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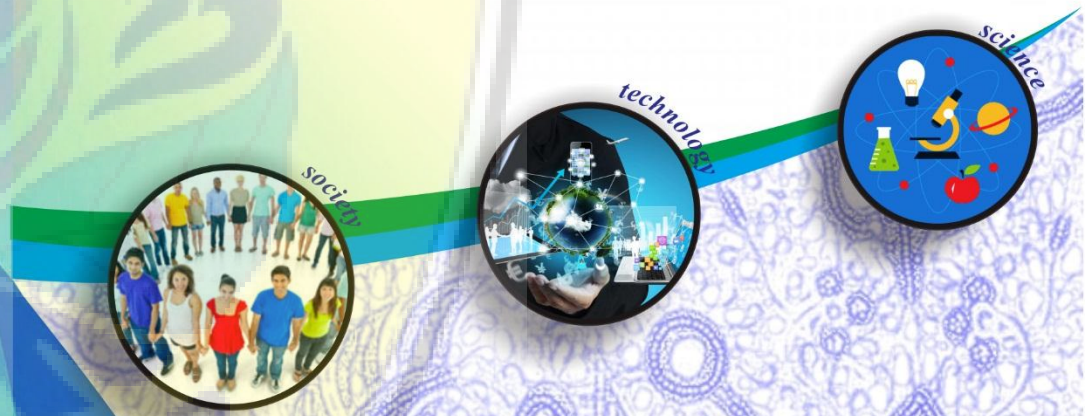
PROCEEDING

International Seminar on Science Education
Volume III

Enhancing Interdisciplinary Practice of Science Education in the Realization of NGSS (Next Generation Science Standard)



Graduate School
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Batik Yogyakarta Motif Semen Sido Mukti

October 28th, 2017

Proceeding of the International Seminar on Science Education Volume III

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PREFACE

Praise to Allah SWT for all the blessings and guidance given to us all, so that the program of the International Seminar on Science Education (ISSE) 2017 with the topic about Enhancing Interdisciplinary Practice of Science Education in The Realization of NGSS (Next Generation Science Standards) which held on October 28th 2017 at Rectorate Hall, Yogyakarta State University can be completed successfully.

This proceeding is presented in four sections: 1) Science; 2) Physics; 3) Biology Chemistry; and 4) General Education. This comprises number of papers that have been presented in the seminar, written by lecturers and students from Yogyakarta State University and other universities.

We owe many parties for the success of the seminar. Therefore, we would like to sincerely extend our gratitude to:

1. The rector of Yogyakarta State University, Prof. Dr. Sutrisna Wibawa, M.Pd for facilitating all the activities of the International Seminar on Science Education (ISSE) 2017;
2. The director of Graduate School of Yogyakarta State University, Dr. Moch. Bruri Triyono for providing all the facilities of the International Seminar on Science Education (ISSE) 2017;
3. The invited speakers for their willingness to share thoughts and insights on science teaching and learning in the seminar;
4. All committee members for the time, effort, and thoughts for the success of this activity; and
5. All presenters and participants who have come a long way to contribute to the success of the seminar.

However, we truth fully understand that some imperfections might be find in this proceeding and in the seminar. Thus, suggestions and constructive criticisms are very much welcome. Finally, we hope that this proceeding may contribute in science and science education

Yogyakarta, Oktober 28th 2017

Chair Person

Prof. Dr. I Gusti Putu Suryadarma, M.S

Digital Repository Universitas Jember
ISSN : 2476-9533
Volume 3, October 2017

TABLE OF CONTENTS

Preface i
Table of Contents ii

Code	Tittle of the paper	Page
S1	Learning Based Education For Sustainable Development To Enhance Scientific Literacy (*Anita Ekantini, Vioni Kurnia Armus, Dwi Safriani Pangestika)*	1
S4	Effectiveness of POE-based Student Worksheet to Improving Student's Argumentation Ability in Energy Materials (*Cahyani Lestari, Abdurrahman, Tri Jalmo*)	4
S5	Enhancing Generic Science Skills Through Cooperative Learning Group Investigation Model (*Rasimah, Saefudin, Ida Kaniawati*)	13
S6	Optimization of Learning Science by Using Teaching Materials Based Local Wisdom to Improve Science Process Skills of Junior High School Students (*Kodirin, Novi Nurmayanti, Nur Balqis Mutia*)	22
S8	Facilitating Students' Conceptual Development of Light Refraction through STEM-based Virtual Lab Utilization (*Muhammad Rifqi Rofiuddin, Anna Permanasari, and Riandi*)	25
S11	Assesing Pedagogical Content Knowledge in STEM Education: Literature Review (*Pramudya Dwi Aristya Putra, Yoshisuke Kumano*)	23
S14	Studies on Experiential Science Education Program Development for Young Children and Their Parents at the Shizuoka Science Museum; RUKURU (*Shoko SAKATA*)	40
S16	Science Learning Integrated Local Potential Through Video To Optimize Science Process Skills Ofstudents (*Sofyan Dwi Nugroho, Jumriani, Insih Wilujeng, Zuhdan Kun Prasetyo, IGP. Suryadarma*)	47
S17	The Influence Of Collaborative Learning On The Science Student's Achievement On Primary School (*Winda Oktavia, Esti Nofiani*)	50

Digital Repository Universitas Jember
ISSN : 2476-9533
Volume 3, October 2017

S18 Development of STEM Learning Materials and Lessons through Project Based Learning Model for Middle School: NGSS Framework (*Lely Mutakinati, Yoshisuke Kumano*).....54

S19 Effectiveness Of Learning With Collaborative Problem Solving (Cps) Model To Improve Science Literacy Skill In Unipdu Jombang (*Miftakhul Ilmi S. Putra, Wahono Widodo, Budi Jatmiko*).....60

S20 Development of Game Based Learning in STEM Education: Validation Case Study (*Nuriman, Fahrobby Adnan, Pramudya Dwi Aristya Putra*).....73

S22 Use of Lesson Study During Microteaching Student Prospective Teachers: Effects on Planning and Teaching of Science (*Maya Istyadji, Rizky Febriyani Putri*) 77

P1 Student's Response to The Virtual Science Laboratory Learning Media-based Website (LAB SITE) on Physical Education in High School (*Aang Zainul Abidin, Muthmainnah, Yohan Aurino Brian Patria, Nunung Fadilah*).....82

P3 The Impact of E-Modules Assisted by Scaffolding Based Android by Using Plickerson The Achievement of Understanding Concepts and Student Independency (*Amar Amrullah, Desy Kumala Sari, Jamiatul Khairunnisa Putri*)...88

P4 The Implementation of Digital Learning to Increase Higher Order Thinking Skills (HOTS) in Physics Learning (*Seftyan Agustihana, Syamiah Alfi*) 93

P5 Effectiveness of SSP on PBL Assisted by E-Learning Based on Physics Learning Completeness and Learning Outcomes (*Bayu Setiaji, Pri Ariadi Cahya Dinata, Arneta Dwi Safitri, Jumadi, Ari Satriana*) 99

P8 Blended Learning Based on Edmodo Assistance to Optimize Achievement of Student Learning Outcomes Class XI IPA Man 1 Yogyakarta (*Dedi Sastradika, Arif Rahamat Zain, Bety Rahayu, Jumadi*) 105

P9 Profile of Students' Level of Understanding and Model Mental on Hydrostatic Pressure Concept (*P. Zakiyatul Jannah, T. Ramlan Ramalis, A. Setiawan*).....111

P13 The Implementation of Problem Based Learning Model Toward Conceptual Understanding at Senior High School (*Indri Eka Putri, Herman, Bunga Dara Amin*).....115

P15 Shifting Attitude from Receiving to Characterisation as an Interdisciplinary Learning Toward Ecological Phenomena (*Nurasyah Dewi Napitupulu, Achmad Munandar, Sri Redjeki, Bayong Tjasyono)* 119

Digital Repository Universitas Jember
ISSN : 2476-9533
Volume 3, October 2017

P17 Development Media Of Physics Learning Based Animated Flash Pro Cs6 On The Senior High School, Cilincing, North Jakarta (*Siwi Puji Astuti, Alhidayatuddiniyah T.W., Ria Asep Sumarni*) 125

P19 Development of Physics Learning Strategies Based on Dynamic Problem Solving (*Abdul Haris, Herman, Aeman Hakim, Sirajuddin Jalil, Nur Dwiyana Alwi, Nurul Kusuma Wardani*) 131

P20 Developing PhyCCTM Android Application on Work and Energy Material for Improving Higher Order Thinking Skills (HOTS) of Senior High School (*Syayid Qosim M. Jafar Al-idrus, Suparno, Mundilarto, Edi Istiyono, Muhammad Zaini, Rattiwizal Alpin Yulianto, Nugroho Prasetya Adi*) 137

P21 Effectiveness of Snake Ladder Game on Physics Instruction: Student's Response View (*Syella Ayunisa Rani, Rizki Ageng Mardikawati, Nunung Fadilah, Sumarna*) 143

P22 The Electricity and Magnetism Phenomenon Modelling with Visual Studio for Senior High School Stud ents (*Asri Setyaningrum, Muhammad Zaki*) 148

P24 Developing Kinect-Based Instructional Media on Collisions Topic (*Laifa Rahmawati, Fajar Fitri*) 157

P25 Potential of Blended Learning to Optimize Performance Outcome, Motivation and Science Communication Skill in Physics Course (*Widya Rahmawati, Rahmi Putri Z, Yhona Arinda, Devi Afriani*) 165

P23 Learning Model Comparison Problem Posing mode Solution Posing Pre with Learning Model Problem Solving Achievement Motivation Against Seen From Physics Student Learning Outcomes (*Tri Isti Hartini, Martin)* 171

B1 Group Investigation: increase learning motivation, cooperative skill, and biology science process skill of students SMA (*Anteng Saraswati, Djukri*) 178

B2 Efficient And Effective Learning: An Innovative Idea Of Approach Scientific In Learning Science (*Armen*) 185

B3 Multimedia Worksheet Development On Environment Pollution As Learning Media For High School Students Class X (*Mieke Miarsyah, Diana Vivanti, Adsiyahputra, Rahmat Fadrikal*) 189

B6 Science Learning Based On Serukam's Local Culture To Improve Analysis Skill And Student Environment Caring Attitude (*Frastika Sasmitatias, Eka Kharisma Handayani, Asri S. Tamalene*) 195

Digital Repository Universitas Jember
ISSN : 2476-9533
Volume 3, October 2017

B9 The Development of Snake and Ladder Game Based Flash of Excretory System Subject on Eleventh grade in Senior High School (*Assyifa Al Khansa*) 200

B10 10th Grade Biology Teacher's PCK Capability in All Surakarta in Preparing Lesson Plan in 2015/2016 Academic Year (*Galuh Arga Wisnu Saputra, Riantina Fitra Aldiya, Riska Septia Wahyuningtyas, Nandhika Wahyu Sahputra, Sutisna*) 204

B11 Correlation between Conservation Knowledge andConservation Attitude of Fishermento Conserve Anadaraspp at Lada Bay of Sunda Strait (*Ratna Komala, Ernawati, Eka Dewi Sriyani*) 210

B12 The Local Knowledge By Karo Ethnic In Doulu Village, Karo District To Intercropping Agricultural (*Marina Silalahi, Nisyawati, Endang Christine Purba, Rani Nur Aini, Avif*) 216

B13 Influence of Type Mastery and Performance Goal Orientation on Learning Result at SMAN 64Jakarta (*Nurmasari Sartono, Rusdi, Dwi Hadianto*) 223

B14 An Analysis Of Ability To Create (C6) Of Biology At Eleventh Grade Of Senior High School Students In Indonesia (*Paidi, Tika Mayang Sari, Iis Aida Yustiana*) ...228

B16 Effectiveness Of Question Student Have Strategies And Macromedia Flash Ecosystem On Student Learning Outcome (*Lady Rahmawati, Rama Cahyati, Aminatun Wakhidah, M. Sukandi Hamzah,Wahyu Oktamarsetyani*) 233

B17 Survey Of Medicinal Plants In Pangandaran Nature Reserve (*Ratna Dewi Wulaningsih*) 238

B18 The Effect of Project- Based Learning and Problem- Based Learning to Thinking Skills in Learning Biology (*Rizqa Devi Anazifa, Djukri*) 245

B19 Implementing Jelajah Alam Sekitarteaching Approaches On Animal Ecology Course (*Sri Ngabekti, Bambang Priyono)* 257

B21 Developing Module Integrated Multimedia With Laboratory Guidelines For High School Students On Human Circulation System (Research And Development) (*Refirman, Supriyatin, Mahrawi Suprapto, Jajang Miharja, Lidya Banila*) 265

B22 An Innovation In Developing Module Integrated Multimedia For High School Students On Metabolism Material (Research and Development) (*Yulilina Retno Dewahrani, Sri Rahayu, Mahrawi Suprapto, Rini Puspitasari, Lidya Banila*) 271

C1 The Effect of Scientific Approach to High Order Thinking Skill (HOTS) of Student at 10th Grade (*Ahmad Nurkohlis Majid, Metridewi Primastuti,Dita Putri Utami, Meidiana Nur Budi Prastiwi, Nani Rahmah, Nur Khayati*).....278

Digital Repository Universitas Jember
ISSN : 2476-9533
Volume 3, October 2017

C2 Metacognitive Knowledge in Chemical Equilibrium Problem Solving: Students' Judgment vs. Teachers' Judgment (*Benny Yodi Sawuwu*).....283

C3 The Effect of Maternal Pre-Pregnancy Body Mass Index (BMI) on Initiation and Duration of Breastfeeding-Systematic Review (*Esti Katherini Adhi*).....289

C7 Campus Yard Management and Utilization as a Learning Facility and Source in Universitas Kristen Indonesia (*Hotmaulina Sihotang, Erni Murniarti, Marina Silalahi*).....297

C4 Developing Student's Global Awareness Through Chemical Literacy: Problems and Possibilities (*Annisa Fadillah, Desfi Annisa, Eka Ad'hiya, Ni Putu Laksmi Cintya Dewi, Satya Sadhu*).....305

C8 Synthesis Of Methyl Ester From Pome Assisted By Ultrasonic Irradiation And Cracking Using Zeolite Catalyst (*Agus Sundaryono, M. Lutfi Firdaus, Dewi Handayani)*.....310

C9 Student Perception of Analytical Thinking Skills on Electrochemistry (*Meidiana Nur Budi Prastiwi, Nani Rahmah, Nur Khayati, Ahmad Nur Kholis Majid, Dita Putri Utami, Metridewi Primastuti*).....316

C10 A Comparative Study of Learning Outcomes in Redox Reaction material by Cooperative Learning Model on NHT and TPS types in SMAN 6 Jambi (*Novaliah, Revnika Faizah, HazlyndaBt Atta)*.....322

O2 Analysis School of the Future: Transitioning Traditional Classroom to Digital (*Achmad Farchan*).....330

Digital Repository Universitas Jember
ISSN : 2476-9533
Volume 3, October 2017

Development of Game Based Learning in STEM Education: Validation Case Study

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Abstract. Nowadays, the computer is significant for our lives to support in daily activities. Even of in education, the using of a computer becomes an issue to assist in a learning process. One of the using the computer is a video game. Video games for education level usually are called Game-Based Learning. This studies concern to Game-based learning to STEM activities in junior high school. The Methodology to develop this game is ADDIE. This video game stills in a process to get a suitable device to implement in the secondary level students. Four experts in the video game had conducted validation test in this game. Some suggestions were given to constructs that video game becomes compatible in STEM activities.
Keywords*: Game Based Learning, STEM, Validation Test*

1. Introduction

The development of technology in the 21st century is running continuously. This technology also affects the study of education. The school that runs began unlimited with space and time. Through science learning at the school level students are starting to introduce the underlying science of technology. Science at the junior level is taught in an integrated manner between chemistry, biology, and physics. Through science lessons at the junior high school level in the 2013 curriculum given the necessary competence subjects "students can present data and reports on the application of biotechnology in support of human survival through food production" ("CURRICULUM 2013 BASIC COMPETENCY Junior High School / Madrasah Tsanawiyah (MTs) "2013). This curriculum requires a learning process that must involve students in conducting contextual learning activities in the field of biotechnology studies.

Biotechnology is one of the major science field studies in the area of science and engineering. Biotechnology is a synergy of science, technology, engineering, and mathematics. Biotechnology is taught at the junior level because biotechnology is concentrated in two areas of study: traditional biotechnology and modern biotechnology. This rapid development in modern biotechnology creates a large gap between the understanding of the scientific community and the understanding that occurs in society, especially in the areas of risk and profit (1). For example, based on the results of the initial survey of teachers at the junior high school level in Jember district that science teachers only teach biotechnology as a traditional study material such as making a "tape," bread or "Tempe." This traditional biotechnology is due to the low level of teacher knowledge on biotechnology studies. By following technological developments that biotechnology is now more on DNA manipulation, genetic transformation in organisms and applications in environments that can maintain sustainability regarding agricultural and food industries (2); (3); (4). Transgenic sugarcane and savvy rice are examples of modern biotechnology applications.

Some issues of biotechnology application have a potential impact on the social and economic scope. In other words, that biotechnology still has a form of public controversy (5). Though the extent of modern biotechnology can revolutionize the big profits and be able to improve culture more dignified (6).

Modern technology is not taught by teachers because the knowledge level of science teachers themselves on this information is low. Their low level of education creates difficulties in designing their learning. Based on the challenges gained by some teachers in a junior high school district of Jember, then the transfer process will be limited to students. Student acceptance is limited to theoretical aspects and only traditional learning about biotechnology. Based on teachers 'attitudes toward biotechnology that teachers influence students' behavior in applying day-to-day practices (1). As the example given that the students know that biotechnology only interacts with the manufacture of

Digital Repository Universitas Jember
ISSN : 2476-9533
Volume 3, October 2017

tape and tempeh only. As a controller in the field of education, this concern will affect the formation of society (students) are literate to science (science literacy). Science literacy is a complex idea that includes an understanding of the process and nature of science, the ability to negotiate everyday situations involving science and technology, and taking an active and critical role in social issues of science and IT (7). If the Literacy of this science is not well constructed to the students, then they will give a proper response to modern biotechnology. So it is suspected that there is a proper relation to the stability of science literacy on the attitude of students receiving biotechnology (1).

2. Methodology

A methodology used in this research was Research and Development, which was developed by ADDIE (Analysis, Design, Develop, Implementation and Evaluation). Hire, the research study only focused in development study about the Game Based Learning in STEM education. The central of research was validation developed Game-Based Learning. This video game is still in process to construct the perfect game based learning in STEM education. The steps of the development research in this study were:

1. Analysis

The study had been conducted as pre-elementary research to get information on the lack of a video game implementation of learning activities. This event focused on observation about science material so that this step could get the requirement in an experimental study in the science subject.

2. Design

The design was visualization from the analysis research. Based on the lack of the observation in science material, video game based learning began to plan. Particular, this step developed a video game script, and it converted in software for the video game.

3. Develop

This move synergized a design shape, which was a scenario to transmit in the video game. In this step, the product developed a support system such as music, character and setting template. After getting the form of a video game, the video game was conducted an expert validation by three validators. They were expert in game and science education. This final step was a revision the video game based on the reviewed from the validator.

3. Result and Discusion

The study only focused on developing a video game in biotechnology material in secondary school. In the analysis, the study provided some of the indicators to suit the video game in the user. Table 1 showed five indicators to determine how the video game is comparable to use in the learning.

Table 1. The measurument indicators a video game based on the users

Indicators	Fungsion
Learningbility	Measure the seccurity the video game to complite a basic task when the user first used a the video game.
Efficiency	Measure the speed of the task after the user finished a basic video game.
Memorability	Measures fundamental knowledge after the user does not reuse for a particular time interval.
Error	Measure errors of use by video game users and measure how fast users are to re-start.
Satisfaction	Measures the level of user satisfaction in running video games

The five indicators are suitable to measure the video game in the learning activities (8). Before the video game based-learning tasted in the users, it conducted a design by the curriculum. The video game was developed by theme, which was seeking a gap in the biotechnology material in the secondary school. In reality, that material included in the uneasy material because it needs complete laboratory tools.

The video game named cross green, which described the modern experimental in biotechnology. This video game gives information about how to make the transgenic plant in the laboratory. This experiment is uncommon to show the students. The result of the pictures show in figure 1.

Digital Repository Universitas Jember
ISSN : 2476-9533
Volume 3, October 2017

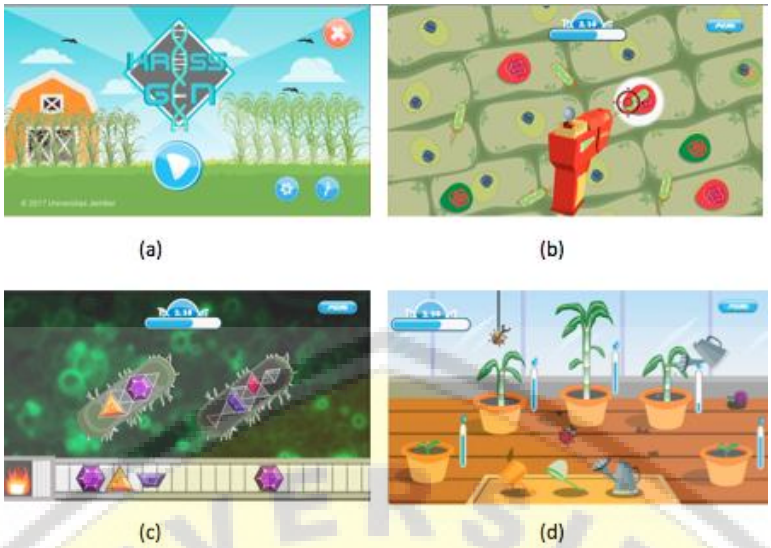

Figure 1. (a) the display of the Kress Gen; (b) the video game control a bacteria growht; (c) the model of the sell plant; (d) the result from transgenic plant

Picture 1 shows some pictures a bacteria growth. In this case, a bacteria is necessary to make a new varietal in biotechnology. As in the picture, the video game will give information about a biotechnological process to students. This game based on the lab experience that will supply a new experience to the students to explore the laboratory types of equipment. This video game is only supplemental instructional media in learning activities. The experimental video game is not often developed by the developer because it is not a commercial video game (9).

Before this video game tested in the users, it would be conducted a validation test. A validation test was used four experts in the vidio game and science education field. The result of validation test is presented in table 2.

Table 2. The result of expert validation

No	Criteria	Result				
		X1	X2	X3	X4	Mean
1	Science Integrated	3	4	4	3	3.50
2	Using mathematic for thinking	3	4	3	5	3.75
3	Create engineering design	4	4	4	3	3.75
4	Suitable for technology in learning activities	4	3	1	4	3.00
5	Embaded STEM perspective	5	4	5	5	4.75
6	Build prototype	5	5	1	5	4.00
7	Build science concept	5	5	1	5	4.00
8	Verbal comunication in video game	5	5	1	5	4.00
9	Needed identification	5	5	1	5	4.00
10	Inquiry process	5	5	1	5	4.00
Total						**3.75**

Based on table 2, the total result showed 3.75 (10). When it compared with the judging criteria, that value included in reasonable standards. Some of the values got the weakness such as criteria number 4,6,7,8,9 and 10. For future, Those items must review and revise to obtain the video game that is suitable for learning activities.

4. Conclusion

This study began to develop a video game focused on biotechnology material. The methodology used only to the development step. The result of developing the video game need to improve until suitable in a learning activity. This video game got the reasonable standard to the point of 3.75.

Digital Repository Universitas Jember
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Volume 3, October 2017

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