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"Improving Professionalism and Reflective
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"Improving Professionalism
and Reflective Thinking through Design Research"

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Preface

It is an honor and privilege to welcome you to the 7th South East Asia Design Research International Conference. The conference's theme, "Improving Professionalism and Reflective Thinking through Design Research," invites us to reflect on the current educational challenges, e.g. globalization and industrial revolution 4.0, and transform them into opportunities through design research. It acknowledges the need to develop our professionalism so that we can proactively contribute to the advancement of educational science and praxis. It challenges us to re-thinking the design research as a method to make learning and teaching innovation possible, but also as a paradigm in building our capacity for innovation.

Yogyakarta is an artsy and historical city which serves as a fitting cultural, social, political, and economic milieu for the conference. The tagline, "Jogja Istimewa," itself shows how the city has special values to be explored and experienced, and we encourage you to absorb the city's abundance: The Kraton, the cultural and political heart of the city; Fort Vredeburg museum; Malioboro road; Dipowisata urban tourism, to name a few.

The perfect ambience of Yogyakarta will provide us with a convenient space to interact and exchange ideas with colleagues as a means of professional learning. Our goal is for you to get new ideas, tools, and materials from the conference which will contribute to your professional development. The variety of sessions, workshops, and social events will give you opportunities to connect with friends and colleagues to expand your networks. We are excited about the keynote and invited speakers. We believe they will share challenging and innovative ideas about education.

This conference is the result of the hard work, support, and dedication of a number of parties. We wish to thank all the committee members who together make the conference possible. The committee has been working throughout the year to propose sessions, review a record number of submissions, answer queries, arrange the schedule, and response to last-minute requests. We also want to thank Sanata Dharma University; Ministry of Research, Technology, and Higher Education of Indonesia; Sogang University and SEAMEO QITEP in Mathematics for their contribution to funding the conference. Thank you for being here with us. We value your presence at the 7th South East Asia Design Research International Conference. Enjoy the conference!

Yosep Dwi Kristanto, Conference Chair
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Contents

Improving the Communication Skills of Grade VII Students for Animals Classification and Set by Using STEM Approach

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Abstract: Communication ability is one of the most important abilities in the 21st century, but at this time students' ability to communicate is very limited. The STEM (Science Technology Engineering and Mathematics) approach helps teachers integrate between science, technology, engineering and mathematics in learning. Learning using the STEM approach makes the knowledge possessed by students intact and able to create effective communication in various forms and contents verbally, written, and using multimedia. This study aims to describe the communication skills of 34 students of Grade VII D on Science and Mathematics subjects with the STEM approach. The research method used is design research (data collection instrument method) The results of the study are in the form of presentations in the form of science and mathematics subjects. This research was conducted at Yogyakarta State Middle School 1 for grade VII students. The results of the study indicate that students' communication skills can be trained structurally indicated by the results of the videos made. The average score of 28 shows good value. The results of this study indicate that science and mathematics learning with the STEM approach has the potential to develop students' communication skills.

Keywords: communication skills, STEM

Introduction

Naturally, humans need to communicate since they were babies until the end of their lives. As social beings, humans will always want to talk, exchange ideas, send and receive information, share experiences, work together with others to fulfill their needs and so on (Aw, 2011). Ruben and Stewart (2006) defined that communication is the process by which someone or several people, groups, organizations, and communities use information to connect with the environment and the others. In teaching and learning, communication skills are very necessary. It will be easier to convey ideas or ideas related to teaching and learning.

If viewed from the form of information messages delivered, communication is divided into two types, namely verbal communication and nonverbal communication. Verbal communication is communication using language which written and spoken. While nonverbal communication is communication that uses cues, motion, images, symbols, facial expressions, and so forth (Devito, 1997). In the learning process, students are required to be active. One of the activities of students is shown by expressing opinions and asking questions. These communication skills need to be developed so that the delivery of information from students can be understood and accepted well. Supratiknya (1995) stated that, communication skills are not abilities that are born from birth and also will not appear suddenly - when people need it. These skills must be learned or trained.

Education is very important in creating civilization in a country. The advance of state education is determined by the quality of education. This is due to the increasing age, which is marked by the rapid advancement and information. Competition in various fields of life in the 21st century is very competitive. Life is currently faced with the demand for the importance of competent human resources so that they can compete in living life. Quality human resources can be the main force to overcome the problems faced in education. Therefore, various countries in the world try to define the 21st century human characteristics in question.

ATCS (Assessment and Teaching for 21st Century Skill) in Greenstein (2012) stated that there are four main things related to the 21st century, namely ways of thinking, ways of working, work tools, and life skills. The way of thinking includes creativity, critical thinking, problem solving, decision making, and learning. How to work includes communication and collaboration. Tools for work include

information and communication technology. Life skills include citizenship, life and career, and personal and social responsibilities.

In the 21st century, students who are able to survive are those who are able to communicate in various ways, both written and verbal. Students are required to understand, manage, and create effective communication in various forms and contents in writing, oral, and multimedia. Students are given the opportunity to use their abilities to express their ideas, both during discussions with friends and when solving problems from the teacher.

Karso et al. (2011) stated that indicators of scientific communication capabilities include: compiling and submitting reports systematically and clearly, explaining the results of experiments, discussing the results of experiments, classifying data and compiling data and describing data in graphs, tables or diagrams.

Learning at SMPN 1 Yogyakarta is dominated by lecture systems and tends to be teacher-centered, interactions between students and teachers are lacking. In learning there are only a few students who actively ask questions and express opinions. When presenting, many students feel nervous and dare not express their opinions in public and are afraid of being criticized. If problems are found in learning, students will find it difficult to work together and discuss with friends. Another problem that is also found is that students are afraid of being wrong in conveying their ideas.

In science and mathematics learning, especially the material set and classification of living things there are several obstacles. Students find it difficult to determine the various types of sets on real objects, so that some objects should not enter into the set that students specify. In the material of classification of living things, students have difficulty if this material is explained without using objects, whether images or real objects.

Some problems that can be identified based on communication skills, researchers obtain the following problems: (1) students' communication skills do not come on their own, but students must be given many opportunities in communicating their ideas, (2) students are afraid of conveying ideas or ideas, (3) difficult students in working together to convey group ideas, and (4) not all students are active in the process of communication and discussion. Hodiyanto (2017) said that the learning model or approach can be used to develop mathematical communication skills, including: PMR approach, problem posing learning model with PMR approach, problem solving learning model with PMR approach, and reciprocal teaching.

The 21st century was marked by the rapid development of technology. Various types of information spread rapidly which led to the emergence of an era of technology-based economy. Individuals who can answer various global challenges are individuals who are able to obtain, process, and interpret various information and knowledge. This requires learning that can improve skills in the 21st century so that students can compete in the era of globalization. Learning using the STEM approach is one solution to answer this educational challenge (Fan & Ritz, 2014).

STEM is an approach in education where Science, Technology, Engineering, Mathematics is integrated with the educational process focusing on solving problems in real life as well as in professional life. STEM is an acronym for science, technology, engineering and mathematics. This term was first launched by the National Science Foundation (NSF) of the United States (US) in the 1990s.

STEM education is a learning that relies on the cross disciplinary approach and Project Based Learning. The purpose of STEM itself is to prepare students to be able to apply their knowledge to solve complex problems and develop STEM expectations (Sukardjo, 2009). Every aspect of STEM has special characteristics that distinguish between these four aspects. The four characteristics are based on the definition outlined by Torlakson (2014), namely: (1) science that represents knowledge of applicable laws and concepts in nature; (2) technology is a skill or a system used in regulating society, organization, knowledge or designing and using an artificial tool that can facilitate work; (3) engineering or engineering is the knowledge to operate or design a procedure to solve a problem; and (4) mathematics is a science that connects between quantities, numbers and spaces that only require logical arguments without or accompanied by empirical evidence.

Bybee (2013) revealed that there are four outlines of improvements that make STEM different from others in the world of education as follows: (1) talk about the global challenges that must be understood by the community; (2) changing perceptions of environmental problems and problems between people; (3) recognize abilities that must be possessed in the 21st century; (4) continuing issues of national defense.

The problems in this study is formulated as follows how communication skills after students experience the learning process using the STEM approach in learning about animal classification and set. This study aims to describe the communication skills of students after experiencing the learning process using the STEM approach in learning about animal classification and sets.

Research Method

This study is design research. Design research is a development model for designing and developing interventions in learning such as; teaching programs, strategies and learning materials (Ploomp & Nieveen, 2013). Basically, design research is relevant to the practice of education (and hence also to educational policy) because it aims to develop research-based solutions to complex problems in educational practice or to develop or validate theories about the learning and teaching process. Whatever the purpose of design research, the research process is always combined with a systematic educational design process.
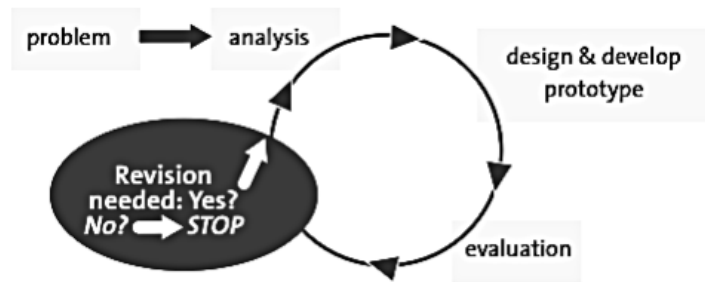
Figure 1. The systematic of design research

This research was conducted in four stages including: (1) initial investigation; (2) theoretical learning; (3) empirical testing; (4) documentation, analysis, and reflection on the process and results. In this initial stage, the researcher determines the place, the subject of the research, and makes other preparations such as arranging the research schedule and cooperation procedures with other teachers to develop teaching materials developed on the students' communication skills. The instruments used in this study were observation sheets, videos, photos, field notes, and assessment guidelines. All instruments are used to collect data in these results. Finally, all data were analyzed using descriptive analysis and triangulation data.

This research was conducted at SMP N 1 Yogyakarta on August 25, 2018 to September 7 2018. The subjects of this study were 34 students of class VII D. In the learning process, to help students understand how the process of classifying animals in science learning, how to distinguish sets and not set, determine the requirements for membership of a set, and write down members of a set.

Observations carried out by students in groups by documenting pictures or photos of various kinds of animals at the Gembira Loka Zoo in Yogyakarta. Photographs of the animals are printed and cut out, and pasted and grouped based on certain characteristics, for example based on the type of food, mobile devices and others. The instrument used in this study is the communication skills assessment sheet on video. The communication skills assessment instrument sheet can be seen in the Table 1.

Table 1. Communication Skills Assessment Instrument

No	Aspects	Score				
		1	2	3	4	5

1	Students are able to express ideas of design that will be made
2	Clarity of concept in the design made
3	Communicate the concept of the design systematically
4	Division of roles in communicating the design concepts proportionally
5	Suitability of design with presentation
6	The logical aspect of design
7	The logical idea of design

The data about communication is descriptive and obtain from video assessments. Assessment in this study using a Likert scale, said to be feasible if the mean (average) of the respondents at least get good criteria. Data in the form of scores are converted into qualitative data (data intervals) with a scale of 5. Changing this score refers has the following conditions:

Table 2. Scores for the Average Score of Each Component

No	Score renge (i)	Score	Category
1	$X \geq Mi + 1.8\ SBi$	A	Very good
2	$Mi + 0.60\ SBi < X \leq Mi + 1.80\ SBi$	B	Good
3	$Mi - 0.60\ SBi < X \leq Mi + 0.60\ SBi$	C	Fair
4	$Mi - 1.80\ SBi < X \leq Mi - 0.60\ SBi$	D	Poor
5	$X < Mi - 1.8\ SBi$	E	Very poor

Symbols:

$M_i = \frac{1}{2}$ (ideal maximum score + ideal minimum score)

SB_i = The ideal standard deviation that can be searched using

$SB_i = (\frac{1}{2}x\frac{1}{3})$ x (ideal maximum score − ideal minimum score)

$= \frac{1}{6}$(ideal maximum score − ideal minimum score)

$\bar{X}$ = empirical score

Ideal maximum score $= \sum$ highest score criteria

Ideal minimum score $= \sum$ lowest score criteria

Determine the overall value by calculating the average score of all assessment criteria, then changing it into qualitative values according to the criteria of the ideal assessment category in table 2 above.

Before the communication skills assessment instrument sheet is used, the validity test is first performed. The validity test is carried out with regard to the accuracy of the measuring instrument against the concept being measured so that it actually measures what should be measured. The validity test of the communication instrument was carried out through the consideration of experts consisting of 2 physics lecturers, 1 mathematics lecturer, and 2 teachers. The results of the considerations are presented in Table 3.

Table 3. The validity of communication instrument

No. Soal	Validator				
	1	2	3	4	5
1	0	1	0	1	1
2	1	1	1	1	1
3	1	0	1	1	1

4	1	1	1	1	1
5	1	1	1	1	1
6	1	1	1	1	1
7	1	0	0	1	1

Information: 1 = Valid, 0= Tidak Valid

The results of the expert scales presented in the Table 3 are then analyzed using the Q-Cochran statistical test.

Table 4. Q-Cochran test on instrument **validity**

N	7
Cochran's Q	2400(a)
Df	2
Asump. Sig.	.666667

Based on Table 4 above it can be seen that the Cochran Q statistical price for validity is 2400 with an asymptotic significance rate of 0.666667. Because the asymptotic significance price is greater than 0.05, it can be concluded that at the 5% significance level the validators give uniform consideration to the validity of the communication instrument.

Discussion

This research begins to determine the material between Science and Mathematics that can be integrated in the learning process. Before the learning process in class, students do an outdoor learning class that is visiting the Gembira Loka zoo on Saturday, August 25, 2018. The purpose of students visited the zoo to observe the layout of the cage, while also looking for data in the form of photographs of animals there. The photos are collected which will later be used in the learning process.

The first lesson was conducted on Monday, September 3, 2018 in the Association material for mathematics and animal classification in science lessons using the STEM approach. Learning is focused on the process of communication skills.

The last meeting was held on September 7, 2018. Students presented the results of their discussions regarding animal classification and set concepts. After the presentation is complete, students are directed to draw conclusions about the classification of living things, define the meaning of sets, distinguish sets and not sets, and determine how to write or present the set.

The technique that students apply is to design zoos based on the concept of animal classification and the set they have learned. Furthermore, zoo designs that have been made are then presented in the form of videos. The video is uploaded to YouTube and the assessment is based on many likes obtained and also from the assessment questionnaire to find out how students communicate.

Here are the results of assessment of students the ability to communicate via video sketch zoo:

Table 5. Data of student communication assessment score

No.	Group's name	No. of question						
		1	2	3	4	5	6	7
1	Group 1	3	4	4	4	3	3	4
2	Group 2	4	3	4	3	4	4	3
3	Group 3	4	4	4	5	4	4	5
4	Group 4	5	4	5	5	5	5	4

5	Group 5	4	5	4	4	4	5	3
6	Group 6	4	3	4	3	4	4	4
	Averages	4	3,83	4,17	4	4	4,17	3,83

Based on the data presented, the number of scores obtained from the assessment of communication skills is then analyzed based on the conversion of a five-scale scoring score. The range of quantitative scores and their categories are as follows:

Tabel 6. Score conversion table for assessment of communication skills

Interval Score		Score	Category
$X > Mi + 1,80 SBi$	$X > 29,41$	A	Very good
$Mi + 0,6 SBi < X \leq Mi + 1,80 SBi$	$21,60 < X \leq 29,41$	B	Good
$Mi - 0,6 SBi < X \leq Mi + 0,6 SBi$	$26,00 < X \leq 34,00$	C	Fair
$Mi - 1,80 SBi < X \leq Mi - 0,6 SBi$	$17,99 < X \leq 26.00$	D	Poor
$X \leq Mi - 0,6 SBi$	$X \leq 17,99$	E	Very poor

The results of students 'communication skills attainment in tables 5 and 6 are known that the total score for communication skills assessment is 28. This score is in the range of scores $21.60 < X \leq 29.41$, so that students' communication skills are included in the B score with good categories. The level of students' ability to communicate well based on the research is due to the learning approach used which is STEM approach. These results are in line with research [8] which shows that the communication skills of junior high school students using STEM-based science learning is good enough.

From table 5 it can be seen that students' communication in developing design concepts is still lacking. That is because students' lack of understanding determines the type of zoo they want to make. In addition, the students is still lacking of logical idea for example: playing rides, canteens, and, sellers of souvenirs that are less appropriate.

Students' abilities in various aspects of communication can be seen from students' ability to discuss problems and make drawings or models. To improve students' communication skills by encouraging students to conduct learning activities in discussion, solve problems, and convey the results of the discussion to other students. When discussing, students will communicate a lot with their members. Students will exchange information and be directly involved in learning and explore their knowledge. These results can be concluded that the STEM approach in the learning process can help students practice structured communication skills.

Conclusion

Based on the results of research and discussion, it can be concluded that the communication skills of students can be trained structurally indicated by the results of the videos made. The average score of 28 shows good value. The results of this study indicate that science and mathematics learning with the STEM approach has the potential to develop students' communication skills.

Referring to the results of the above research, things can be suggested as follows: (1) When learning using STEM, it is better to be integrated between science, technology, engineering, and mathematics. So that learning will be intact and make it easier for students to find concepts in learning. (2) The STEM approach can develop students' communication skills, so that it can be an alternative for teachers in the natural teaching and learning process. (3) The STEM approach can also help students prepare themselves to face the industrial revolution. (4) For schools, it is best to apply the STEM approach to learning and enter the curriculum system.

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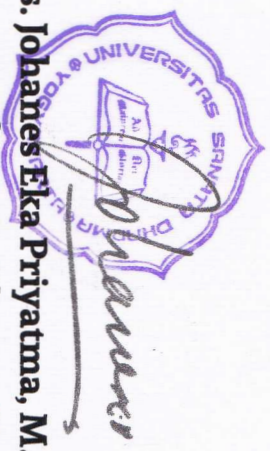
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This is to certify that

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has participated in **The 7th South East Asia - Design Research International Conference (SEA-DR 2019)**

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