The Need Analysis Developing STEM Embeded Project

Yennita[(1,2)]Nur Afni[(1)], Tengku Kazmi[(1)], Azizahwati[(1,2)], Fakhruddin[(1,2)]
[1)]Master of Science Education Study Program, University of Riau
[2)]Physics Education Study Program, University of Riau
yennita@lecturer.unri.ac.id

Abstract. At this time, the work environment requires basic skills that are integrated with real life experience. Many students who fail to acquire these skills face the risk of unemployment because they only have theories or memorization that are not accompanied by the application of theory in daily life. Thus, to be more innovative, to have good, ideal and imaginative creativity, one must have high order thinking (HOT) to enhance their creative thinking and critical thinking skills. Therefore, this research emphasizes how to instill thinking skills through the STEM (Science Technology Engineering and Mathematic) project, to increase student attention in learning. This survey research was carried out as a first step in the development of the embedded STEM project in the city of Pekanbaru. The benefit of research is that we will get what students need at the moment in learning science. The analysis of this need is seen based on 4 indicators namely a) analysis of learning problems, b) analysis of objectives, 3) analysis of learners and d) analysis of settings. Based on the results of this study obtained information that the development of embedded STEM projects received a good response and is feasible to be developed in the city of Pekanbaru.

Keywords: Need analysis, STEM Embeded, and Project

1. Introduction

The ability of Indonesian students based on the 2015 PISA survey (OECD, 2018) is still relatively low. Achievements in the fields of science, mathematics and reading were 62, 63 and 61 of the 69 countries evaluated. This is not much different from the results of the PISA survey in 2012 and 2009. Seeing this reality, there arises our concern about the competitiveness of Indonesian students in the future. Let alone compared with Singapore which won all aspects and indicators of assessment, with other Southeast Asian countries we are left behind. Noted Vietnam is far in the top rankings and Thailand is also superior in Indonesia.

Based on the above problems, we need a new strategy in Indonesian education today. Educational institutions not only educate students who are equipped with knowledge but also to educate individuals to know how to access knowledge and produce new information using the knowledge they have acquired. (Kamaruddin, 2018) History is a actual science that have important values associated with character formation and strengthening of national identity. History has various understanding of the values of life. Various events in history can evoke emotions, values, and ideals which create life more meaningful. History is an educational tool to get to know the people and culture.

Permendikbud (2016) states that to strengthen scientific approaches (scientific), integrated thematic (thematic between subjects), and thematic (in a subject) need to be applied inquiry-based learning. To encourage the ability of students to produce contextual work, both individually and in groups it is strongly recommended to use a learning approach that produces work based on problem solving (project based learning). The mandate of Curriculum-2013 above which requires thematic in one learning (Physics, Biology and Chemistry), then the study of STEM in science is needed in learning. STEM stands for science, technology, engineering and mathematics (Meng & Noraini, 2014).

STEM is a group of knowledge that is closely related to each other. Science requires mathematics as a tool in processing data, while technology and engineering are applications of science. The STEM approach to learning is expected to produce meaningful learning for students through the systematic integration of knowledge, concepts and skills. Some of the benefits of the STEM approach make students able to solve problems better, innovators, inventors, independent, logical thinkers, and technological literacy (Morrison in Stohlmann, Moore, & Roehrig, 2012). According to Afriana et al (2012) Implementation of Project Based Learning (PjBl) STEM makes learning more interesting and can motivate students and form creative attitudes. Students feel happy working in groups so that they want PjBL STEM learning to be reapplied to other material.

In connection with the implementation of STEM Education, Bybee (2013) states that in STEM learning, at the higher education level it needs to be challenged to perform authentic engineering tasks as a complement of science learning through project activities that integrate science, energy, technology, and mathematics. (Wahyunu, 2019) Education is very important because with education, someone can equip themselves with science in order to compete and defend themselves. In addition, with the existence of education, it will change one's mindset for the better. So is the importance of education for UMKM business owners.

Furthermore Sedath (2019) suggested that teachers should be given a professional development program to prepare for STEM projects (Sedat 2019). STEM education strengthens the creativity and problem solving skills of students "Yıldırım (2016). Shi-Jer Lou at all. (2016) states that STEM-Imagination project activities have a positive effect on their learning, attitudes and strategic performance in problem solving. In this study the STEM model developed was the amphibious vehicle project. Facilitating learning for students is the main important task of teachers (Islami, 2018).

In STEM education, there are two discussions for the integration of science and mathematics into engineering as context and content (Moore & Smith, 2014). In context integration, engineering design is seen as a tool to teach mathematical content and science fields, whereas for content integration, engineering skills form part of the learning objectives together with science and mathematics content. Through STEM learning, students have scientific and technological literacy so that it can be used as provisions for social life and solving problems encountered in daily life related to the STEM field (Mayasari et al., 2014). The following in Table 1 is the definition of STEM National Governor's Association Center Literacy.

Table 1. STEM Literacy Definition

Science	Scientific literacy: The ability to use scientific knowledge and processes to understand the world and to participate in making decisions to influence it
Technology	Technology literacy: knowledge of how to use new technologies, understanding how new technologies are developed, and having the ability to analyze how new technologies affect individuals, society and the nation and the world
Engeneering	Understand how technology can be developed through the process of engineering/design using project-based learning themes by integrating from several subjects
Mathematic	Mathematical literacy: the ability to analyze reasons, and communicate ideas effectively from how to behave, formulate solutions, and interpret solutions to mathematical problems in applying different situations

Three methods of teaching approach in STEM education at this time are often done. The difference between each method lies in the level of STEM content that can be applied. The three STEM education approach methods that are often used are the silo approach, the embedded approach, and the integrated approach. The three STEM approaches are as follows:

The Silo approach to STEM education. Each discipline is taught separately to maintain the domain of knowledge of each discipline (William E. Dugger, Jr. Senior Fellow 2010). The embedded approach emphasizes maintaining the integrity of subject matter, rather than focusing on interdisciplinary subjects. Integrated STEM education connects the four STEM fields (Blackley and Howell 2015). The three types of STEM can be seen in Figure 1

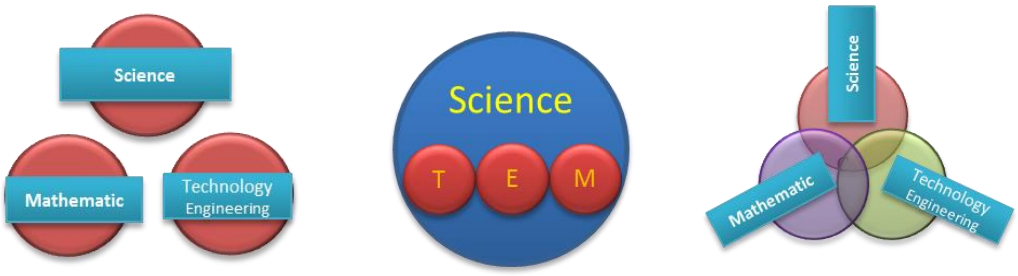

Figure 1. Pendekatan STEM a) Silo, b) Embeded c) Integrated

Based on Figure 1, the STEM silo approach is difficult to apply in Indonesia, because combining three subjects namely science, technology-engineering and mathematics. STEM Embeded can be applied because the main subject is the subjects of science, technology, engineering and mathematics are only tools to realize the product. Integrated STEM is very suitable to be applied in elementary schools with thematic learning.

Need analysis is used to look at the gap between what is already available and what is expected, and the process of gathering information about the gap and determining the main priorities for taking action. The analysis of learning problems is the analysis of learning problems, analysis of students, analysis of learning objectives and analysis of learning settings.

An assessment of needs can be done when the learning program designer is able to conduct a series of analyzes related to the needs needed to develop a good learning program. The analysis is, (1) analysis of learning problems (instructional problem); (2) student analysis (audience analysis); (3) goal analysis; and (4) instructional setting analysis (Tageh, 2014).

2. Methodology

2.1. Research Flow

This research is a survey research involving 35 high school students. The sampling technique used in this study is to use a cluster sampling procedure or sampling based on a specific area. To determine which population will be used as a source of data, the sampling is based on a predetermined population area.

Survey research procedures can be seen through the scheme shown in Figure 2.

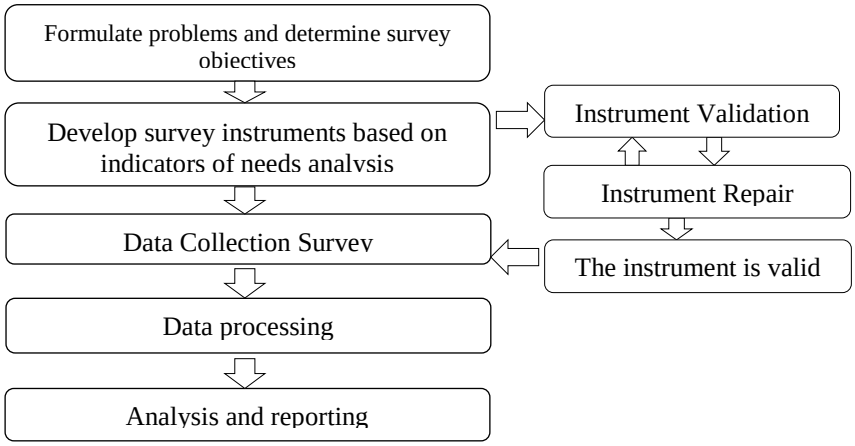

Figure 2. Research Flow

2.2 Research Instruments

The research instrument used was a closed questionnaire developed by researchers based on an analysis of learning needs. The questionnaire developed consisted of 17 question items from the 4 indicators shown in Table 2.

Table 2. Questionnaire indicators for the need to develop an Embedded STEM project

Indicators of need analysis	Number of question items
Analysis of learning problems	7
Student analysis	4
Analysis of the objectives	3
Analysis of learning settings	3

The question items in Table 2, made consisted of 4 choices (Strongly agree score 4, agree score 3, disagree score 2 and strongly disagree score 1). Before the questionnaire instrument was given to students, construct validation was carried out by 2 science experts. If this expert has declared this instrument valid, then the instrument can already be used for surveys.

Data on the results of the questionnaire level of the need to develop an Embedded STEM project in the city of Pekanbaru were analyzed using descriptive statistics that are averages and percentages. To determine the level of development requirements for the Embedded STEM project for each indicator guided by Table 3.

Tabel 3.Category analysis of needs

No	Range average score	Categories	Decision
1	>3,25 - 4	Very High	need
2	>2,5 - ≤ 3,25	High	need
3	>1,75 - ≤ 2,5	Low	no need
4	1- ≤ 1,75	Very Low	no need

3. Result and Discussion

Based on the analysis of the data in this study it was found that, obtained information that the analysis of STEM Project requirements for each indicator of analysis, can be seen in Figure 2 below

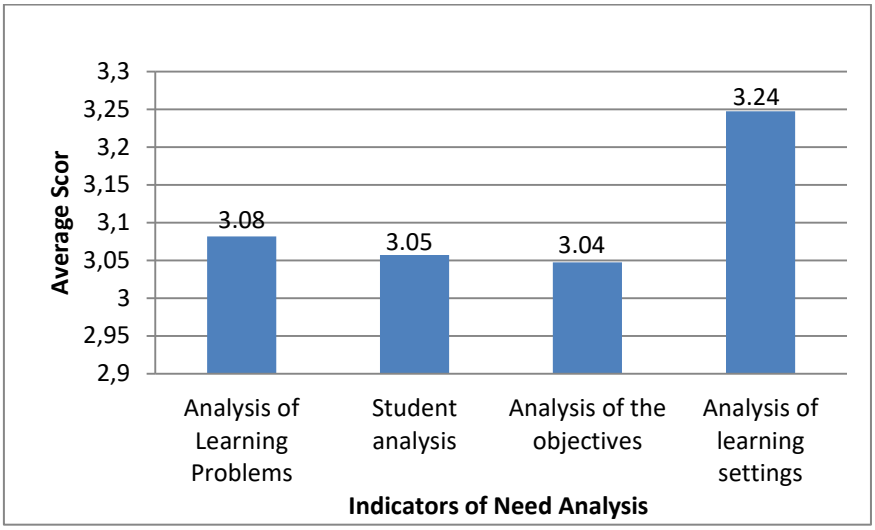

Figure 1. Results of the Embeded STEM Project Needs Analysis

Need analysis is one way to find solutions to learning problems. This was stated by As, Arizal at al. (2017) that it is important to have an effort in solving learning problems so there are no gaps in learning. Based on Figure 1 above, it can be seen that the average range of scores answered by students is 2.5-3.5. This means that students agree with positive statements about the application of the STEM Embedded approach. Embedded STEM is the solution of the problems in learning science in the city of Pekanbaru.

One of the statements agreed upon by students in overcoming learning problems is, students are not interested in learning that is merely writing without the practice of solving problems directly this is in accordance with the research of Esra Ucak (2019) which states that most students expect their teachers to entertain, they want their lessons to be taught through games and experiments, and they don't want to write much in their class.

Richards (2007) believes that a good education program must be based on an analysis of student needs. Figure 2 above can be seen that the average range of scores answered by students is 3.05, this means that students agree with positive statements about the application of the STEM Embedded approach in learning to meet students' self needs. One of the positive statements agreed upon by students can make students feel that the approach can meet students' needs in learning. Students feel they will understand more about the science material taught when the end of learning is assigned to design a product. This is in accordance with the opinion of Heafner (2004)that Students identify that working with technology is easier and possible for students to work quickly and efficiently.

Learning needs analysis needs to be done in the initial stages of designing learning model development activities. This step is carried out to determine the learning objectives to be achieved. More specifically, this step is to determine the purpose of learning orientation, for example conceptual, procedural, or theoretical orientation. (Peniati at al. 2013). analysis of further learning needs is the analysis of learning settings. By using quality learning tools, with a constructivist learning

model setting, it will help students build their own knowledge through experience from their interactions with the environment, so students will feel the meaning of learning more, students become more understanding and understanding because of the knowledge they get with look for themselves, besides the goals and competencies that are expected to be mastered by students will be fulfilled. (Heni, Budi & Setiawan 2015). based on the diagram above it can be seen that the range of scores answered by students related to the analysis of learning needs is an average of 3-3.25. this means students agree with the STEM Embedded approach able to meet the analysis of learning needs so that students are able to understand learning well.

Based on the graph above it can be seen that the average range of scores answered by students is 2.5-3.5. this means that students agree with positive statements about the application of the STEM Embedded approach in learning to make students achieve the goals of science learning well. One positive statement approved by students that can make students achieve learning goals that is, students will easily understand the material in detail/real if students are invited directly in designing a science product if students have understood the learning material well means students already have new knowledge in learning thus students means that they have achieved the learning objectives well. This is consistent with the opinion of Rebecca, Mark et al. (2015) Ie, learning objectives are generally categorized into one of two main categories, with mastery goals reflecting the desire of students to develop competencies by gaining new knowledge or skills, and performance goals that involve a desire to show competence one relative to another.

Analysis of learning setting, based on the graph above it can be seen that the average range of scores answered by students is 3-3.5 this means that students agree with positive statements about the application of the STEM Embedded approach. One positive statement that is agreed upon by students can make students feel that the approach can be beneficial for science, technology, mathematics, and engineering. Very important to be controlled for the future of the country. This is in accordance with research from one of the American organizations namely the American Association for the Advancement of Science (AAAS) in 1989 in Inas Aref (2018) states the link between science, mathematics, and technology is the core means of science education to scientific literacy.

4. Conclusion

Analysis of the need for developing STEM projects, in terms of 4 indicators: learning problem analysis, goal analysis, student analysis, learning setting analysis. Based on the results of the study it was found that, there is a need for learning based on STEM projects in junior high school students in Pekanbaru

Acknowledgement

Thank you to the University of Riau Research and Community Service Institute (LPPM) for the funds that have been provided through the University of Riau PNBP 2019

References

Afriana, A Permanasari, A Fitriani. 2014. Project Based Learning Integrated to STEM to enhance Elementary School's Student Scientific Literacy. Jurnal Pendidikan IPA Indonesia. JPII 5 (2) (2016) 261-267. DOI: 10.15294/jpii.v5i2.5493

Aref Inas, 2018. The Degree of Including International Standards of Science Education in the Physics Syllabus of Palestinian Secondary Schools. World Journal of Education.V olume 8 No 3. ISSN 1925-0746. http://wje.sciedupress.com

Asrizal, Festiyed & Ramadhan Sumarmin. 2017. Analysis of the Need for Development of Integrated Science Teaching Materials with Literacy in the Digital Era for the Learning of VIII Middle School students. Jurnal Eksakta Pendidikan (JEP). Volume 1 No1. ISSN 2579-860X.

Blackley, S., & Howell, J. (2015). A STEM narrative: 15 years in the making. Australian Journal of Teacher Education, 40(7). DOI:10.14221/ajte.2015v40n7.8.

Bybee, R. W. (2013). The case for STEM education: Challenges and opportunity. Arlington, VI: National Science Teachers Association (NSTA) Press.

Esra Ucak. 2019 "Science Teaching and Science Teachers" from Students' Point of View . International Journal of Educational Methodology .Volume 5, Issue 1, 221 - 233. ISSN: 2469-9632. http://www.ijem.com/

Heafner, Tina. 2004. Using Technology to Motivate Students to Learn Social Studies. Cite Journal. Volume 4 No 1. ISSN 1528-5804. http://www.aace.org

Heni, Budi & Setiawan. 2015. Development of Science Learning Tools by Setting Community Science Technology to Enhance Science Process Skills and Creative Thinking Skills of Middle School Students. e- Journal Graduate Program at Ganesha University of Education. Volume 5 No 1

Inas Aref, 2018. The Degree of Including International Standards of Science Education in the Physics Syllabus of Palestinian Secondary Schools. World Journal of Education.V olume 8 No 3. ISSN 1925-0746. http://wje.sciedupress.com

Islami N (2018) Demonstration of the Google Earth as a Tool in Learning the Earth Physics. *Journal of Educational Sciences. Vol. 2, No. 1, 2018, 66-73*

Kamaruddin and Ahmal (2018) The study of history based on local antiquity: A case study of existence of Kampar River in analyzing the past maritime in teaching history. *Journal of Educational Sciences. Vol. 2, No. 1, 2018, 72-82*

Mayasari, T., Kadorahman, A., & Rusdiana, D. 2014. Effect of integrated learning of science, technology, engineering, and mathematics (STEM) on student learning outcomes: Meta-analysis study, Proceedings of the National Seminar on Pensa VI "The Role of Science Literacy" (p.371-377). Surabaya: UNESA

Meng, C.C., Noraini I & Eu, L K,.2014. Secondary Students' Perceptions of Assessments in Science, Technology, Engineering, and Mathematics (STEM). EURASIA Journal of Mathematics, Science & Technology Education, v10 n3 p219-227

Moore, T.J., & Smith, K.A.(2014). Advancing the State of the Art of STEM Integration. Journal of STEM Education, 15(1), 5-10.

OECD 2018. PISA 2015 Results in Focus

Peniati, Parmin & Purwantoyo. 2013. Self Evaluation Analysis Model for Developing the Ability of Prospective Science Teacher Students in Designing Laboratory Development in Schools. Jurnal Pendidikan IPA Indonesia. Volume 2 No 2. ISSN 107-119.

Permendikbud 2016. Salinan Lampiran. Peraturan Menteri Pendidikan dan Kebudayaan Nomor 22 Tahun 2016 Tentang Standar Proses Pendidikan Dasar dan Menengah

Rebecca A, Mark W, Helena D,Kyle H, Nathan C. 2015. Exploring Student Persistence in STEM Programs: A Motivational Model . Journal of Education. Volume 38 No 1. www.cje-rce.ca.

Sedat Kanadh 2019. A Meta-Summary of Qualitative Findings about STEM Education. International Journal of Instruction January 2019. Vol.12, No.1 e-ISSN: 1308-1470. www.e-iji.net p-ISSN: 1694-609X pp. 959-976

Sedat Kanadh 2019. A Meta-Summary of Qualitative Findings about STEM Education. International Journal of Instruction January 2019. Vol.12, No.1 e-ISSN: 1308-1470. www.e-iji.net p-ISSN: 1694-609X pp. 959-976

Shi-Jer Lou. Huei-Yin Tsai, Kuo-Hung Tseng, Ru-Chu Shih 2016. Effects of Implementing STEM-I Project-Based Learning Activities for Female High School Students. STEM UDUCATION. Concepts, methodologies, Tools and Applications. Information ResearchManagement Assosiasion. Volume 1.

Shi-Jer Lou. Huei-Yin Tsai, Kuo-Hung Tseng, Ru-Chu Shih 2016. Effects of Implementing STEM-I Project-Based Learning Activities for Female High School Students. STEM UDUCATION. Concepts, methodologies, Tools and Applications. Information Research Management Assosiasion. Volume 1.

Stohlmann, M., Moore, T. J., & Roehrig, G. H. 2012. Considerations for teaching integrated STEM education. Journal of Pre-College Engineering Education Research. 2(2), 1–28. http://doi.org/10.5703/1288284314653

Tageh & Made. 2014. Development Research Model. Graha Ilmu. Yogyakarta

Wahyuni D, Caska and Indrawati H (2019) Analysis of Education Levels of Business Owners and Factors Affecting Business Success in Sago-Based UMKM in Kepulauan Meranti Regency. *Journal of Educational Sciences Vol. 3 No. 2 (May, 2019) 216–226*

William E. Dugger, Jr. Senior Fellow 2010. Evolution of STEM in the United States. International Technology and Engineering Educators Association (wdugger@iteea.org) and Emeritus Professor of Technology Education Virginia Tech (dugger@vt.ed

Yıldırım, B. (2016). An analyses and meta-synthesis of research on STEM education. *Journal of* Education and Practice, *7*(34), 23-33.