

## *Implementing Inquiry-based STEM Learning in Tenth Grade Students*

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### **Abstract**

Inquiry-based STEM learning (iSTEM) is now familiar with science education and active learning for 21st century learners. This study aims to investigate learning achievement in biology in 10th grade students. Eight lesson plans with 12 hrs of iSTEM and achievement test were used for implementation. Inquiry-based STEM learning consisted of engagement, exploration, explanation, elaboration, and evaluation which support by creative activities. Data were analyzed by percentage, mean, and standard deviation. Students had 93.32 % of their mean score after learn with iSTEM. They also had learning behavior into science classroom in actively.

Keywords: STEM education, inquiry-based learning, achievement

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## **Introduction**

Science, Technology, Engineering, and Mathematics (STEM) literacy is an important element in science related programs of 21st century (Daugherty, 2013). The decisions related to individuals and societies in the 21st century, which demand scientific and technological understanding more and more to sustain daily life. If life without technology and engineering is unimaginable, then society has less innovation. The engineering component of STEM education doesn't just stand on the solutions but emphasizes process and design of solutions. In this way, students can discover mathematics and science in a more personal way and adopt critical thinking skills that can be used throughout their academic lives and works. Students can use engineering to explore, discover and to solve problems. One part of STEM Education can really help understanding the others (Ceylan and Ozdilek, 2015).

STEM refers to (1) obtain scientific, technological, engineering and mathematical knowledge and using it to identify issues, get new knowledge, and use it for issues about STEM, (2) comprehend the characteristics of STEM disciplines as forms of human efforts including inquiry, design, and analysis processes, (3) understand how STEM disciplines give shape to our material, intellectual and cultural world, and (4) engage in issues about STEM by using ideas related to science, technology, engineering, and mathematics as thoughtful, sentimental and contributed citizens (Bybee, 2010). STEM education is needed to keep up with today's developments. For that purpose, it is essential to investigate the scope, theory, and practices of STEM education in all educational levels and reorganize the instructional programs in compliance with the approach (Turkish Ministry of National Education, 2009).

To engage students in science and technology, various reports include scientific inquiry in their courses (Rocard et al, 2006). So, in this research we integrate inquiry-based with STEM education to inquiry-based STEM (iSTEM) to motivate more young people to choose science and engineering as their future career path to keep our future economy competitive. However, we need to improve example of lesson plans in 10th grade students. It will be an example for our science teaching program in STEM education.

## **Method**

One-group posttest only design was used in this study. The participants were 45 of 10th grade students in Sarakhampittayakhom school, Mahasarakham, Thailand. Eight lesson plans with 12 hrs. of Inquiry-based STEM learning (iSTEM) were developed for the topic of digestive system in biology subject. iSTEM consisted of engagement "the aim is to motivate of students' prior knowledge to engage in learning the topic", exploration "the students in each group share the theory and knowledge with others. Then they create the innovation from their ideas", explanation "the students explain the concept to how their innovation can work", elaboration "students use their new knowledge in a different situation", and evaluation "after the implementation, an achievement test that assesses the students' learning". Twenty-five item of multiple choices achievement test on digestive system in biology subject was used to collecting the data. The quantitative data were analyzed by percentage, mean, and standard deviation.

## Result

Descriptive statistics involving percentage, mean, and standard deviation were used to determine the students' achievement test. The results of quantitative data of students' achievement is presented in Table 1.

	<i>N</i>	<i>Full Score</i>	$(\bar{x})$	<i>SD</i>	<i>Percentage</i>
Achievement test	45	25	23.33	2.55	93.32

**Table 1.** Students' achievement test results on digestive system

Forty-five students had mean score is 23.33 from 25, standard deviation is 2.55 and 93.32 % of their mean score after learn with iSTEM.

From the learning activity record form of each lesson plan we found that, the students were actively, communicative, and collaboratively in classroom. They are present of ideas to create the innovation with confident and shared their knowledge to others learning groups in Figures 1. From students interview of implementation we found the students happy with iSTEM activity because they inquiry the theory and knowledge implicate to the learning topic and brainstorming to design and create the innovation in their style without pressure in the classroom.



**Figures 1.** A. Students created innovation to solve problem.  
B. Students present of ideas to create the innovation with confident.

## Discussion and Conclusions

The Inquiry-based STEM learning (iSTEM) lesson plan that was developed by the researcher on 10th grade students can help students to reach high score on digestive system in biology subject (93.32% of mean score) after the implementation. They gain to sufficient level of learning score, that mean is iSTEM improved the students' knowledge to competitive in the real-world to more opportunity of good career. The results of this study are consistent with the study conducted by Ceylan and Ozdilek (2015) There are developed the lesson plan by using 5E learning intergrade with STEM education. Their study showed that students' achievement on post- test were higher than the pre- test. Moreover, the qualitative data show that, iSTEM activity engage student's learning behavior into science classroom in actively. Furthermore, STEM enable students to transfer their knowledge and skills to real-world problems,

to be motivated to learn, and to improve their math and science scores (Diana, 2012) and/or a capstone projects to fulfill graduation requirements (Scott, 2012).

In conclusion, we can say that, iSTEM is the alternative to use in the science classroom in 21st century because iSTEM help students to reach high score in achievement. Moreover, iSTEM enable learning activity. Students were actively, communicative, and collaboratively in classroom. The iSTEM will create knowledge and skills to real-world problems and motivate more young people to choose science and engineering as their future career path to keep our future economy competitive in the real-world. That is why, iSTEM important in 21st century to implementation in classroom.

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