what is important when planning to teach students. The LMDP organizes its 8 questions through three sequential phases: Outcomes, Strategy and Evidence. Each phase represents the bodies of information that its associated questions seeks to purse. The LMDP represents a rethink of the various cu0irriculum development models that have predominated the planning of teaching and curriculum in the developed world over past decades. The teacher develops their 'teaching plan' by engaging with each phase and its questions and recording 'findings' (or answers) in plan form. In this research study, the learning management according to the concept of the STEM education method was designed to manage the instructional innovation on two lesson plans with the Basic Education Core Curriculum B.E. 2551 (A.D. 2008).

1.2 The Basic Education Core Curriculum 2008

The Basic Education Core Curriculum 2008 thus formulated will provide local communities and schools with a framework and orientation for preparing school curriculums. The learning standards and indicators prescribed in this document will enable agencies concerned at all levels to clearly visualise expected learning outcomes throughout the entire course of study. The Basic Education Core Curriculum has therefore prescribed the following eight learning areas: Thai Language, Mathematics, Science, Social Studies, Religion and Culture, Health and Physical Education, Arts, Occupations and Technology, and Foreign Languages. Learning areas comprise bodies of knowledge, skills or learning processes and desirable characteristics, attainment of which is required of all basic education learners.

1.3 Science Learning Area

Science also involves technologies, instruments, devices and various products at our disposal, which facilitate our life and work. All these benefit from our scientific knowledge, which is combined with creativity as well as other disciplines. Science enables us to develop our thinking skills in various respects; logical, creative, analytical and critical. The learning area of science is aimed at enabling learners to learn this

subject with emphasis on linking knowledge with processes, acquiring essential skills for investigation, building knowledge through investigative processes, seeking knowledge and solving various problems. The main content areas are prescribed as follows: Living Things and Processes of Life, Life and the Environment, Substances and Properties of Substances, Forces and Motion; Energy, Change Process of the Earth, Astronomy and Space, and Nature of Science and Technology strands. In this research study focused on Strand 1: Living and Family; Standard Sc1.2: Understanding of process and importance of genetic transmission; evolution of living things; biodiversity; application of biotechnology affecting humans and the environment; investigative process for seeking knowledge and scientific mind; communicating knowledge that could be applied for useful purposes in cording to the key stage indicators at the 10^{th} – 12^{th} grade levels of experiment and explain maintenance of cell equilibrium of living things, experiment and explain mechanisms for maintenance of water equilibrium in plants, search for data and explain mechanisms for control of equilibrium of water, minerals and temperature by human beings and other animals, and apply acquired knowledge for useful purposes, and explain the body's immune system, and apply acquired knowledge for health care, such as; to explain the processes of genetic transmission, transformation, mutation and the origin of biodiversity, to search for data and discuss effects of biotechnology on human beings and the environment, and apply the knowledge gained for useful purposes, to search for data and discuss effects of biodiversity on human beings and the environment, and to explain natural selection processes and their effects on diversity of living things.

1.4 The Concept of the STEM Education Method

STEM stands for science, technology, engineering, and mathematics. STEM is important because it pervades every part of our lives. Science is everywhere in the world around us. Technology is continuously expanding into every aspect of our lives. Engineering is the basic designs of roads and bridges, but also tackles the challenges of changing global weather and environmentally-friendly changes to our home. Mathematics is in every occupation, every activity we do in our lives. By exposing students to STEM and giving them opportunities to explore STEM-related concepts, they will develop a passion for it and hopefully pursue a job in a STEM field. A curriculum that is STEM-based has real-life situations to help the student learn. Programs like *Engineering For Kids* integrates multiple classes to provide opportunities to see how concepts relate to life in order to hopefully spark a passion for a future career in a STEM field. STEM activities provide hands-on and minds-on lessons for the student. Making math and

science both fun and interesting helps the student to do much more than just learn (Engineering for Kids, 2016).

In the 21st century, scientific and technological innovations have become increasingly important as we face the benefits and challenges of both globalization and a knowledge-based economy. To succeed in this new information-based and highly technological society, students need to develop their capabilities in STEM to levels much beyond what was considered acceptable in the past. STEM education helps to bridge the ethnic and gender gaps sometimes found in math and science fields. Initiatives have been established to increase the roles of women and minorities in STEM-related fields. STEM education breaks the traditional gender roles. In order to compete in a global economy, STEM education and careers must be a national priority. Each and every decision made uses an aspect of STEM to understand the implications. In conclusion, STEM education is critical to help the United States remain a world leader. If STEM education is not improved, the United States will continue to fall in world ranking with math and science scores and will not be able to maintain its global position. STEM education in school is important to spark an interest in pursuing a STEM career in students. However, teachers do not carry the whole burden of STEM education. Parents also must encourage their children to pursue STEM activities and increase awareness and interest at home and in extracurricular activities of the merits of STEM education (National Science Foundation, 2016).

2. STEM Education in Thailand

Thailand is a developing country by economic prosperity is a metric Thailand believes this figure according to the opinion of the West counties. The numbers are the basis for measuring the possibility of different countries. In the world and one factor, this has a direct effect on the competitiveness of the economy, the quality of education of the population. Education reform has changed many times during the various governments. There are several levels of education that are updated every ten years. The concept of educational reform policy is diverse. The intention of the leading academics who wish to educate Thailand is equal to civilization. They adapted or introduced Western educational system concepts into the Thai education system by looking forward to Thailand's development of human resources leap forward. There are times when the education system is facing failure in applying the principles and policies of the dream education to practical applications. Therefore, the educational

discourse is that Thai students are mice using the educational curriculum (Siriratanajit, 2013).

STEM Education is an educational approach that integrates knowledge from four fields: Science, Technology, Engineering, and Mathematics. Teaching STEM in primary and secondary education can help students become interested in STEM careers and build a nation's STEM-educated workforce that can be used to meet the demands of business and industry in a complex and technology-driven economy. Under the Newton Fund, British Council Thailand is working with The Institute for the Promotion of Teaching Science and Technology (IPST) and the Office of Vocational Education Commission (OVEC) to develop STEM Education programme for the national curriculum in Thailand. The programme will support knowledge exchange and partnership opportunities between UK and Thailand and increase the understanding of and engagement with science, technology, engineering, and mathematics in Thailand (British Council in Thailand, 2015).

3. Students' Learning Achievements

Student achievement has become a hot topic in education today, especially with increased accountability for classroom teachers. The ultimate goal for any teacher is to improve the ability level and prepare students for adulthood. Defining student achievement and factors that impact progress is critical to becoming a successful teacher. Student achievement measures the amount of academic content a student learns in a determined amount of time. Each grade level has learning goals or instructional standards that educators are required to teach. Standards are similar to a 'to-do' list that a teacher can use to guide instruction. Student achievement will increase when quality instruction is used to teach instructional standards. For instance, teachers have a to-do list that involves three tasks: dropping off the cleaning, filling their gas tank, and studying for a final. Questions teacher may ask themselves are: In what order do student accomplish my tasks? How is student going to get each task finished? Should student study at the library where it is quieter or at home where student may be distracted? Is it worth it to purchase gas a few blocks from home at a higher price or drive a short distance to save money? Their goal is to get their to-do list finished in the most efficient and timely way possible (Foundation of Education, 2015).

When teaching, teacher must use the same process when addressing instructional standards. Questions teacher should ask to successfully complete their 'to-do list' or learning standards in a timely and efficient manner include: What type of

students do student have? How is student going to teach the standard? Will they understand the vocabulary? How long do student think it will take for students to fully learn the material? Successful instruction of standards results in student achievement. However, knowing the 'what' and the 'how' is just the first step to successful student achievement. Understanding the factors that can impact a student's ability to learn is equally important. There are many variables that can impact successful student achievement, but the most critical are classroom instruction and learning disabilities. It is important to remember that all students do not learn the same way or at the same rate. Students are like leaves on a tree; there are no two exactly the same. Just as a leaf comes in unique colors, shapes and sizes, each student has their own unique learning style. Teacher must use a variety of teaching methods and understand the background and individual needs of each student (Carter, 2014).

4. Pretest and Posttest Designs

The basic premise behind the pretest–posttest design involves obtaining a pretest measure of the outcome of interest prior to administering some treatment, followed by a posttest on the same measure after treatment occurs. Pretest–posttest designs are employed in both experimental and quasi-experimental research and can be used with or without control groups. For example, quasi-experimental pretest–posttest designs may or may not include control groups, whereas experimental pretest–posttest designs must include control groups. Furthermore, despite the versatility of the pretest–posttest designs, in general, they still have limitations, including threats to internal validity. Although such threats are of particular concern for quasi-experimental pretest–posttest designs, experimental pretest–posttest designs also contain threats to internal validity (Salkind, 2012).

5. Solving Problem Thinking Skills

Problem solving requires two distinct types of mental skill, analytical and creative. Analytical or logical thinking includes skills such as ordering, comparing, contrasting, evaluating and selecting. It provides a logical framework for problem solving and helps to select the best alternative from those available by narrowing down the range of possibilities (a convergent process). Analytical thinking often predominates in solving closed problems, where the many possible causes have to be identified and analyzed to find the real cause. Creative thinking is a divergent process, using the imagination to

create a large range of ideas for solutions. It requires us to look beyond the obvious, creating ideas which may, at first, seem unrealistic or have no logical connection with the problem. There is a large element of creative thinking in solving open problems. The creative thinking skills can be divided into several key elements: fluency - producing many ideas, flexibility - producing a broad range of ideas, originality - producing uncommon ideas, elaboration - developing ideas (Guilford, 1950). Effective problem solving requires a controlled mixture of analytical and creative thinking. To be a good problem solver you need to be able to switch from one group of skills to the other and back again, although this is not always easy. Traditional education gives far greater encouragement to the development and use of left-brain thinking. This is reinforced in the way we are required to work, where emphasis is placed on rational, logical analysis of data in drawing conclusions (Hong Kong Education, 2012).

In this study was created the learning management according to the concept of the STEM education method for enhancing students' learning achievements and their solving problem thinking skills in biology course at the 10th grade level. Based on the above-mentioned concept, the researchers adopted the 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. Thus, the model of STEM Education teaching and learning was integrated into the model of science experiment of the upper secondary students at the 10th grade level at Borabu Wittayakhan under the Secondary Educational Service Area Office 26 in Maha Sarakham Province is the context of research limitation in this study.

6. Methodology

Research was integrated problem solving ability into science, technology, engineering, and mathematics of secondary students at the 10th grade level by learning management in STEM education instructional method in biology experimental research with the experimental research through the pre-experimental design in cording the one group pretest-posttest design technique.

6.1 Research Aims

1. To develop the instructional lesson plan with the learning management according to the concept of the STEM education method for processing performances and the performance results efficiency (E_1/E_2) at the determining criteria as 80/80.

2. To assess students' post learning achievements with the learning management according to the concept of the STEM education method and the criteria learning outcomes at 80%.
3. To compare between students' solving problem thinking skills to their pre and post STEM education instructional method.
4. To analyze of associations between students' post learning achievements and their perceptions of their solving problem skills.

6.2 Research Procedures

Step I: Selected of the Context of the Strand and Learning Standard in Science Learning Area

Observance of the principles of development of the brain and multiple intelligences is required to achieve learners' balanced development that has therefore prescribed the following eight learning areas: Thai Language; Mathematics; Science; Social Studies, Religion and Culture; Health and Physical Education; Art, Occupations and Technology; and Foreign Languages. In terms of the Strands and Learning Standards in Science learning core, which it contains of eight Strands and 13 Learning Standards. In this research study focused on Strand 1: Living and Family; Standard Sc1.2 :

Understanding of process and importance of genetic transmission; evolution of living things; biodiversity; application of biotechnology affecting humans and the environment; investigative process for seeking knowledge and scientific mind; communicating knowledge that could be applied for useful purposes in cording to the key stage indicators at the 10^{th} – 12^{th} grade levels of experiment and explain maintenance was selected of the context of In this research, there was content about transporting cellulosic material through the second semester of the tenth grade. The study plan was the STEM education in 12 hours of study (3 hours/week of 4 weeks) content limitation at the first phase.

Step II: Pretest-Posttest Designs for Assessing the Achievements of Learning

A main innovative lesson plan was provided a general definition of student achievement, 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. Student achievement has become a hot topic in education today, especially with increased accountability for classroom teachers. The ultimate goal for any teacher is to improve the ability level and prepare students for adulthood. Defining student achievement and factors that impact progress is critical to becoming a successful teacher. Student achievement measures the amount of academic content a student

learns in a determined amount of time. Each grade level has learning goals or instructional standards that educators are required to teach. Standards are similar to a 'to-do' list that a teacher can use to guide instruction. Student achievement will increase when quality instruction is used to teach instructional standards. Researchers want to monitor the effect of a new teaching method upon groups of students. Pretest-posttest designs were an expansion of the posttest only design with the target groups, one of the simplest methods of testing the effectiveness of an intervention. In this design, which was given the treatment and the results were gathered at the end with statistical analysis that can then determine the intervention had a significant effect.

Step III: Using the Popular Instructional Method in 21st-Century: STEM Education

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 Cellular Transportation Issue was selected instruction for STEM units were assessed by the professional expert educators were checked of their efficiency quality, this was the third phase.

6.3 Adapted the Bruce Woodcock's theory to Testing Solving Problem Skill

Basically, the Solving Problem Skill develops people ability to tackle complex problems in the workplace using known analytical problem solving techniques, design thinking, and effective research. The solving problem skills are a key part of the job, there is likely to be a question on the application form which asks teacher to give evidence of the competency in these areas, such as: Describe a situation in which teacher analyzed data and solved a complex problem; Describe a complex problem teacher have faced and the steps that teacher took to solve it; describe a setback in student life and say what teacher did to overcome it, what lessons did teacher learn from this? describe a time when teacher demonstrated creativity in solving a difficult problem; describe a time when teacher provided a new or different solution to a problem; give teacher a specific example of a time when teacher used good judgment and logic in solving a problem; describe a difficult problem that teacher have

solved, to state how teacher decided which were the critical issues, say what teacher did and what student solution was responses?, what other approaches could teacher have taken? and give an example of a problem teacher have solved that required analysis, what methods did teacher use and what conclusions did teacher reach? (Woodcock, 2013).

6.4 Sample Target

The target group consisted of 33 secondary students at the 10^{th} grade level in a biology class that was administered of their instructional innovative lesson plan on the cellular transportation issue from Borabu Wittayakhan under the Maha Sarakham Secondary Educational Service Area Office 26 in Thailand.

6.5 Data Analysis

Using 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 and discriminant validity. 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 creative thinking abilities to their perceptions toward their physics laboratory classroom environments with simple and multiple correlations, standardized regression weight abilities and the coefficient predictive value (R^2) were used.

7. Results

Using the STEM Education instructional innovation's lesson plans were managed the instructional activities, the 30-item *Learning Achievement Test* (LAT) were designed on the multiple choices with the five options, and students' solving problem skills were enhanced with the 10-item *Solving Problem Skill Test* (SPST) on the subjective quizzes. Statistically significant were analyzed with the Simple and Multiple Correlations, Standardized Regression Weight Validity (β), and Coefficient Determinant Predictive Value (R^2) were associated.

7.1 The Efficiency with the Learning Management

To analyze the effectiveness of the innovative instructional lesson plans based on the model of learning management in a STEM Education Method of secondary students at

the 10th grade level in biology environment class with the processing and performance resulting effectiveness at 80/80 criteria. Table 1 reports of the effectiveness of the innovative instructional lesson plans.

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 (E_1)	60	49.45	1.54	82.42
Efficiency Performance Results (E_2)	30	24.67	1.90	81.38
The Lessoning Effectiveness (E1/E2) = 82.42/81.38				

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 82.42and the performance effectiveness (E2) indicates that of 81.38, so the lessoning effectiveness (E1/E2) evidences of 82.42/81.38 over the threshold setting is 80/80.

7.2 Comparisons between Students' Learning Achievements of their Post Assessing Test and the Criteria Learning Outcomes at 75% with the STEM Education Instructional Method (STEME)

Using the average mean scores of students' learning achievements of their post assessing test and the criteria learning outcomes at 75% with the STEM Education Instructional Method (STEME) were analyzed. Table 2 shows the result of this research study.

Table 2: The Mean, Standard Deviation, Total Score, the Criteria Score of 80%, Mean Different, and Independent Variable t-test for the STEME Method

Students' Number	Total Score	Criteria Score 80%	Mean	S.D.	df	t-test	Sig. (*p*)
33	30	22.50	24.67	1.89	32	6.55**	.004**

In Table 2, it was found that the comparisons of mean scores on students' learning achievements later learning management using the STEME formulation as the basis of the Cellular Transportation Issue of upper secondary educational students at the 10th grade level with 80% of the 33 students, using the 30-item *Learning Achievement Test* (LAT) as 5 multiple choice, it was found that the mean scores of post-course achievement were 24.67, the standard deviation was 1.89 when analyzing the difference

using t-test statistics (One-Way ANOVA), it was found that the t-test indicated that was 2.92 and statistically significant at the level of .01, differently.

7.3 Comparisons between Students' Solving Problem Abilities and the Criteria Learning Outcomes at 75% with the STEM Education Instructional Method (STEME)

The result of this research section would be reported of students' solving problem abilities and the criteria learning outcomes at 75% with the STEM education instructional method (STEME) in biology class toward science were compared. Using the 10-item *Solving Problem Thinking Skill Assessment* (SPTSA) which was the multiple choices and total score of 40 was administered.

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. (ϱ)
33	40	30	32.67	2.41	32	6.36***	.00***

*$\rho < 0.05$, **$\rho < 0.01$, ***$\rho < 0.001$*

Table 3 reveals that Students' responses of their post solving problem thinking skills ($\overline{X}$ = 32.67, S.D. = 2.41) and the criteria level of 75% on digestion of cellular transportation issue were differentiated of statistically significant at the level of 0.001.

7.4 Associations between Students' Post Learning Achievements and their Solving Problem Thinking Skills

In this study, it was also considered important to investigate associations between students' learning achievements and their solving-problem abilities with their *Solving Problem Thinking Skill Assessment* (SPTSA) toward science. The selection of an evaluation and assessment suitable for answering the fourth research aim was required. This suggests that the associations between mean scores of the 30-item *Learning Achievement Test* (LAT) and the 10-item *Solving Problem Thinking Skill Assessment* (SPTSA) in biology class.

Table 4: *Associations between the LAT and the SPTSA in Biology Class in Terms of Simple Correlation (r), Multiple Correlation (R), Standardized Regression Weight Validity (β), and Coefficient Predictive Value (R^2) of the STEME*

Variable	Mean (100 Scoring Mean)	S.D.	Simple Correlation (r)	Standardized Regression Weight Validity (β)	Multiple Correlation (R)	Coefficient Predictive Value (R^2)
LAT	24.67/30	1.89	0.33**	0.33**	0.8026**	0.6442**
SPTSA	32.67/40	2.41				

N = 33, *ϱ<0.05, **ϱ<0.01, ***ϱ<0.001

Associations between students' post learning achievements and their solving problem thinking skills were positive relative (r = 0.33, p<.01), the relationships between two variables with the standardized regression weigh validity were found (β = 0.33, p<.01), the multiple correlation value indicated that of 0.8026 (R = 0.80, p<.01), and the coefficient predictive value was evidence at 0.6442 (R^2 = 0.64, p<.01) and indicated that 64% of the students' achievement group is good learning has implications for thinking skills in solving problems that have been learned in the field of biology toward science.

7.5 STEME Learning Activities

STEM learning activities' exciting for students to build a love for learning and a solid base for understanding key concepts later on encourage experimenting, tinkering, building, observing, exploring, problem solving, and creating: *Create curiosity; Create passion; Create an opportunity for students to push the limits* of what they can do. This STEM learning activities plus STEM challenges will help students fall in love with the world of STEM Education Method to their Yogurt Homemade productive learning in biology class (see in Figure 1).

Figure 1: The 5-step of STEM learning activities' STEM Education Method to their Yogurt Homemade productive learning in biology class

8. Conclusions

In this research study was to investigated of learning management according to the concept of the STEM education method for enhancing students' learning achievements and their solving problem thinking skills in biology course at the 10th grade level, which sample size of 33 students in a biology class in the second semester of academic year 2016 at Borabu Wittayakhan School under the Maha Sarakham Secondary Educational Service Area Office 26 in Thailand.

The context of the content that it composes of the Cellular Transportation from the Strand 1: Living and Family; Standard Sc1.2: Understanding of process and importance of genetic transmission; evolution of living things; biodiversity; application of biotechnology affecting humans and the environment; investigative process for seeking knowledge and scientific mind; communicating knowledge that could be applied for useful purposes in cording to the key stage indicators at the 10th – 12th grade levels of experiment and explain maintenance was selected of the context of In this research, there was content about transporting cellulosic material through the second semester of the tenth grade. The study plan was the STEM education in 12 hours of study of 3 hours/week in 4 weeks, which content limitation in this research study.

The efficiency with the learning management in according to the concept of the STEM education method of the processing performances and the performance results

(E_1/E_2) indicated that evidence of 82.42/81.67, which was higher than with the criteria of 80/80. Students' learning achievements of their posttest assessment ($\overline{X}$ = 24.67, S.D. = 1.89) and the criteria level of 75% using t-test statistics (One-Way ANOVA), it was found that the t-test indicated that was differentiated at the level of .01, significantly. Students' responses of their post solving problem thinking skills ($\overline{X}$ = 32.67, S.D. = 2.41) and the criteria level of 75% on digestion of microorganism issue were differentiated of statistically significant at the level of 0.01. Associations between students' post learning achievements and their solving problem thinking skills were positive relative ($r = 0.33$, $p<.01$), the relationships between two variables with the standardized regression weigh validity were found ($\beta = 0.33$, $p<.01$), the multiple correlation value indicated that of 0.8026 ($R = 0.80$, $p<.01$), and the coefficient predictive value was evidence at 0.6442 ($R^2 = 0.64$, $p<.01$) and indicated that 64% of the students in the student achievement group Good learning has implications for thinking skills in solving problems that have been learned in the field of biology.

9. Discussion

The results of this research study have probably got some ideas of how experiments should be run in Science, Technology, Engineering and Mathematics; STEM, and therefore, STEM education are vital to our future the future of our country, the future of our region and the future of our children. Besides, STEM is everywhere; it shapes our everyday experiences. Let's consider how STEM effects what is closest and dearest to us; our children**.** STEM is their future; the technological age in which they live, their best career options, and their key to wise decisions. Because STEM is so important for our children, our region and our country, we need to encourage the students currently in our educational systems, as well as future generations of students, to understand and embrace the technology that affects them every day of their lives. Students should be advised on the merits of taking as many math and science courses in middle and high school as possible. And these courses need to be taught by engaged and enthusiastic teachers using hands-on and minds-on activities. Making science and math courses fun and interesting will not only help students to learn, but might also plant the "seed of interest" that could grow into an exciting and rewarding STEM career.

Problems are at the center of what many people do at work every day. Whether teachers 're solving a problem for a client (internal or external), supporting those who are solving problems, or discovering new problems to solve, the problems teacher face can be large or small, simple or complex, and easy or difficult. The key to a good

problem definition teacher is ensuring that deal with the real problem – not its symptoms. For example, if performance in their department is substandard, teacher might think the problem is with the individuals submitting work. However, if teacher look a bit deeper, the real issue might be a lack of training, or an unreasonable workload. In this research study, the four-step approach to solving problems that we mentioned at the beginning of this article will serve you well in many situations. However, for a more comprehensive process, you can use Simplex, Appreciative Inquiry or Soft Systems Methodology (SSM) are adapted to design of this research study. These provide detailed steps that you can use to solve a problem effectively.

As researchers strive to better prepare students for real world careers and challenges, we need to focus on developing students' solving problem skills. Educators can encourage students to become 21st-century problem solvers by introducing them to a wide variety of thinking tools. Affording students the opportunity to flex their creative problem solving skills offers them the chance to practice skills that are highly prized in real-world situations. Entering college or the workforce with well-developed creative thinking skills proves a great advantage for today's new grads. In education, we routinely teach students how to use various sets of cognitive tools to make academic work easier, more efficient, or more productive: for example, research methods, note-taking strategies, or ways to remember and organize information. In teaching thinking, we need to give students cognitive tools and teach them to use these tools systematically to solve real-life problems and to manage change. These tools apply to two essential categories: creative thinking abilities. Suggestions that the effects of the activity-based on learning approaching management through the STEM education instructional method for fostering the creative thinking abilities, learning achievements, and environmental performances in biology of students at the 10th grade level that should be needed to know how to implement authentic STEM teaching and learning into classrooms are following as the 21st century, responsibility.

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