proceeding

MISEIC
Mathematics Informatics Science Education International Conference

“Emerging Trends of Research in Mathematics, Informatics, Science, and Education”

July 21st, 2018
Best Western Papilio Hotel,
Jl. Jendral Ahmad Yani no. 176-178,
Surabaya 60235, Indonesia
Proceeding

THE 2\text{nd} MATHEMATICS, INFORMATICS, SCIENCE, AND EDUCATION INTERNATIONAL CONFERENCE (MISEIC) 2018

“Emerging Trends of Research in Mathematics, Informatics, Sciences, and Education”

Proceedings Book

Keynote Speakers:

Prof. Chih-Hsiung Ku (National Dong Hwa University, Taiwan)
Husam Al-Najar, Ph.D. (The Islamic University of Gaza, Palestine)
Prof. Dr. Rajkumar Buyya (University of Melbourne, Australia)
Dr. Abadi, M.Sc. (Universitas Negeri Surabaya, Indonesia)

July 21, 2018
Papilio Hotel Surabaya, Indonesia
Organized by: UNESA (Universitas Negeri Surabaya)
Proceeding

THE 2nd MATHEMATICS, INFORMATICS, SCIENCE, AND EDUCATION INTERNATIONAL CONFERENCE (MISEIC) 2018

“Emerging Trends of Research in Mathematics, Informatics, Sciences, and Education”

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ABOUT MISEIC

The 2nd Mathematics, Informatics, Science and Education International Conference (MISEIC) is organized by FMIPA Universitas Negeri Surabaya. This international conference aims to bridge the scientists, education experts and practitioners, and students in the scientific forum through sharing ideas and issues about theoretical and practical knowledge in mathematics, informatics, science and education.

This seminar was held on July 21, 2018 and will take place in Surabaya, Indonesia. The theme for this conference is “Emerging Trends of Research in Mathematics, Informatics, Sciences, and Education”.

The scope of the seminar includes, but is not limited to:

2. **Science and Technology** (Biotechnology, Earth and Space Sciences, Energy and Catalyst, Environmental Sciences, Food Science and Technology, Instrumentation, Material and Biomaterial, Nanotechnology, Nuclear)
4. **Mathematics, Science, and Computer Science Education** (Assessment and Evaluation, Curriculum Development, Distance Learning, Higher Order Thinking, Learning Resources, Models of Teaching, Multimedia, Teacher Professional Development)
PREFACE

The 2nd Mathematics, Informatics, Science and Education International Conference (MISEIC) is motivated as scientific ideas and issues sharing forum for the scientists, education experts and practitioners, and students. This seminar was held in and taken place in Surabaya, Indonesia on July 21, 2018. The theme for this conference is “Emerging Trends of Research in Mathematics, Informatics, Sciences, and Education” with the ideas and issues sharing about theoretical and practical knowledge in mathematics, informatics, science and education. Thus, this conference has aims: (1) to bring together the scientists, engineers, researchers and practitioners, students, and civil society organization representatives in the scientific forum. (2) To share and to discuss theoretical and practical knowledge about innovation in applied science and engineering.

This conference hosted by the Universitas Negeri Surabaya is considered to accommodate discussion among researchers in the field of mathematics, informatics, science and education as a scientific forum. Therefore, the invited speakers in this conference are expert in the field of mathematics, informatics, science and education.

The 2nd MISEIC 2018 involved more than 250 participated papers from various topics including pure and applied mathematics, science and technology innovation, computer science, and innovation in mathematics, science, and computer science education. There are selected papers that published in this proceeding.

We would like to thank the organizing committee and the members of reviewers for their kind assistance in reviewing the papers. We would also extend our best gratitude to keynote speakers for their invaluable contribution and worthwhile ideas shared in the conference.
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CONTENTS:

ABOUT MISEIC  

PREFACE  

COMMITTEE:  

CONTENTS:  

WORD OF WELCOME  

INTRODUCTION OF KEYNOTE SPIKERS  

PAPERS:

<table>
<thead>
<tr>
<th>Paper Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PORTOFOLIO APPLICATION DESIGN IN SENIOR HIGH SCHOOL 1 PONOROGO</td>
<td>1</td>
</tr>
<tr>
<td>EFFECTS OF FREELETTICS AND HIGH INTENSITY INTERVAL TRAINING EXERCISE ON</td>
<td>5</td>
</tr>
<tr>
<td>INCREASING CARDIOVASCULAR, STRENGTH, AND SPEED</td>
<td></td>
</tr>
<tr>
<td>Comparative Study of Application of Algorithm C4.5 and Naïve Bayes as</td>
<td>11</td>
</tr>
<tr>
<td>Supporting Money Loan Decision (Case Study at Employee Cooperative PT</td>
<td></td>
</tr>
<tr>
<td>Karyamitra Budisentosa Pandaan)</td>
<td></td>
</tr>
<tr>
<td>DESIGN OF MONITORING HEART SIGNAL BASED ON TELEMEDICINE</td>
<td>18</td>
</tr>
<tr>
<td>Characterization and Analysis Biochemical Properties of Amylase-Producing</td>
<td>26</td>
</tr>
<tr>
<td>Bacteria Originated from Pariangan Hot Spring: Isolate S2.3</td>
<td></td>
</tr>
<tr>
<td>Validation Of Physics Learning Devices For The Subject Matter Of Temperature,</td>
<td>30</td>
</tr>
<tr>
<td>Heat, And Heat Transfer By Methods Of Real Experiments And Virtual Experiments</td>
<td></td>
</tr>
<tr>
<td>Developing Learning Management System Moodle based on Behaviorism Theory</td>
<td>39</td>
</tr>
<tr>
<td>Segmentation of HIV/AIDS Clinical Description using PATHMOX-PLS</td>
<td>45</td>
</tr>
<tr>
<td>Bayesian Network to Analyze the Relationship Amongst Motor Aspects in Daily</td>
<td>51</td>
</tr>
<tr>
<td>Living Activities: A Case Study in People with Early Parkinson’s Disease</td>
<td></td>
</tr>
<tr>
<td>The use of Computer-Based Test (CBT) on Moodle as platform in formal</td>
<td>57</td>
</tr>
<tr>
<td>education</td>
<td></td>
</tr>
<tr>
<td>Study of The Low Students’ Mathematical Connection Ability</td>
<td>63</td>
</tr>
<tr>
<td>Analysis of Mathematical Critical Thinking Ability Based on FRISCO Indicator</td>
<td>68</td>
</tr>
</tbody>
</table>
The Ability of Students’ Mathematical Representation to Solve Linear Program’s Problems Reviewed Gender Differences
Feriyanto

Profile of Students’ Metacognitive Skills on Chemistry Subject in the XI Grade High School
D A T Soffa, S Poedjiastoeti, P Setiarso

Improvement Of Mathematical Connections Using A Scientific Approach On Students Of Class X Vocational High School
F N Fatimah, Riyadi, D R Sari

Designing of Assessment on Learning Evaluation and Process Course Based on KKNI
A Maizeli, S Nerita, A Afza

The prototypes of mathematical knowledge for teaching based on teacher’s conceptual on quadrilateral
L Sahidin, M T Budiarto, Y Fuad

Validity of Student Activity Sheet Based on 4C with CORE Learning Model on Students
K Bariyah, Tjandrakirana, Raharjo

Misconception of Basic Algebraic Concept of Junior High School
D Permata, P Wijayanti, Masriyah

The Effectiveness of Guided Inquiry Model to Improve the Scientific Process Skills of High School Students
A Zahrotin, Wasis, Soegimin WW

The Development of Physics Learning Material Based On Guide Inquiry to Improve Creative Thinking Skills
M Nizar, Madlazim, Wasis

Exploring Student’s Creative Thinking Process Using Open-Ended Problem in Learning Fraction
S Triyani, I K Budayasa, S M Amin

The Effectiveness of Student Activity Sheet (LKS) Science based on Problem Based Learning (PBL) for Improving Ability to Solve Problems of Elementary School Students
R Hidayati, T Kirana, M Ibrahim

Learning Resources Development with Project Based Learning Model to Improve the Critical Thinking Ability of Primary School Students in Science Subject
A Hartini, M V Roesminingsih, Suryanti

Effectiveness of Student Activity Sheet Science Based Quantum Teaching to Improve the Critical Thinking Skills of Primary School Students
Kurniayu T R A Ratu, M Ibrahim, Suryanti

Students creativity in solving realistic-mathematical problems
W M Andhari, S M Amin, T Y E Siswono

Contextual Video and Their Effectiveness on Science Learning
M F Abror, W Widodo, M Ibrahim

An Analysis of Scientific Thinking Skills as a Basis for Selecting the Learning Model: On the Application of Creative Problem Solving Model with Scaffolding

Ratnasari D, Suciati, Maridi

THE IMPORTANCE OF MITIGATION EDUCATION IN REDUCING DISASTER RISK BASED ON LOCAL COMMUNITY LOCALITY
E Juita, R Zulva, H Edial

PHYSICS LEARNING DEVELOPMENT GUIDED INQUIRY MODEL FOR IMPULS AND MOMENTUM TO TRAIN SCIENCE PROCESS SKILLS AT VOCATIONAL HIGH SCHOOL ONE SURABAYA
Y D Candrarini, Madlazim, Soetijpto

Practicum Design Of Purifying Bioethanol Using Distillation Device With Condenser Of Household Plastic Waste To Increase Student Creativity On Petroleum Materials
A Amirul

The Development Teaching Materials of Biology Integrated Science Literacy Assisted by Macromedia Flash
S Muzeyyana, M Ibrahim, Tjandrakirana

Influence of Cooperative Learning Model Type Pair Cheks Based Tasks Submission Problems To Student Problem Solving Ability Mathematics
Muksin, T Y E Siswono· R Ekawati

Innovation of Lycopene Isolation Procedure from Tomatoes (Lycopersicum esculentum)
E S Dewi, A Hakim, L R T Savalas

An Analysis of Ethnomathematic Activities in the Making Process of Tulungagung Marble
B M F Pratama, Mardiyana, D R Sari

The effectiveness of using science students’ book based on learning cycle models integrated with ethnoscience to improve critical thinking skill of primary school students
D Widyaningtyas, M Ibrahim, W Widodo
WORD OF WELCOME

Dear all MISEIC 2018 participants, welcome to Surabaya, Indonesia. We are very glad to have you all, to participate in this conference.

Universitas Negeri Surabaya, proudly presents “Mathematics, Informatics, Science and Education International Conference 2018”. The conference is conducted to bring together diversified ideas of researchers, educators, lecturers, teachers, students, and those who have interests in research on Mathematics, Information, Science as well as on its Education with theme Emerging Trends of Research in Mathematics, Informatics, Sciences, and Education.

We are very honored to have Prof. Chih-Hsiung Ku (National Dong Hwa University, Taiwan), Husam Al-Najar, Ph.D (The Islamic University of Gaza, Palestine), Prof. Dr. Rajkumar Buyya (University of Melbourne, Australia) and Dr. Abadi, M.Sc (Universitas Negeri Surabaya, Indonesia) as keynote and plenary speakers.

On behalf of the Organizing Committee and Steering Committee, I wish you all a blessed and productive time in our MISEIC 2018. God bless you all.

Surabaya, July 21st, 2018

Rooselyna Ekawati, Ph.D
Conference Chair of MISEIC 2018
Universitas Negeri Surabaya
INTRODUCTION OF KEYNOTE SPEAKERS

Prof. Chih-Hsiung Ku
National Dong Hwa University, Taiwan

Doctorate in Institute of Science Education, National Taiwan Normal University

Research Interests:
• The Psychology of Science Learning
• Philosophy of Science
• Social Cognition and Science Learning
• Cognitive Psychology and Science Learning
• Physics Education

Argument Learning and Scientific Explanations: From the Perspective of “Hot Cognition”

Prof. Chih-Hsiung Ku
National Dong Hwa University, Taiwan
E-mail: chku@gms.ndhu.edu.tw
MISEIC2018(21st July)@ Surabaya

Extended Abstract

It is important to cultivate the student with scientific literacy that can distinguish evidence-based argument from personal opinions. However, there are many factors affecting judgment, such as individual’s motivation, feeling, awareness of authority, and social norms.

In the past few years, an increasing number of research have focused on argumentation in science education (Lee, Wu, & Tsai, 2009; Lin, Hong, & Lawrenz, 2012). Recently, the Organisation for Economic Co-operation and Development (OECD) had defined argumentation as one of the capabilities for scientific literacy. Students should be able to provide evidence-based conclusions and identify the difference between ‘personal opinions’ and ‘evidence-based conclusions (OECD, 2008). In other words, it’s important to equip pupils with argumentation ability.

Concept cartoon had its genesis in 1992, it has been employed in a variety of ways for educational purposes such as promoting reading skills and vocabulary, eliciting tacit scientific knowledge, making scientific ideas accessible (Keogh & Naylor, 1999). Hodson (1998) argued that if science teacher could establish appropriate environment, it would help student to proceed efficient discussion. These key points include: (1) preparing a controversial issue, (2) setting up the issue according to student’s prior knowledge, (3) motivating student interest to the issue. Because of the characteristics of concept cartoon, the present study adopted the strategy of using concept cartoon to establish appropriate environment to incite student’s discussion.

Motivation is one of the crucial factor affecting students’ learning in school. It can be defined as any process that initiates and maintains learning behavior. Motivation is important for learning because students can not learn unless they are motivated (Palmer, 2009). Therefore, motivation could be viewed as an essential pre-requisite and co-requisite for learning.
Decades ago, many researcher construct cognitive models for explaining student's conceptual change in science learning, but their reliance on a model of academic learning as cold and isolated cognition (Pintrich, Marx & Boyle, 1993). In fact, motives and goals and the institutional and social sources need to be considered (Strike & Posner, 1992). The students' emotional and motivational beliefs not only play a critical role in learning but also influence the direction of thinking as they attempt to adapt to the different constraints and demand placed on them by the tasks and activities they confront in classrooms (Lin, Hong, Chen & Chou, 2011; Lin, Hong & Huang, 2012; Maria, Santos & Mortimer, 2003).

The scientific community sees itself as the very paradigm of institutionalized rationality. In the domain of scientific philosophy, there are different arguments about the concept of rationality. For example, the rationalists proposed the rational model for explaining the scientific change and the non-rationalists argued that any scientific theory was incommensurable. Actually, the modern concept of rationality should be situational (Newton-Smith, 1981; Sarkar, 1995). In other word, the internal and external factor must be considered simultaneously when discussing about the scientific change.

In life world and science learning, judgment is often based on information available through media and variety of resources that may report competing claims. The individual judge not only base on the content of the claim but also the source of the claim and the social factor such as individual's motivation, feeling, awareness of authority, and social norms. The concept of hot cognition, comparative to cold cognition, refers to those mental processes that are driven by our desires and feelings—those cases where our goals and moods color our judgment (Thargard, 2006, 1989; Kunda, 2000). People are always affected on judgment as social interaction occurring. For example, Solomon (1994) founded that children might change their own ideas in order to agree to others' opinion even though their answer were correct.

Sandoval and Cam (2011) explored the elementary student's judgment on two scientific explanation for the casual claim. One of the scientific explanations is authority version and the other is plausible mechanism version. Sandoval and Cam found that elementary student appeared to agree to the scientific explanation of plausible mechanism version. And the student's main reason for judgment was its credibility. However, Ku, Sun, Chen and Yang (2010) found that hot cognition was aroused and affected children's judgment of scientific explanations was influenced by class social norms. The elementary student tended to agree to the scientific explanations with most classmates' agreement. In spite of different finding of Sandoval and Cam and Ku et al, both of them just exploring student's judgment on scientific explanation without performing any teaching to empower student's argumentation ability to identify the difference between 'personal opinions' and 'evidence-based conclusions.'

Hot cognition is the behaviors that are motivation/emotion-loaded and affected by need and feelings, causing judgment to be colored by goals or emotions. This study aims to explore the effect of the elementary upper graders' argument learning on judgment of scientific explanations by applying the strategy of concept cartoon argument instruction. Meanwhile, we also try to investigate the arousal of hot cognition on children's judgment of scientific explanations under the intervention of class social norms. The quasi-experimental method was adopted in this research. The subjects were 361 upper graders of 12 classes at the eastern Taiwan elementary schools. Eight classes were selected as experimental groups. The other four classes were assigned as contrast groups. The self-developed instruments "Argumentation Ability Test, AAT" and "Rationality on Scientific Explanation Test, RSET" were adopted in this study. The main findings include: (1) the students' performance in AAT was progressed after concept cartoon argument instruction, CCAI, (2) the students tended to agree to that the justifications with Toulmin's Argument Pattern Form (TAP-form) is more reasonable in 2nd RSET after CCAI, (3) the students tended to agree to that the justifications with class social norms is more reasonable in 3rd RSET. The implications for science teaching and learning were discussed.
INTRODUCTION OF KEYNOTE SPEAKERS

Husam Al-Najar, Ph.D
The Islamic University of Gaza, Palestine

Research Interests:
Environmental Engineering

The Effect of Education Level on Accepting The Reuse of Treated Effluent in Irrigation

Husam Al-Najar
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Abstract: Gaza strip suffers from a serious shortage in water resources, due to the continuous increase in population, life changes, political conditions and drought caused by climate change. Due to increased demand for water for domestic use, resulting accumulation of large quantities of wastewater in the treatment plant in Rafah, therefore reuse of treated wastewater is one of the most recently accepted approaches to save groundwater or domestic use. The aim of this research is to study the treated effluent quality from Rafah Treatment Plant, in addition to the effect of education level of the farmers on reusing treated wastewater for irrigation. A questionnaire was distributed to farmers to investigate the acceptance of using treated effluent for irrigation, meanwhile the effluent parameters were tested. The BOD, COD, TKN, NH₄, NO₃, P, Cd, Pb, and Cu accounted for 110, 250, 108, 127, 0.23, 17.9 mg/l, < 0.003, <0.001, and 19.9 µg/l. Most of reuse parameters were higher than the recommended levels for the effluent reuse based on the recommended Palestinian Standards for irrigation. About 80.7%, of farmers accept using treated wastewater in irrigation and the Chi-square test analysis showed that, at P-value =0.00095 < α= 0.05, there is a close relationship between the educational level of farmers and the acceptance of using of treated wastewater in irrigation, provided they are safe and healthy.
INTRODUCTION OF KEYNOTE SPEAKERS

Prof. Dr. Rajkumar Buyya
University of Melbourne, Australia

Bachelors in Computer Science Engineering, Bangalore University, India (1992)
Masters in Computer Science Engineering, Bangalore University, India (1995)
Doctorate in Computer Science and Software Engineering, Monash University, Australia (2002)

Career History:
• Future fellow of The Australian Research Council (ARC) at University of Melbourne
• Director of CLOUDS Lab at Melbourne
• Led development of some popular software—Cloud Sim, Aneka, InterCloud Brokers, GridSim, Workflow Engine-used in 40+ Countries
• Founder CEO of Manjrasoft Pty Ltd
• Editor-In-Chief of IEEE Transactions on Cloud Computing (TCC)

Research interest:
Computer Science and Software Engineering

Cost-Efficient Orchestration of Containers in Clouds: A Vision, Architectural Elements, and Future Directions

Rajkumar Buyya
Cloud Computing and Distributed Systems (CLOUDS) Lab
School of Computing and Information Systems
The University of Melbourne, Australia

Abstract This paper proposes an architectural framework for the efficient orchestration of containers in cloud environments. It centres around resource scheduling and rescheduling policies as well as autoscaling algorithms that enable the creation of elastic virtual clusters. In this way, the proposed framework enables the sharing of a computing environment between differing client applications packaged in containers, including web services, offline analytics jobs, and backend pre-processing tasks. The devised resource management algorithms and policies will improve utilization of the available virtual resources to reduce operational cost for the provider while satisfying the resource needs of various types of applications. The proposed algorithms will take factors that are previously omitted by other solutions into consideration, including 1) the pricing models of the acquired resources, 2) and the fault-tolerability of the applications, and 3) the QoS requirements of the running applications, such as the latencies and throughputs of the web services and the deadline of the analytical and pre-processing jobs. The proposed solutions will be evaluated by developing a prototype platform based on one of the existing container orchestration platforms.
INTRODUCTION OF KEYNOTE SPEAKERS

Dr. Abadi, M.Sc
Universitas Negeri Surabaya, Indonesia


Career History:
• Head of Mathematics program at the Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya (2012-2016)
• Governor of IndoMS East Java (2016-2018)
• Vice Director of academic and student affairs, Postgraduate Program, Universitas Negeri Surabaya (2016 - present)

Research Interest:
Applied Mathematics

Heteroclinic Bifurcation in the Predator-Prey System with Herd Behavior

Abadi
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Universitas Negeri Surabaya
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Abstract: The existence of cyclic solutions is typical in a predator-prey interaction. These solutions very often may lead to interesting phenomena. Likewise, when the prey of the system exhibits herd behavior. This work started by modeling the predator-prey system with herd behavior by modifying the Lotka-Volterra system, analyzed the stability of the equilibria, and studied the behavior of the solutions of the system. Rigor analyses started with linearization and variable manipulations resulted in the emergence of typical limit cycles that lead to Hopf bifurcation. Further, Melnikov’s method gave a heteroclinic bifurcation of the limit cycles. Computer simulations and biological interpretations of the results are also presented in this study.

Key Words: Predator, Prey, Bifurcation, Heteroclinic.
Portofolio Application Design In Senior High School 1 Ponorogo

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²Teknik Informatika, Institut Teknologi Sepuluh Nopember, Indonesia
(E-mail: rizayoga30@gmail.com)

Abstract. Senior High School 1 Ponorogo is one of the favorite schools in Ponorogo District. However, during this development of SI / IT in Senior High School 1 Ponorogo still less and need to be improved. The impact of learning is still conventional and the evaluation of students still using paper. Related to the threats and weaknesses that exist in Senior High School 1 Ponorogo need to design the application portfolio with the aim of supporting facilities and school infrastructure and facilitate teachers in delivering subjects as well as facilitate students in absorbing lessons. This research will create a portfolio application design that is needed in Senior High School 1 Ponorogo for the future. And performed an analysis using several approaches to support the process of designing portfolio applications that fit the needs. The results of this classification were obtained from observations and SWOT analysis and PEST analysis. From the results of the proposed application is expected to soon be implemented. So that can take advantage of information technology in teaching and learning process and evaluate student learning result so as to produce openness in the form of value and other it to school party, to student and also to parent student.

1. Introduction
In the era of globalization, one component to increase the competitiveness of a school is Information Systems (SI) and Information Technology (IT) which is expected to improve the effectiveness and performance of a school. In order to improve the effectiveness and efficiency of school performance, an IT / IT must be well designed and built to suit the school's needs. Through the application portfolio design, a school can objectively look at internal conditions, so that it can anticipate technological changes in the environment internally.

But during this development of SI / IT in Senior High School 1 Ponorogo still less and need to be improved. The impact of learning is still conventional and the evaluation of students is still not paperless. Under such conditions the Senior High School 1 Ponorogo is required to create a strategy that can bring the school to continue to excel and can compete with other schools.

Related to the threats and weaknesses that exist in Senior High School 1 Ponorogo need to design the application portfolio with the aim of supporting facilities and school infrastructure and facilitate teachers in delivering subjects as well as facilitate students in absorbing lessons. So the application can be directed and can be felt for all parties.

2. Portofolio Applications
According to Ward (Ward, 2002) At this stage will be defined related to how resources and technology will be managed and developed in order to meet the information system strategy that has been obtained by referring to the business strategy of the organization. Potential applications that have been obtained from the results of the analysis will be formed or grouped in a matrix that has been defined by McFarlan. According to Ward (Ward, 2002) the purpose of making this matrix is related to
determining the priority of each of these applications. In this matrix will also be defined applications that are being used at this time.


<table>
<thead>
<tr>
<th>STRATEGIC</th>
<th>HIGH POTENSIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical to achieving future</td>
<td>May be critical to achieving</td>
</tr>
<tr>
<td>business strategy</td>
<td>future business success</td>
</tr>
<tr>
<td>Critical to existing business</td>
<td>Valuable but no critical to</td>
</tr>
<tr>
<td>operation</td>
<td>success</td>
</tr>
</tbody>
</table>

3. Modeling

Research on the design of this application portfolio using Ward & Peppard method. The flow of the Ward & Peppard methodology can be seen on

![Ward & Peppard Methodology](image)

Ward & Peppard methodology broadly divided into three stages, namely input, process, and output. Activities undertaken in each stage and methods used in the design of portfolios in SMAN 1 Ponorogo can be explained as follows:

At this stage of input is analyzed the condition of organization and SI / TI Senior High School 1 Ponorogo at this time, which include analysis of internal business environment, internal business environment, analysis of internal SI / IT environment, and analysis of external SI / IT environment. Furthermore, based on the above input, the process of preparing SI / TI Senior High School 1 Ponorogo by aligning business goals with the use of SI / TI in Senior High School 1 Ponorogo

The above process will produce 3 artifact consisting of Business IS Strategy, IS / IT Strategy Management, and IT Strategy. Based on these three strategies, Future Application Portfolio is generated as an illustration of the application of IT / SI needed to support Senior High School 1 Ponorogo business.
4. Result
SWOT analysis is used to identify the strengths, weaknesses, opportunities and threats experienced by the company. In addition, this analysis is also used to find out the best way to use enterprise resources that take into account the internal and external situation of the company and to build the company's resource base in the future. The result will be automatically mapped to strengths, weaknesses, opportunities and threats.

From IFAS (strengths & weakness) and EFAS (opportunities & threats) above, IFAS (strengths & weakness) score is 0.025 and EFAS (0.174) is 0.174. With the value of IFAS (strengths & weakness) is the coordinate of the X axis and EFAS is the Y-axis coordinate, then the position of Senior High School 1 Ponorogo in the SWOT quadrant is at the point (0.025,0.174) that is the SO strategy quadrant focusing on increasing the existing strength by exploiting the opportunities appear.

With reference to the results of the application mapping suggested, then analyzed the contribution of each application to Senior High School 1 Ponorogo both in the present and future. The existing application is divided into 4 sections in accordance with the concept of McFarlan Matrix analysis that is Strategic Application, High Potential Application, Key Operational Application, and Support Application. Based on the results of the previous analysis obtained the following details, Strategic Applications amounted to 1 application with new application status and 1 existing old application with the status increase, High Potential Applications amounted to 1 with the status improvement of existing old application, Key Operational Applications amounted to 2, where the other is a new application while the other one is the old application with the status increase, Application Support amounted to 4 with conditions 2 new applications, 2 old applications that need to be improved.

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<thead>
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<th>Strategic</th>
<th>High Potential</th>
</tr>
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<tbody>
<tr>
<td>Key Operational</td>
<td>Support</td>
</tr>
<tr>
<td>E-Raport*, PPDB (Registration of New Student) Online**</td>
<td></td>
</tr>
</tbody>
</table>

5. Conclusion
The process of designing portfolio applications on SI / TI from Senior High School 1 Ponorogo does not stop after generating recommendations, but this process is an ongoing process to improve school competitiveness and advance information technology in the school sphere. the resulting strategy is to improve the performance of existing applications such as applications Elearning, Dapodit, E-Raport, Wifi Management and Web Profile Senior High School Ponorogo 1 then add new applications such as Helpdesk System, Finger Print, Exam Application & Try Out Online, PPDB (Registration of New Student) Online as a recommendation for future needs. Strategic Applications numbered 1 application with new application status that is Application Exam & Try Out Online and 1 existing old application with the elevation status that is Application of Elearning, Application of High Potential amounted to 1 with status improvement of existing old application that is Dapodit, Key Operational Application amounted 2, where one is a new application that is PPDB (Registration of New Student) Online while the other one is the old application with the status of the E-Raport, Support Application amounted to 4 with conditions 2 new applications of Finger Print and Helpdesk System, 2 applications old needs to be improved yitu Management WiFi and Web Profile Senior High School 1 Ponorogo.
6. Suggestion
In the final stages of this study, the authors are aware of all the limitations that arise in preparing this study, then there are some suggestions put forward so that if this research can grow for the better. Some suggestions that the authors want to ask is: Suggestions to this research is, the authors suggest conducted an analysis of the costs that arise, as well as analysis of investment feasibility in implementing it, so have a reference to the costs that arise to the strategy gained. Suggestions to schools, which improve overall performance in all aspects so as to anticipate all possible problems that arise against the school and periodically evaluate the system is needed to avoid adverse effects that may arise in the future.

7. References
Effects Of Freeletics And High Intensity Interval Training Exercise On Increasing Cardiovascular, Strength, And Speed

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Abstract. This paper deals effect of freeletics and High Intensity Interval Training (HIIT) exercises on capacity cardiovascular, strength, and speed. Subjects used 31 male futsal players at sub elite. Data analysis used mean, standard deviation, t-test (paired sample t-test) and manova (multivariate analysis of varians). The results clear show that three finding important difference between pretest and posttest mean of each group were: (1) experiment group I freeletics for cardiovascular = 1.77 ml/kg/min, strength= 14.36 kg, and speed = -0.25 second. (2) Experiment group II HIIT for cardiovascular = 1.82 ml/kg/min, strength = 10.85 kg, and speed = -0.30 second. (3) Control group for cardiovascular = 0.4 ml/kg/min, strength= 2.75 kg, and speed = -0.07 second. Concluded this paper significant exercise of freeletics strongly effect on the increase in muscle strength and performance. While exercise of HIIT strongly effect on the increase in cardiovascular and speed. Implication of this study can be used to evaluate the training program in order to improve performance enhancement of the players.

1. Introduction

Efforts to improve physical capabilities and maximize biomotor performance should be supported by good training programs and meeting the principles of practice. Because if the exercise is well programmed then the desired results will be achieved. Currently, there is a wide range of cardiovascular type developments, and the most notoriously effective are Freeletics and HIIT exercises. Freeletics is a physical exercise that includes a flexible type of exercise (movement, time, and place) relying solely on the burden of the body, and can be done by everyone. Freeletics training on increasing endurance, strength, and conditioning. Freeletics training session consists of a combination of movements.

The nature of this intense and varied movement allows the body to burn calories, increase body metabolism, and train almost all the muscles as needed. Freeletics is a high intensity exercise that is determined and only use weight, the goal is to complete the exercise as soon as possible which lasts 5-45 minutes and does not require additional equipment [1]. Freeletics is a new exercise that covers a lot of variety movements consists of plank and squat for beginners and more challenges for experienced athletes [2].

HIIT is a type of cardiovascular exercise that combines a type of high intensity exercise with a type of moderate or low intensity exercise over a period of time. HIIT exercise is very effective because with HIIT exercise can improve heart performance affects the metabolism of the body also increases sharply. HIIT based exercise performed 3 sessions a week, showed improved performance to increased endurance and VO2max. This training with a certain time interval that can spur heart work with more hard so that it can increase oxygen consumption and increase body metabolism [4]. Freeletics and HIIT training that not only uses aerobic energy system but also anaerobic. Some sports that involve shorter and more intensive runs required to run further require a balance of energy system proportions, not just aerobic systems but also anaerobic systems [5]. Authors plan to develop research on the above by Futsal Players at sub elite.

2. Methods

2.1 Subjects
A group of junior high school 31 male futsal players aged 15-16 years, divided into three groups. 11 players group freeletics training, 10 players group HIIT training and 10 players group control.
2.2 Procedures
The data retrieval process was performed at pretest and posttest with cardiovascular endurance test with Multistage Fitness Test (MFT), leg muscle strength with Leg Dynamometer, and speed with test run 30 meters.

2.3 Statistical analysis
Statistical analysis of the data was conducted using the Microsoft Excel computer system. All data were reported as mean, standard deviation, t-test (paired samples t-test) and manova.

3. Result and Discussion
3.1. Result
The results clear show that three finding important the difference between pretest and posttest mean of each group.

Experiment group I freeletics for cardiovascular the mean pretest of 36.64 ml/kg/min and the mean posttest of 38.41 ml/kg/min, increase percentage of 4.8% and the sig < 0.05. Strength the mean pretest of 64.82 kg and the mean posttest of 79.18 kg, with increase percentage of 22.1% and the sig <0.05. Speed the mean pretest of 4.52 second and the mean posttest of 4.27 second, increase percentage of 5.8%. Experiment group II HIIT for cardiovascular the mean pretest of 35.91 ml/kg/min and the mean posttest of 37.73 ml/kg/min, increase percentage of 5.1% and the sig <0.05. Strength the mean pretest of 65.00 kg and the mean posttest of 75.85 kg, increase percentage of 16.6% and the sig <0.05. Speed the mean pretest of 4.63 second and the mean posttest of 4.33 second, with increase percentage of 6.9%. The following tables display data and result of the t-test (paired sample t-test) and manova.

Table. 1 Description of Freeletics Group

<table>
<thead>
<tr>
<th>No</th>
<th>Inisials</th>
<th>Cardiovascular ml/kg/min</th>
<th>Strength kg</th>
<th>Speed second</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
<td>Pretest</td>
</tr>
<tr>
<td>1</td>
<td>ANC</td>
<td>37.50</td>
<td>39.60</td>
<td>89.50</td>
</tr>
<tr>
<td>2</td>
<td>LA</td>
<td>42.00</td>
<td>43.30</td>
<td>72.00</td>
</tr>
<tr>
<td>3</td>
<td>RDK</td>
<td>43.90</td>
<td>45.80</td>
<td>44.50</td>
</tr>
<tr>
<td>4</td>
<td>AGK</td>
<td>37.10</td>
<td>38.50</td>
<td>74.50</td>
</tr>
<tr>
<td>5</td>
<td>RF</td>
<td>35.00</td>
<td>36.40</td>
<td>79.50</td>
</tr>
<tr>
<td>6</td>
<td>RTN</td>
<td>26.80</td>
<td>28.00</td>
<td>90.00</td>
</tr>
<tr>
<td>7</td>
<td>TP</td>
<td>44.50</td>
<td>45.80</td>
<td>50.00</td>
</tr>
<tr>
<td>8</td>
<td>HS</td>
<td>32.60</td>
<td>33.90</td>
<td>55.00</td>
</tr>
<tr>
<td>9</td>
<td>BK</td>
<td>37.50</td>
<td>42.60</td>
<td>57.50</td>
</tr>
<tr>
<td>10</td>
<td>AW</td>
<td>32.90</td>
<td>34.30</td>
<td>40.50</td>
</tr>
<tr>
<td>11</td>
<td>GBJ</td>
<td>33.20</td>
<td>34.30</td>
<td>60.00</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>36.64</td>
<td>38.41</td>
<td>64.82</td>
</tr>
</tbody>
</table>

% Enhancement 4.8% 22.1% 5.8%
Table 2. Description of HIIT Group

<table>
<thead>
<tr>
<th>No</th>
<th>Initials</th>
<th>Cardiovascular ml/kg/min</th>
<th>Strength kg</th>
<th>Speed second</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
<td>Pretest</td>
</tr>
<tr>
<td>1</td>
<td>JAW</td>
<td>38.90</td>
<td>40.50</td>
<td>76.50</td>
</tr>
<tr>
<td>2</td>
<td>DK</td>
<td>36.80</td>
<td>38.90</td>
<td>77.00</td>
</tr>
<tr>
<td>3</td>
<td>BNC</td>
<td>33.90</td>
<td>35.40</td>
<td>76.00</td>
</tr>
<tr>
<td>4</td>
<td>STG</td>
<td>31.00</td>
<td>32.90</td>
<td>83.50</td>
</tr>
<tr>
<td>5</td>
<td>MRA</td>
<td>32.90</td>
<td>34.70</td>
<td>58.50</td>
</tr>
<tr>
<td>6</td>
<td>ILM</td>
<td>42.00</td>
<td>43.60</td>
<td>72.50</td>
</tr>
<tr>
<td>7</td>
<td>MIA</td>
<td>34.70</td>
<td>36.80</td>
<td>64.50</td>
</tr>
<tr>
<td>8</td>
<td>GNC</td>
<td>46.50</td>
<td>48.40</td>
<td>45.50</td>
</tr>
<tr>
<td>9</td>
<td>HRS</td>
<td>31.00</td>
<td>32.90</td>
<td>43.00</td>
</tr>
<tr>
<td>10</td>
<td>CD</td>
<td>31.40</td>
<td>33.20</td>
<td>53.00</td>
</tr>
<tr>
<td></td>
<td>Mean</td>
<td>35.91</td>
<td>37.73</td>
<td>65.00</td>
</tr>
</tbody>
</table>

% Enhancement: 5.1% 16.6% 6.9%

Figure 1. Chat of Pretest and Posttest Experiment and Control Group

Table 1. Paired Samples Test of Freeletics Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pair</th>
<th>Mean</th>
<th>N</th>
<th>t</th>
<th>Df</th>
<th>Sig.(2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>posttest-pretest</td>
<td>1.772</td>
<td>11</td>
<td>5.144</td>
<td>10</td>
<td>0.00</td>
</tr>
<tr>
<td>Strength</td>
<td>posttest-pretest</td>
<td>14.363</td>
<td>11</td>
<td>7.733</td>
<td>10</td>
<td>0.00</td>
</tr>
<tr>
<td>Speed</td>
<td>posttest-pretest</td>
<td>-0.250</td>
<td>11</td>
<td>-16.885</td>
<td>10</td>
<td>0.00</td>
</tr>
</tbody>
</table>
This shows that the significance level of each variable is 0.00 or $P < 0.05$. Concluded that there are differences after given HIIT.

### Table 2. Multiple Comparison LSD

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Method</th>
<th>(I) Training Methods</th>
<th>Mean Difference (I-J)</th>
<th>Standard Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>Freeletics</td>
<td>HIIT</td>
<td>.6791</td>
<td>2.1174</td>
<td>.000</td>
<td>-3.6584 - .7017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>Control Group</td>
<td>HIIT</td>
<td>-71.5845*</td>
<td>5.50813</td>
<td>.000</td>
<td>-82.8674 - -60.3016</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength</td>
<td>Freeletics</td>
<td>HIIT</td>
<td>71.5845*</td>
<td>5.50813</td>
<td>.000</td>
<td>60.3016 - 82.8674</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>Control Group</td>
<td>HIIT</td>
<td>.646345*</td>
<td>5.50813</td>
<td>.000</td>
<td>-75.9174 - -53.3516</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>Freeletics</td>
<td>HIIT</td>
<td>.0645</td>
<td>.14612</td>
<td>.000</td>
<td>-0.0439 - 0.2348</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference</td>
<td>Control Group</td>
<td>HIIT</td>
<td>-0.4005*</td>
<td>.14612</td>
<td>.000</td>
<td>-0.2999 - -0.7012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>Freeletics</td>
<td>HIIT</td>
<td>-3.3360*</td>
<td>1.4955</td>
<td>.000</td>
<td>0.2423 - -0.4297</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>Control Group</td>
<td>HIIT</td>
<td>-3.3360*</td>
<td>1.4955</td>
<td>.000</td>
<td>0.2012 - 0.6999</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The mean difference is significant at the 0.05 level

Based on the above table, it can be seen that the sig. value of 0.00 or $P < 0.05$. Concluded that there are differences in influence on the dependent variable (cardiovascular, strength, and speed) between the three groups.

### 3.2. Discussion

The purpose of this systematic review was to critically analyze the literature to determine how freeletics training and HIIT on increase explosive power and speed. The main findings included in this review are freeletics training and HIIT significant and effective to increase explosive power and speed. Performance on the cardiovascular, strength, and speed of freeletics training groups increased significantly. Freeletics training can improve cardio [1]. Explain that the strength that muscles can...
produce depends directly on in maximum strength [6]. Freeletics training there are many muscles that play a role so as to increase muscle strength. Strength muscle contraction is a response of dynamic loading or rapid strain of muscle involved [7].

Freeletics training to increase this speed is given the exercise run with maximum speed so there are many muscles that influence. Some physical activity that requires rapid acceleration in the legs requires leg muscle strength which must have muscles in the limbs and hips as it is important to support sports activities. Example to run suddenly quickly or at the time of tackling [8]. Maximum speed will increase the speed of muscle contraction and movement speed as high as possible.

Freeletics training is an exercise that only uses the weight of the individual without the aid of any tool and the high intensity of the exercise form with the level of difficulty can be tailored to each individual who performs and according to the needs of the sport.

Freeletics workout program used in this study consist of nine high intensity forms of exercise are: Deep Jump, Squat, High Jump, Burpee, Burpee Frog, Lunges, Jumping Jack, Sprint 200 m, and 40 m. HIIT is a powerful and time-saving training method to induce both central (cardiovascular) adaptation and peripheral adaptation (skeletal muscle) associated with improved health. HIIT exercise program includes an interval run and a ladder drill with a high intensity of 80-90%. HIIT exercise is very effective in increasing the anaerobic threshold. Anaerobic threshold is the level of oxygen consumption where there is a rapid and systemic increase in blood lactate concentration. HIIT exercise 5 week program is associated with increased VO2peak and VO2max [9]. HIIT workout program used in this study consist of nine high intensity forms of exercise are: interval training 30 second sprint and 60 second jogging, Lateral In Out, Straddle Squat Hops, High Knee Run, Ali Shuffle, and Sprint 10 m.

Freeletics and HIIT training are equally high intensity exercise that can improve cardiovascular capacity. Cardiovascular improvement is due to an increase in heart rate during exercise. Increased heart rate during this exercise increases stroke volume. Increased stroke volume and increased heart frequency can lead to an increase in cardiac output ie the volume of blood released by both ventricles a minute [10]. High intensity exercise causes increased stroke volume resulting in decreased pulse while cardiac output remains, efficiency of heart muscle in supplying blood throughout the body. Efficiency of heart rate is indicated by decreased pulse rate.

Low intensity exercise interspersed between high intensity workouts at interval training helps remove metabolism from muscles during periods of rest during high intensity interval exercises being performed by the body. Changes in the period of exercise that take turns helps the body increase the volume in consumption oxygen during exercise. Oxygen leading to this active muscle breaks down lactic acid into energy [11]. HIIT exercise combines aerobic and anaerobic energy systems leads to faster muscle contraction because the exercise requires a great deal of energy and high intensity. Exercise is programmed it increases muscle strength that directly increases speed. The aerobic energy system will train the mitochondria so enzym in the body will grow better, where as in anaerobic energy systems train anaerobic metabolism, which means muscle cells utilize energy without oxygen. Research on HIIT training on exercise interval training for 15 minutes showed a great influence on the increase of VO2max and speed. This paper finding HIIT exercises conducted for six weeks can increase strength and speed [12]. The results of this study indicate that the provision of training programs to freeletics and HIIT, showed significant improvement results to improve cardiovascular, strength, and speed.

4. Conclusion

Based on the above analysis, it can be concluded that there is a significant effect of freeletics and HIIT on cardiovascular improvement, strength, and speed. Freeletics training is more effective than HIIT training and control groups in increasing strength. HIIT exercise is more effective than the freeletics exercise and control group in improving cardiovascular and speed.

Acknowledgments

The authors wishes to acknowledge the Rector of Universitas Negeri Surabaya and the futsal players for supporting and assisting the data.
References


Comparative Study of Application of Algorithm C4.5 and Naïve Bayes as Supporting Money Loan Decision (Case Study at Employee Cooperative PT Karyamitra Budisentosa Pandaan)

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Abstract. Money lending system in the cooperative employees of PT. Karyamitra Budisentosa has a central role because members of the co-operatives themselves are 100 members and need to be analysed by whom members are eligible to be loaned. The risk of a non-performing loan system will cause bad debts, it will disrupt the financial system and business processes that exist in the cooperative. while non-performing loans based on data collected from 2013 to 2017 amounted to 57.69% in 2013, 50% in 2014, 52.38% in 2015, 71.4% in 2016 and 72.72% in 2017 which occurred on Employee Cooperative PT. Karyamitra Budisentosa when compared with credit with the status paid off. This research uses the tool of RapidMiner 8.0 which is machine learning to study the data history with method C4.5 and Naïve Bayes then from both methods is taken the highest AUC (Area Under Cover) value, the AUC value is the interpretation of the average sensitivity for all Specificity values (accuracy, precision, recall) are possible. The AUC value is used to measure the general diagnostic test in analysing the data history, Naïve Bayes is a method that calculates the probability of the rate of occurrence of data on one another. The C4.5 algorithm is one of several algorithms in the decision tree method that converts data into decision tree, to then be inferred into rule-rule. Based on the comparison of test results through various scenarios on both methods, Naïve Bayes method obtained an average AUC value of 0.866 based on 4 sampling models while the C4.5 method with an average AUC value of 0.786 based on 4 sampling models of each method tested using a 5-fold test scenario with Cross Validation so Naïve Bayes is the best recommended method in the form of a Decision Suport System, which in this study is also provided a basic model in applying the Naïve Bayes method into the decision support system submitted to management of Cooperative Employee PT. Karyamitra Budisentosa.

1. Introduction
The cooperative started at 20th century which is generally the result of an effort that is not spontaneous and is not done by very wealthy people. Cooperative grew from among the people, when the suffering in the economic and social field caused by the system of capitalism is mounting. Some people whose modest livelihoods with limited economic capabilities, fueled by the same suffering and economic burdens, spontaneously unite themselves to help themselves and their fellow human beings. (Hendrojogi, 2004)

The background of the authors choosing money lending in cooperatives is the existence of bad loans based on data that has been collected from the year 2013 to 2017 of 57.69% in 2013, 50% in 2014, 52.38% in 2015, 71.4% in 2016 and 72.72% in 2017 that occurred in Employee Cooperative PT. Karyamitra Budisentosa when compared with credit with the status paid off. Prior research on the classification algorithm between decision tree C4.5 and Naïve Bayes combined with forward selection...
method for accuracy of student concentration selection obtained the highest accuracy with selected algorithm C4.5 with an accuracy value of 84.98% (Supriyanti, 2015).

Ironically, the results of other studies conducted, based on the accuracy and recall value, naive bayes is higher than the decision tree (C.45) with accuracy of 75.66% for decision tree and 76.97% for naive bayes. For naive bayes recall value is superior that is 96.89% compared to decision tree (C.45) 89.78%. Although in this research the level of Precision was higher decision tree that is 85.23% compared to naive bayes 84.17%. The final result of this research is naive bayes method better used than decision tree method (C.45) with total value 250.67% for decision tree (C.45) and 258.03% for naive bayes with dataset from puskesmas Kartasura about data of growth of children under five (Listiana, 2015).

Based on the above explanation, we will compare the method of C4.5 and Naive Bayes which of the 2 methods will provide the best solution based on the largest AUC value.

2. Data Pre-processing

Pre-processing data is a process of data preparation conducted with the aim of adjusting the data conditions to fit the needs of the process of analysis (data mining).

2.1. Data Collecting

At this stage done the process of collecting data with manual input because some data in physical form, then perform data analysis and evaluate the quality of data used in this study. From data permission process submitted, data obtained by debtors in the year 2013 as many as 77 data records, in 2014 as many as 60 data records, in 2015 as many as 35 data records, 2016 as many as 17 record data and in 2017 as many as 24 record data, 213 data records from 2013-2017. From each data has 19 attributes with the value possessed by the attribute is the categorical value and the value of the number, there are certain attributes that each year the data record changed its value that is the working period attribute.

2.2. Preparation of Data Pre-processing

At this stage the raw data preparation then determines the attributes used to analyse the problem. In the preparation of data processing there are some pre-processing or processing techniques used to process raw data that is:

1. Data Cleaning, at this stage is done cleaning the values in the empty attribute and delete the missing data (missing values and noisy).
2. Data Integration, at this stage is done unification of different data into one data. In this case, there are two data taken as data warehouse that is debtor database and nominative data credit,
3. Data Reduction, the number of attributes and data used for training data and test data may be too many and only a few attributes and data are required in conducting research so that unnecessary attributes and data are removed. In this phase, the data removal process that is duplicated and the data of the debtor who can not apply for credit that may occur because they still have dependents in the previous year, so it is possible to be recorded next year reporting.
4. Data Conversion, data that still have value in the form of numbers must be done data conversion process with data classification of attribute.

In the process of processing data from raw data to the dataset that is ready to be processed into machine learning occurs several stages of pre-processing that are used include: Data Cleaning, at this stage is done cleaning the values in the empty attribute and remove the empty data (missing values and noisy) , at this stage data integration is made from year to year for 5 different years into a data record. Data Reduction, minimize the number of attributes on the dataset, so that only some attributes and data
needed in doing research. In this phase, the data removal process that is duplicated and the data of the debtor who can not apply for credit that may still be dependent in the previous year, so it is possible to be recorded in the reporting year. Data Conversion, the data that still have the value of the numbers must be converted with the classification of the data from the contents of one of the attributes amount of borrowed money that became one of the key input variables of the format dataset excel that will be inserted into machine learning.

3. Formatting the text
At this stage the selection of appropriate modeling techniques is selected. In this study, using model or algorithm C4.5 and Naïve Bayes. With the help of RapidMiner which is software that is open source. RapidMiner is a solution for analysing datamining, text mining and prediction analysis. RapidMiner is an easy-to-use tool for analysing the accuracy, precision, recall, predictive classification of datasets entered.

Figure 1. Framework of RapidMiner

1. The data set
The data set describes the dataset with input variables to RapidMiner 8.0 as in table 1

2. Method of datamining
The datamining method is the method used in studying the dataset in this study using C4.5 and Naïve Bayes method with the equation below

a. Equation C4.5

\[ \text{Gain}(S, A) = \text{Entropy}(S) - \sum_{i=1}^{n} \frac{|S_i|}{|S|} \times \text{Entropy}(S_i) \]  

With:
S: The set of cases
A: Attribute
n: Number of partition attributes A
|S_i|: Number of cases on ith partition
|S|: Number of Cases in S

While the calculation of entrophy value can be seen in the following formula 2:

\[ \text{Entropy} (S) = \sum_{i=1}^{n} -p_i \times \log_2 p_i \]
With:
S: The set of cases
Pi: The proportion of Si against S
n: Number of partition attributes A
Having known Gain, Enterophy sought Gain Ratio value using the following formula:

\[
Gain Ratio(S,A) = \frac{Gain(S,A)}{Splitinfo(S,A)}
\]

Where the Splitinfo formula based on equation 4 follows:

\[
Splitinfo(S,A) = -\sum_{i=1}^{S} \frac{S_i}{S} \log_2 \frac{S_i}{S}
\]

With:
S: The set of cases
A: Attribute
Si: Number of cases on ith partition
S: Number of Cases in S

b. Naïve Bayes equitation is much simpler

\[
P(x|y) = \frac{P(x|y)p(x)}{p(y)}
\]

Information:

y = data with unknown class
x = hypothesis of data y is a specific class
P(x | y) = probability hypothesis x from condition y (posteriori probability)
P(x) = probability hypothesis x (prior probability)
P(y | x) = probability y based on the condition on the hypothesis x
P(y) = probability of y.

4. Evaluation
In this study use confusion matrix as performance evaluation of method C4.5 and Naïve Bayes which yield accuracy, precision and recall that make ROC graph with AUC value.

Tabel 1. Confusion matrix

<table>
<thead>
<tr>
<th>Correct Classification</th>
<th>Classfied as</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+</td>
</tr>
<tr>
<td>+</td>
<td>True positives (A)</td>
</tr>
<tr>
<td>-</td>
<td>False positives (C)</td>
</tr>
</tbody>
</table>

The calculation of accuracy with the confusion matrix table is as follows:

\[
Accuracy = \frac{A + D}{A + B + C + D}
\]

\[
Precision = \frac{A}{C + A}
\]

\[
Recall = \frac{A}{A + D}
\]
The ROC curve shows accuracy and compares the classification visually. ROC express confusion matrix. ROC is a two-dimensional graph with false positive as horizontal and true positive lines as vertical lines. AUC (the area under curve) is calculated to measure the performance difference of the method used. ROC has a level of diagnostic value that is:

a. Accuracy is 0.90 - 1.00 = excellent classification
b. Accuracy is 0.80 - 0.90 = good classification
c. Accuracy is 0.70 - 0.80 = fair classification
d. Accuracy is 0.60 - 0.70 = poor classification
e. Accuracy is worth 0.50 - 0.60 = failure (Rosely, 2015)

5. Result
Model test results are divided into several main scenarios. Testing of classification model using 5-fold cross validation technique. Testing using 5-fold cross validation is considered quite good because the number of records data obtained after pre-processing data is considered quite a bit.

To facilitate in analysing the 5-folds test results against each of the 4 sampling methods shown with graphs such as Figures 2, 3, and 4

![Figure 2](image1.png)

**Figure 2.** Graph of average result test of C4.5 Method

![Figure 3](image2.png)

**Figure 3.** Graph of average result test of Naïve Bayes Method
The graphs in Figures 2 and 3 show the results of the performance comparison test of the use of C4.5 and Naïve Bayes on the analysis of the classification of bad debts and paid off. As for the results, the accuracy, precision and recall performance of C4.5 method resulted in better performance, where the average value of each sampling to the accuracy, precision and recall value is 79.04%, 81.16% 67.43%. For Naïve Bayes where the average value of each sampling to the value of accuracy, precision and recall is 78.53%, 77.86%, 71.22%. To determine the best method we need the AUC value of each method to know the quality of each method, as for the graph of the AUC value represented in Figure 4 below.

Based on Figure 4 it can be seen that the average AUC value of each method against the sampling test scenario is 0.786 for the C4.5 and 0.866 methods for the Naïve Bayes method. The AUC value (the area under curve) is calculated to measure the performance difference of the method used. The ROC graph is a graph of the true positive rate on the Y axis with 1-specificity on the X axis (false positive rate), as if illustrating the bargain between sensitivity and specificity, ROC graphs used To assess the accuracy and quality of some tests diagnose method. The value of AUC is interpreted as the average sensitivity for all possible values of specificity (accuracy, precision, recall). AUC values are used to measure diagnostic tests in general. (Rosely, 2015)

6. Conclusion
Based on the results of research that has been done then can be taken some conclusions, among others:

1. The accuracy, precision and recall value of the C4.5 and Naïve Bayes comparison methods calculated using Cross Validation with 5-fold average sampling resulted in accuracy: 79.04%, precision: 81.16%, recall: 67.43 %; while for Naïve Bayes method: accuracy: 78.53%, precision: 77.86%, recall: 71.22%. From the average value of Cross Validation 5-fold sampling test it can be seen that the C4.5 method has a higher degree of accuracy and precision than Naïve Bayes method but in terms of recall Naïve Bayes is superior.

2. The best method based on the value of AUC (Area Under Curve) is Naïve Bayes which is valued at 0.866 based on the average value of Cross Validation 5-fold AUC sampling of 0.896 while the C4.5 method is 0.786. So it is recommended to the Cooperative Employees PT. Karyamitra Budisentosa to build an information system to predict the credit appropriateness of applying the Naïve Bayes method with the proposed basic model.

7. Suggestion
As for suggestions to be submitted for further development of this research include:
1. Further research is needed on more detailed and significant predictor variable selection methods, as well as the most optimal determination of Naïve Bayes parameters.
2. Classification using the Naïve Bayes method that already has good results needs to be combined with the use of Adaboost, Fuzzy, KNN to get the maximum implementation results.

8. References
Design of Monitoring Heart Signal Based On Telemedicine

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Abstract. An electrocardiograph machine is a standard equipment used to monitor heart signals, especially for early detection of heart attacks in humans. This ECG machine can be used to monitor heart examination not only in hospitals, but also at home. As medical technology developed, particularly heart signals monitoring machine with the development of microcontroller technology, the design innovation of ECG machine needs to be developed through researches. In this research, the researcher designed telemetry- based ECG machine with ATMEGA microcontroller technology. The design of this research started by recording heart signals, creating bio amplifier circuit, transmitter and receiver Xbee-based circuit that results can be displayed through internet which can be seen in personal computer (PC). The research design used Quasi Experimental Design, i.e. Time-Series Design. The independent variables of this research are ECG phantom or human, and the dependent variable is ECG machine. The design of ECG machine based on telemedicine is created though the following stages: a) designing ECG bio amplifier circuit; b) designing microcontroller circuit and PC display circuit; c) designing heart sounds amplifier; d) designing Xbee module (transmitter and receiver) to process ECG signal by multipoint to point; e) designing data acquisition program, data storing, ECG digital signal filter and analog to PC data plotting; f) measuring heart signal response in heart signal monitoring machine (ECG machine); g) testing the output calibration circuit. The results and analysis of the research of BPM measurement using phantom with 5% tolerance show that: a) the measurement of 60 BPM with speed 25 mm/s in ECG 1, the % error number is 0,1123 and uncertainty (UA) 0,06901; b) the measurement of 60 BPM with speed 25 mm/s in ECG 2, the %error number is: 0,05555 and uncertainty (UA):0,09404; c) the measurement of 60 BPM with speed 25 mm/s in ECG 3 the %error number is: 0,0333 and uncertainty (UA): 0,11066; The result of data analysis of three heart beat monitoring machines, especially heart rate, is under the tolerance number allowed, i.e. less than 5%. Thus, the machine is feasible. However, if this machine is used to count heart beats, it needs heart rate count restrictions in 1 (one) period so the detection of heart beats reaches normal number. If it is observed based on sensitivity (0,5,1 and 1,5 ) analysis results, ECG 1 machine shows %Error 0, 0, 1 and and Uncertainty (Ua) 0, 0,and 0,22, ECG 2 machine shows %Error : 0, 0, and 1 and Uncertainty (Ua) : 0,22 and ECG 3 machine shows Error : 0,0 and 1 and Uncertainty (Ua) : 0, 0, and 0,22. This means that three machines are feasible, because it is under the tolerance allowed, i.e. 2%. The picture of heart output signal that consists of 12 records sent via internet which is shown in PC, the results are good although the parameter is different like speed 25 and 50 mm/s. The research conclusions are: 1) the result of ATMEGA microcontroller listing program design can be used to run telemedicine-based ECG program module by displaying heart beat numbers, beep per R signal and ECG signal; 2) the result of design ECG based on telemedicine is feasible since the design of bio amplifier circuit that is combined with tapping selection and filter circuit can be used to process heart signal; 3) the design of 1 mV circuit produces the frequency from differentiator 10.17 Hz, but there is still noise after passing microcontroller circuit and displayed in PC; 4) the design of microcontroller circuit can process heart signal from bio amplifier circuit which result can be transmitted into PC and web with URL tekmed.penelitian.poltekkesdepkes-sby.ac.id, with display like heart beat followed by sound, heart signal from three ECG machines alternately; 5) the design of software is used to run signal receiver program from tapping until transmitted to internet multipoint to point.

Key word : ECG, Heart signal
1. Introduction

An electrocardiograph (ECG) machine is a standard machine used to monitor heart signals, especially to detect human heart attack early. Not only for monitoring heart examination in hospitals, electrocardiograph machines can also be used at home. As medical technologies develop, especially heart signal monitoring machine related to microcontroller technology development, the innovation of ECG machine design need to be developed through researches.

The studies of microcontroller technology to design ECG machine have been conducted by some researchers; i.e. “Research of portable ECG Monitoring Device” (Genghuang Yang, Xin Cai, Feifei Wang, Shigang Cui 2011), “Design of the intelligent simple Electrocardiograph (Jie Sun 2012), Microcontroller based data acquisition system for Heart Rate Variability (HRV) measurement (Nazneen Akhter, Jinan Fadhil Mahdi, Ganesh R Manza 2012), “A Multi channel optoelectronic sensor to accurately monitor heart rate against motion artefact during exercise” (Alzahrani et al. 2015), “Haert rate monitoring and PQRS detection based on graphical user interface with matlab” (AL-Ziarjawey 2015)

This is a development of the previous research about “design of Electrocardiograph machine based on Atmega microcontroller (Science & Irianto 2016). The weaknesses of the previous research are the recording speed that only applied one speed 25 mm/s and one sensitivity 1 mV. However, the fact showed that, for the speeds 22 mm/s and 50 mm/s and the sensitivity 0.5 mV, 1 mV, and 2mV, the signal received was not perfect. It needs improvement in the filter. Besides, this machine only monitors point to point heart signal. This means this machine is only used for one patient and monitored by one ECG machine. It does not use multi point to point that is by using several ECG machine, but can be monitored from one place.

Although there are some researches that use point to point wireless, i.e. “The study and design of a wireless ECG monitoring system”(Yang & Chai 2012); “Design of wireless ECG transmitter” (Muhammad Asrhaf, 2012); there is still noise when ECG signal 2 channels are sent. “Desaign of wireless sensor network platform for tele-homecare” (Chung & Liu 2013); Desaign of the improved CPR simulation control system based of wireless telemetry”(Li & Hua 2013); “Wireless ECG monitoring system using 3 G (Manjare & Deshmukh 2014); In addition, a research using multi point to point has been conducted by Hadiyoso (2014) entitled “Multi point to point ECG monitoring based on ZigBee”(Hadiyoso & Aulia 2014) but it used 1 channel only. Based on the identification of problems, the researcher wants to complete and develop the previous researches using telemedicine multipoint to point by design of monitoring heart signal based on telemedicine.

The research problems are:

1. Can microcontroller be used as a media to process multipoint ECG signals?
2. Can microcontroller be combined with Xbee transmitter to send ECG signals 12 channels?
3. Can microcontroller be combined with Xbee receiver to receive ECG signals?
4. Can a combination of microcontroller and Xbee Rf module send heart beat data?
5. Can Xbee module (transmitter and receiver) process ECG data with multipoint to point system?

2. Material and Methods

The general aim of this research is to design of heart signal monitoring based on telemedicine with ATMEGA microcontroller technology. The steps of desaigning of heart signal monitoring based on telemedicine are a) designing ECG bio amplifier circuit; b) designing microcontroller circuit and PC display circuit; c) designing heart sound amplifier circuit; d) designing Xbee module (transmitter and receiver) to process ECG signal multipoint to point; e) designing programs: data acquisition, data storing, ECG signal digital filter and analog data to PC plotting; f) measuring heart signal response in ECG; g) testing output calibration circuit.

This research applies Quasi Experimental Design namely Time-Series Design. The independent variable is ECG phantom or human and the dependent variable is ECG machine. The research processes or plots are run as explained in the following block diagram:
The electric signals from the heart are drawn through three electrodes that tap two measurement sectors, i.e. frontal sectors (bipolar) that consist of Lead 1, 2 and 3. The tapping result from this phantom will get in each ECG machine, in which later ECG signal data from each ECG machine will be transmitted by XBee RF module 1, 2, and 3 to receiver XBee. The result from XBee receiver will be forwarded to central monitor and the result can be read of saved in central monitor which later can be accessed via web or the IP address of Electro medical Engineering Department, Health Polytechnic of Surabaya.

This research takes place in Microcontroller Laboratory, Electromedical Engineering Department, Health Polytechnic of Surabaya and Balai Pemeriksaan Fasilitas Kesehatan (BPFK) Surabaya in 6 (six) months.

3. Result
The result of heart rate measurement (heart rate/ BPM) in PC.

<table>
<thead>
<tr>
<th>Set Media</th>
<th>Personal Computer (BPM)</th>
<th>Average</th>
<th>% Error</th>
<th>SD</th>
<th>UA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead 1</td>
<td>59 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead 2</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead 3</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead AVR</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead AVL</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead AVF</td>
<td>60 60 60 60 60 59,96667</td>
<td>0,0556</td>
<td>0,18102</td>
<td>0,02356</td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V3</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V4</td>
<td>59 60 60 60 60</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>V5</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Table 2. Measurement Heart rate 60 BPM in ECG machine 2 speed 25 mm/s

<table>
<thead>
<tr>
<th>Set Media</th>
<th>Personal Computer (BPM)</th>
<th>Average</th>
<th>% Error</th>
<th>SD</th>
<th>UA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead 1</td>
<td>59 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead 2</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead 3</td>
<td>60 60 60 60 60</td>
<td></td>
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</tr>
<tr>
<td>Lead AVR</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead AVL</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lead AVF</td>
<td>60 60 60 60 60 59,96364</td>
<td>0,0606</td>
<td>0,219784</td>
<td>0,028614</td>
<td></td>
</tr>
<tr>
<td>V1</td>
<td>59 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V3</td>
<td>60 60 60 60 60</td>
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<tr>
<td>V4</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td>V5</td>
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<td></td>
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</tr>
<tr>
<td>V6</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Table 3. Measurement Heart rate 60 BPM in ECG machine 3 speed 25 mm/s

<table>
<thead>
<tr>
<th>Set Media</th>
<th>Personal Computer (BPM)</th>
<th>Average</th>
<th>%Error</th>
<th>SD</th>
<th>UA (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead 1</td>
<td>59 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Lead 2</td>
<td>59 60 60 60 60</td>
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<td>Lead 3</td>
<td>59 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVR</td>
<td>60 60 60 60 60</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>AVL</td>
<td>60 60 60 60 60</td>
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</tr>
<tr>
<td>AVF</td>
<td>60 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Measurement Heart rate 60 BPM in ECG machine 3 speed 25 mm/s

<table>
<thead>
<tr>
<th>Set Media</th>
<th>Personal Computer (BPM)</th>
<th>Average</th>
<th>%Error</th>
<th>SD</th>
<th>UA (p)</th>
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</thead>
<tbody>
<tr>
<td>V1</td>
<td>59 60 60 60 60</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>V2</td>
<td>59 60 60 60 60 59,96</td>
<td>0,0667</td>
<td>0,219784</td>
<td>0,028614</td>
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</tr>
<tr>
<td>V3</td>
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<td></td>
</tr>
<tr>
<td>V4</td>
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<td>V5</td>
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<td>V6</td>
<td>60 60 60 60 60</td>
<td></td>
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</tr>
</tbody>
</table>
Table 4. Measurement Sensitivity for ECG 1, ECG 2 and ECG 3

<table>
<thead>
<tr>
<th>Setting Sensitivity (mV)</th>
<th>Output ECG (mm)</th>
<th>Measurement (mm)</th>
<th>Average</th>
<th>SD</th>
<th>Error</th>
<th>Toleransi</th>
<th>UA</th>
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<tbody>
<tr>
<td>1.4.2.16</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>±5%</td>
</tr>
</tbody>
</table>

Table 5. Measurement Paper speed ECG1, ECG 2 and ECG 3.

<table>
<thead>
<tr>
<th>Setting Paper speed (mm/s)</th>
<th>Measurement (mm/s)</th>
<th>Average</th>
<th>SD</th>
<th>(%) Error</th>
<th>Toleransi</th>
<th>UA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td></td>
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<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 2. Signal ECG 1 Lead 2.

Figure 3. Signal ECG 2 Lead 3.
4. Discussion

The designs of monitoring heart signal based on telemedicine and the circuits of ECG 1, ECG, and ECG 3 are similar. The complete ways of working are:

The electric signals from the hearts of three phantoms are tapped by each heart signal monitoring machine or ECG machine. Then, they enter to bioamplifier instrument circuit through filter circuit. Further, they enter to microcontroller circuit. This microcontroller circuit is used to process analog heart signals to digital signal, which then enter to XBee transmitter circuit and are received by XBee receiver circuit in the PC. The displays are various ranging from various heart rate, various tapping speed, and also various sensitivity of the heart signal monitor. Next, the signals enter the server and are transmitted to web with URL: tekmed.penelitian.poltekkesdepkes-sby.ac.id and can be downloaded though the address alternately. This will be shown in pictures of heart signal monitoring download. All data drawn from ECG phantoms.

4.1 Discussion of Heart Rate (BPM)

From the result of BPM measurement shown in table 1 – 3, the data can be analyzed as follows:

a. The measurement of 60 BPM with speed 25 mm/s in ECG 1, the %error number is 0,0556 and the uncertainty (UA) is 0,02356
b. The measurement of 60 BPM with speed 25 mm/s in ECG 2, the %error number is 0,0606 and the uncertainty (UA) is 0,028614

c. The measurement of 60 BPM with speed 25 mm/s in ECG 3, the error number is 0,0667 and the uncertainty (UA) is 0,028614

The result of the analysis shows that the tolerance number of three heart signal monitoring machines, especially heart rate, is below the number allowed, i.e. less than 5%. Thus, these machines are feasible.

4.2 Discussion of ECG Sensitivity

The result of ECG sensitivity analysis shows in table 4, the data can be analyzed as follows:

1. ECG 1 shows Error: 0 and Uncertainty (UA): 0
2. ECG 2 shows Error: 0 and Uncertainty (UA): 0
3. ECG 3 shows Error: 1 and Uncertainty (UA): 0.22

This condition states that all heart signal monitoring machines are feasible based on the sensitivity because the numbers are below the tolerance numbers, i.e 5%.

4.3 Discussion of ECG paper tapping speed

The analysis result of ECG paper tapping speed of three ECG machines used to monitor heart signals shows that Error: 0 and the uncertainty: 0. Thus, all ECG machines are feasible because the tolerance numbers are below the numbers allowed, i.e. 2%.

4.4 Discussion of Heart Signal transmitted via internet

By seeing the display in the PC that receive the pictures, the results are similar with the original one, although some parameters are used like the speed 25 mm/s.

5. Conclusion and Suggestion
5.1. Conclusion

This research results show that the design of bioamplifier circuit combined with the circuit of tapping choice and filter can be used to process heart signals. However, in the design of circuit 1 mV that produces frequency from differentiator 10,17 Hz, there is still some noise after it is transferred through microcontroller circuit and displayed in the PC.

The use of microcontroller circuit in this research is proven that it can process heart signal (heart rate followed by heart signal sound) from three ECG machines alternately that come from bioamplifier circuit. The result of heart signal process can be transmitted to PC and web with URL tekmed.penelitian.poltekkesdepkes-sby.ac.id by multipoint to point.

5.2. Suggestion

The heart signal reception needs improvement because sometimes there is some noise.

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Characterization and Analysis Biochemical Properties of Amylase-Producing Bacteria Originated from Pariangan Hot Spring: Isolate S2.3

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Abstract. Amylase produced by bacteria or bacteria amylase is an enzyme that can hydrolyze starch to sugar. Amylolytic enzymes play a role in the manufacture of glucose syrup, bread making, and baby food. In the field of non-food industry, amylolytic enzymes play a role in the paper industry, leather tanning, pharmaceuticals, textiles and as detergent additives. Amylase derived from the thermophile bacteria is widely used in various industries because it is stable to high temperature and pH, such as bacteria derived from hot springs Pariangan. Isolation and screening of amylase-producing bacteria originating from Pariangan hot spring, Tanah Datar regency, West Sumatera province have been successfully performed. There were 4 isolates of amylase-producing bacteria and 1 bacterium isolate with the highest activity, ie isolate S2.3. The characterization and analysis of the biochemical properties of isolate S2.3 are not known.

The aims of the study were to investigate the morphology and biochemical properties of isolate S2.3. The method used is characterization of isolate S2.3 (color, shape, edges, and elevation), Gram staining (morphology and spores), biochemical properties of isolate s2.3 (TSIA, Catalase, Oxidase, Indole, Urea Citrate, Lactose, Glucose, Sucrose, Mannitol, MR, VP, OF, Arabinose, Nitrate, and Gelatin. The result of this study showed that the bacteria isolate S2.3 is a Gram-positive bacterium and classified into Bacillus sp.

1. Introduction
Amylase produced by bacteria or bacteria amylase is an enzyme that can hydrolyze starch to sugar [15]. In the field of food industry, amylolytic enzymes play a role in the manufacture of glucose syrup, bread making, and baby food. In the field of non-food industry, amylolytic enzymes play a role in the paper industry, leather tanning, pharmaceuticals, textiles and as detergent additives [11]. Amylase is one of the three largest groups of industrial enzymes and accounts for approximately 65% of the world enzyme [1]. Amylases from the plant and microbial sources have been employed for centuries as food additives.

Amylase derived from the thermophile bacteria is widely used in various industries because it is stable to high temperature and pH, such as bacteria derived from hot springs Pariangan [10]. Isolation and screening of amylase-producing bacteria originating from Pariangan hot spring, Tanah Datar regency, West Sumatera province have been successfully performed. There were 4 isolates of amylase-producing bacteria and 1 bacterium isolate with the highest activity, ie isolate S2.3. The characterization and analysis of the biochemical properties of isolate S2.3 are not known. The aims of the study were to investigate the morphology and biochemical properties of isolate S2.3.
2. Methodology

2.1 Characterization of isolate S2.3
Characterization of bacteria is done through macroscopic observation, i.e., observation of colony form from bacteria, colony edge, elevation, surface, and colony pigmentation. Microscopic observation was done through observation of bacterial cell form, spore staining and reaction to Gram staining [7].

2.2 Biochemical properties of bacteria
Biochemical properties of bacteria were performed by biochemical tests, such as TSIA, Catalase, Oxidase, Indole, Urea Citrate, Lactose, Glucose, Sucrose, Mannitol, MR, VP, OF, Arabinose, Nitrate, and Gelatin.

3. Result and Discussion
The process of observing bacterial morphological features or screening morphology may help to group two or more bacteria suspected of having the same species, especially if the bacteria to be identified are present in large quantities.

3.1 Characterization of isolate S2.3
The result of this study showed that the bacteria isolate S2.3 had white colonies, rounded shape, flat surface, and flat elevation. Characterization of bacterial morphology derived from compost has also been done by [13], the results obtained are CS3.1 bacterial isolates, irregular shapes, grooved edges, and elevated elevations. The result of Gram staining and biochemical properties showed that S2.3 isolate classified to Gram-positive and has spores (Figure 1).

![Figure 1. The result of Gram staining S2.3 isolate](image)

The endospore produced by *Bacillus* aims protecting bacteria from a state that is not profitable such as drought, nutrient deficiency, freezing, as well as chemicals. The bacterial endospore types this is resistant to environmental changes, resistant to heat, and chemical disinfectants certain in a long time [17]. If the environment is good, then endospores will experience sporogenesis and be forming a vegetative cell [18]. Endospores produced by Bacillus have high resistance to chemical and physical factors, like extreme temperatures, alcohol, and so on. These types all contain Dipicolinic Acid (DPA) and they have degrees unparalleled dormancy in life forms another. The spores carry a cycling development where vegetative cells can form spores and spores than can grow germination into vegetative cells [18].

3.2 Biochemical properties of bacteria
Based on the results of the test biochemical properties of bacterial isolate S2.3 (Table 2) showed that isolate S2.3 belong to *Bacillus* sp. The results of characterization and test of biochemical properties of bacterial isolates originating from hot springs in Jordan showed that isolates were grey, creamy, and white, opaque or translucent, rough or smooth, with regular or irregular edges. Colonies might appear
finely wrinkled and adherent to the agar surface. Based on Gram staining, the isolates were found mostly to be Gram-positive and microscopic observation revealed spore-forming a rod-shaped bacterium arranged in the chain [16].

Table 1. The result of a test of biochemical properties

<table>
<thead>
<tr>
<th>No.</th>
<th>Test of biochemical properties</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TSIA</td>
<td>Red/yellow</td>
</tr>
<tr>
<td>2</td>
<td>Catalase</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td>Oxidase</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Indole</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>Urea</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>Citrate</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Lactose</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>Glucose</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td>Sucrose</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>Mannitol</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>MR</td>
<td>+</td>
</tr>
<tr>
<td>12</td>
<td>VP</td>
<td>-</td>
</tr>
<tr>
<td>14</td>
<td>OF</td>
<td>-</td>
</tr>
<tr>
<td>15</td>
<td>Arabinose</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Nitrate</td>
<td>+</td>
</tr>
<tr>
<td>17</td>
<td>Gelatine</td>
<td>+</td>
</tr>
<tr>
<td>18</td>
<td>Xylose</td>
<td>+</td>
</tr>
</tbody>
</table>

Endospores round, oval, elliptical, cylinder, which is formed inside the cell vegetative. The endospores differentiate Bacillus from types of forming bacteria exospora [8]. The genus Bacillus was isolated from all explored sites, the presence of Bacillus in all sampled locations could be due to the ability of this genus to move at high rates and their resistance to harsh environmental conditions [4], in addition to its adaptation for hot surroundings [2;12]. The Bacillus genus is a bacterium rod-shaped can be found on the ground and water including sea-water [8]. Bacillus is known to produce a variety of extracellular enzymes and can be used in various industries [3]. The same study by [14] reported that Bacillus was found in the Odishi hot springs, India that could produce various thermostable enzymes (thermozyme). So it is with Khalil. [6] reported that Bacillus sp was found in hot springs in Saudi Arabia that could produce amylases with high activity. Some types of Bacillus produce extracellular enzymes that can hydrolyze proteins and polysaccharides complex [12].
References


Validation of Physics Learning Devices For The Subject Matter Of Temperature, Heat, And Heat Transfer By Methods Of Real Experiments And Virtual Experiments

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Abstract. This study aims to validate the physics learning device for the subject matter of temperature, heat, and heat transfer using real experiments and virtual experiments method. Components of validated physics learning tools consist of syllabus, learning implementation plan, learning subject matter analysis, student worksheet, instructional media, and learning result test. The assessed aspects of the physics learning tool are format, content, and language. Expert validation comes from lecturers, teachers, and alumni consisting of 6 people. The conclusions of the assessment of the physics learning device generally fall into either category with a value of 3, so that the physics learning device can be used with little revision.

Introduction
Learning tools that must be made by teachers before teaching in the class consists of 6 components namely syllabus, learning implementation plan, learning subject matter analysis, student worksheet, instructional media, and test of learning result. Learning tools are useful to facilitate teachers implement learning in the class so that the desired goal can be achieved. The ability of teachers in developing learning tools is one of the factors that affect student learning outcomes. One effort that can be done by lecturers from universities is to facilitate teachers in developing their ability to develop learning tools. Things that can be done by lecturers, among others, is to conduct research on the development of learning tools by involving teachers who come from school.

According to [1], Syllabus is one of the curriculum development products containing the outline of the subject matter, the learning activities, and the design of the assessment. The learning implementation plan is the step-by-step guide that will be done by the teacher in the learning activities arranged in the activity scenario. Student worksheets are student guides that are used to conduct investigation or troubleshooting activities. Student book is a guidebook for students in learning activities that contain the subject matter, concept-based inquiry activities, science activities, information, and examples of the application of science in everyday life. Learning media is as a messenger from several channel sources to the recipient of the message. The test result of learning is a test item used to know the result of student learning after following teaching and learning activity.

This study aims to validate the physics learning device for the subject matter of temperature, heat, and heat transfer using the real experiments and virtual experiments method. The benefit of this research is the availability of physics learning tools with real experiments and virtual experiments method that teachers can use in teaching basic materials about temperature, heat and heat transfer in senior high school. In addition, learning tools generated from this research can be used as a reference by teachers in developing learning tools for other subject matter in physics as well as in other subjects.

Method
The model of learning device development in this research uses four-D model (Define, Design, Develop, Disseminate) as suggested by Thiagarajan, Semmel, and Semmel in [1] and [2]. The purpose of the Define stage is to define and define the requirements required in the lesson. The steps taken at
the Define stage are needs analysis, student analysis, task analysis, concept analysis, and the formulation of learning objectives. The purpose of Design stage is to design prototype learning device. The steps taken at the Design stage are the preparation of tests, media selection, and format selection. The purpose of the Develop stage is to generate a revised learning tool based on input from the validator. The steps undertaken at the Development stage are the device validation by the expert, the simulation of the Lesson Plan, and the limited trial. The Disseminate stage is the stage of use of devices that have been developed on a wider scale such as in other classes, in other schools, by other teachers. Another goal of the Disseminate stage is to test the effectiveness of the use of the device in teaching and learning activities.

The Define and Design stage has been performed in the first year of study (2017). This paper discusses the development stage which is the result of second year research (2018), while the Disseminate stage is planned to be done in third year research (2019). Activity validation of learning tools by experts, as part of the development stage, is a validator assessment of the learning tools so that learning tools developed to be better than the learning device at the Design stage.

Learning tools that are considered to consist of 6 components namely syllabus, learning implementation plan, learning subject matter analysis, student worksheet, instructional media, and learning result test. Each component of the learning device is assessed from 3 aspects of format, content, and language. The scoring scale used is 4 with criteria that criterion 1 means "not good", criterion 2 means "less good", criterion 3 means "good", criterion 4 means "very good". The rating category for each criterion is category 1 means "not yet used and still requires consultation", category 2 means "can be used with many revisions", category 3 means "can be used with little revision", category 4 means "can be used without revision". Each instrument of the learning device's validation sheet is accompanied by a comment or improvement suggestion page.

<table>
<thead>
<tr>
<th>Table 1. Validator Rating Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

(Modified by Researcher, Source: [1] & [3])

The number of validator of learning device in this research is as much as 6 people, that is 2 people come from lecturer in physics education (college), 2 people come from physics subject teacher in senior high school, and 2 people come from alumni of physics education program.

Results
General validator assessment results on learning tools developed are 3 with Good category (can be used with a little revision). Here are comments and suggestions for improvement from Validator 1 (Dra Hj Haerunisyah Sahidu, M.Pd.) from Higher Education (Lecturer at Physics Education Study Program at Mataram University).

<table>
<thead>
<tr>
<th>Table 2. Comments and Repair Suggestions from Validator 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Device</td>
</tr>
<tr>
<td>Syllabus</td>
</tr>
<tr>
<td>learning implementation plan</td>
</tr>
</tbody>
</table>
In the teaching materials, correct the words that are not complete writing, the writing is less clear, because near with the box and paragraph writing should not be separated or connected with the previous word. The degree writing (°C) must also be correct. The writing of bibliography is adjusted with the writing of scientific papers.

The term used in Curriculum 2013 is not a Student Worksheet (Lembar Kerja Siswa/LKS) but a Student Working Sheet (Lembar Kerja Peserta Didik/LKPD). For LKPD 3 it is equated with the way of writing with other LKPD. Title writing (page 48) is also tailored to the others, located in the middle.

The writing of bibliography is adjusted with the writing of scientific papers.

The image is scaled down so as not to exit the border. Option writing should not connect on the next page. The attitude assessment rubric adjusts to the activity on the skill. The term "Gotong royong" is replaced by "cooperation (kerja sama)".

<table>
<thead>
<tr>
<th>Learning Device</th>
<th>Comments and Repair Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabus</td>
<td>Fixed writing, table name, image, attachment, and others. The size should be consistent.</td>
</tr>
<tr>
<td>learning implementation plan</td>
<td>Improve writing and factual, conceptual, and procedural grammar and grouping. The reference / referrer should follow the APA system. In general, complete components can be used. We recommend that the activities of teachers and learners are differentiated in the learning stage.</td>
</tr>
<tr>
<td>learning subject matter analysis</td>
<td>Consistency of text writing and terms. There is some text in the unread box. Adjust the size and spacing of text in the box. There are mathematical equations that use numbering, some have not. The name of the drawing and its layout, for the name preferably in the center. Some text of his words joined. Table name included.</td>
</tr>
<tr>
<td>student worksheet</td>
<td>Student worksheets are supported with relevant images, questions and activities should relate to the image. The formulation of the problem and its stages for what is described in the goal. For phases related to PhET software, the stages need to be supported by the relevant printscreen. The font size used should be consistent and systematic. Consider more procedural stages according to purpose.</td>
</tr>
<tr>
<td>instructional media</td>
<td>-</td>
</tr>
<tr>
<td>learning result test</td>
<td>Consider the distribution of questions for each session, each material, the duration of the material taught, the degree of difficulty of the problem, the distribution of key answers, and so on.</td>
</tr>
</tbody>
</table>

Here are comments and suggestions for improvement from Validator 2 (Dr. Gunawan, S.Pd., M.Pd.) from Higher Education (Lecturer in Physics Education Study Program at Mataram University).

Table 3. Comments and Repair Suggestions from Validator 2
Table 4. Comments and Repair Suggestions from Validator 3

<table>
<thead>
<tr>
<th>Learning Device</th>
<th>Comments and Repair Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabus</td>
<td>For the “content” validation of writing indicators, writing out learning objectives, accuracy between indicators and basic competencies, the accuracy of indicators with learning objectives, the appropriateness of time allocation may not be included because the syllabus / syllabus format is only 3 columns (revised edition). The columns in question are columns for basic competencies, learning materials, and learning activities. Thus, the syllabus does not need to be revised, but if it refers to Permendikbud No. 22 of 2016 on Process Standards, then the syllabus needs to be slightly revised.</td>
</tr>
<tr>
<td>learning implementation plan</td>
<td></td>
</tr>
<tr>
<td>learning subject matter analysis</td>
<td>Added to a case / problem / incident in everyday life then given a brief question.</td>
</tr>
<tr>
<td>student worksheet</td>
<td>-</td>
</tr>
<tr>
<td>instructional media</td>
<td>-</td>
</tr>
<tr>
<td>learning result test</td>
<td>-</td>
</tr>
</tbody>
</table>

Here are comments and suggestions for improvement from Validator 4 (Siti Dhomroh, S.Pd.) from School (Physics Teacher Subject at SMAN 1 Gerung).

Table 5. Comments and Repair Suggestions from Validator 4

<table>
<thead>
<tr>
<th>Learning Device</th>
<th>Comments and Repair Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabus</td>
<td>This syllabus can be used but it needs to be improved as follows: (1) The core competency is written referring to Permendikbud No. 21 of 2016. There is a discrepancy between Permendikbud No. 24 and No. 21 on core competence, then returned to the source of Permendikbud no. 21 of 2016 on Content Standards; (2) In accordance with the standard process of Permendikbud No. 22 and Curriculum Guidance 2013 Revisions, the minimum syllabus component contains: Basic Competencies, Learning Materials, Indicators of Competency Achievement, Learning Activities, time allocation, assessment, learning resources; (3) In this syllabus not yet written Indicator of Achievement of Competence and learning resources, assessment also not yet specific.</td>
</tr>
<tr>
<td>learning implementation plan</td>
<td>This Lesson Plans can be used with the following improvements: (1) The basic competence requirement is to analyze (C4) but the Indicator of Competency Achievement in writing is still C3 maximally on basic knowledge competence; (2) In order to change the operational verbs in the Competency Achievement Indicator demanding C4 (analyze); (3) In the introductory activity, to include activities that reflect the school culture; (4) In the core activities, to be more detailed / clarified activities of learners and teachers; (5) on concluding activities, to include activities that reflect the culture of the community; (6) As Permendikbud no. 22 on Process Standards, the Learning Implementation Plan should be completed with an assessment component after the learning activity.</td>
</tr>
<tr>
<td>learning subject</td>
<td>This teaching material can be used with the following revisions: (1) Fixed</td>
</tr>
</tbody>
</table>
matter analysis the identity of the table and the order of images with the source; (2) More consistent in typing and grammar; (3) adding conventional heat flow rate formula; (4) to be consistent in the determination of the typeface.

student worksheet This student worksheet can be used with the following remedial suggestions: (1) on the Student Worksheet "Inserting a test mark on the Thermometer", improved instructions on step activities by adding tools and materials; (2) on the Student Worksheet "Scale on Liquid Thermometer" to be added about data analysis and conclusions; (3) on the Student Worksheet "Heat Influence on Being Substance" and Student Worksheet "Designing experiments to determine the calorific equation" corrected identity of the Student Worksheet; (4) on the Student Worksheet "Design an experiment to determine the calorific equation" to be consistent in the writing of symbols; (5) in general, to be consistent in the use of letter type and size.

instructional media This learning medium can be used without revision, but to have a referral list.

learning result test Because the Competency Achievement Indicators in the Lesson Plan should be revised, the Indicator of Competency Achievement in the Learning Results Test must also be revised.

Here are comments and suggestions for improvement from Validator 5 (Muhammad Tantawi Jauhari, S.Pd.) from Alumni of Physics Education Program, Mataram University.

**Table 6. Comments and Repair Suggestions from Validator 5**

<table>
<thead>
<tr>
<th>Learning Device</th>
<th>Comments and Repair Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabus</td>
<td>-</td>
</tr>
<tr>
<td>learning implementation plan</td>
<td>Need to pay attention to the number of students per group, preferably one group of 4 people so that the learning process using PhET simulation more effective. Need to pay attention to time sharing especially on experimental activities using PhET simulation.</td>
</tr>
<tr>
<td>learning subject matter analysis</td>
<td>-</td>
</tr>
<tr>
<td>student worksheet</td>
<td>We recommend adding a screenshot / print screen to the work section of the Student Worksheet to make it easier for students to experiment. We recommend adding a hand-click icon to the sections for which students should click. We recommend reducing work-related items by excluding volume change experiments so that point number 3 questions can be excluded on the Student Worksheet &quot;Heat Effect on Temperature Temperature&quot; using PhET simulations. In the tool and materials section, it is necessary to add a millimeter block paper which students will use to graph the temperature and object changes, or to make millimeters of block directly in Microsoft word on the observation result (Student Worksheet &quot;Heat Influence on Substance&quot;).</td>
</tr>
<tr>
<td>instructional media</td>
<td>-</td>
</tr>
<tr>
<td>learning result test</td>
<td>-</td>
</tr>
</tbody>
</table>

Here are comments and suggestions for improvement from Validator 6 (Muhamad Khairul Azmi, S.Pd.) from the Alumni of Physics Education Program, Mataram University.
Table 7. Comments and Repair Suggestions from Validator 6

<table>
<thead>
<tr>
<th>Learning Device</th>
<th>Comments and Repair Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syllabus learning implementation plan</td>
<td>The allocation of opening and closing time not yet listed in the Lesson Plan may be added in order to manage time efficiency. The time allocation for &quot;Data Collection&quot; is too long for 30 minutes, should be 25 minutes, so 5 minutes can be allocated for the &quot;Opening&quot; activity. The time allocation for &quot;Data Interpretation&quot; is too long for 20 minutes, preferably 15 minutes, so that 5 minutes time allocation can be used for closing activities.</td>
</tr>
<tr>
<td>learning subject matter analysis</td>
<td>-</td>
</tr>
<tr>
<td>student worksheet</td>
<td>Explanation of the steps of virtual experiment is still not in detail. This is necessary so that students better understand the operation of the virtual lab in question.</td>
</tr>
<tr>
<td>instructional media</td>
<td>-</td>
</tr>
<tr>
<td>learning result test</td>
<td>-</td>
</tr>
</tbody>
</table>

Discussion

Physics learning device developed in this study using experimental methods. Experiments method in question is divided into 2 methods of real experiments and virtual experiments. In real experiments method used learning media in the form of three dimensional media, while in virtual experiments method used learning media in the form of computer simulation in PhET form. The main material developed is about temperature, heat, and heat transfer. The worksheet of students using real experiments method includes six activities, namely Inserting a test mark on the Thermometer, the expansion of substance, the change of the form of objects, the black principle, the heat transfer, and the heat equation. The student worksheet using virtual experiment method includes two activities that is to know the influence of heat to the temperature of the substance and to know the influence of heat on the form of the substance.

The application of real experiments method (using three dimensional media) and virtual experiments method (using computer simulation) can be used in accordance with the characteristics of students and learning materials. Research [4] found that there was no significant difference between the knowledge gained through real experiments and through computer simulations. Meanwhile, [5] investigated the effect of using Virtual Laboratory (VL) on grade 10 students’ conceptual understanding of the direct current electric circuit and their attitudes towards physics. Participants were randomly assigned into two groups of 25 students each. The experimental group was taught using VL, where experimental activities were conducted through Circuit Construction Kit developed by the PhET simulations. However, the control group was taught through interactive demonstrations using real laboratory equipment. Both groups were pre and post-tested by means of two instruments: —Determining and Interpreting Resistive Electric current Concepts test (DIRECT) and —Physics Attitude Scale (PAS). The data analysis of the DIRECT test scores showed that, after 10 weeks, the conceptual understanding of the direct current electric circuit had markedly improved in both groups. However, the mean score of the experimental group was significantly higher than that of the control group. On the other hand, there was no significant difference in students' attitudes towards physics between the two groups.

The findings of [6] showed that the modern physics virtual laboratory model was effective to improve the students’ critical thinking disposition. The results of [7] showed that there was an increase of students’ creativity in both classes. The experiment class had a higher creativity increase than the control class. Verbal and figural creativity improved in both classes. Verbal creativity increased higher than figural creativity. This shows that the model of project based learning with virtual media that applied successfully improve the students’ creativity in physics learning.
Computer simulation used in this research is PhET simulation. Research from [8] reveals that the Physics Education Technology (PhET) project creates useful simulations for teaching and learning physics and makes them freely available from the PhET website (http://phet.colorado.edu). The simulations (sims) are animated, interactive, and game-like environments in which students learn through exploration. In these sims, we emphasize the connections between real-life phenomena and the underlying science, and seek to make the visual and conceptual models of expert physicists accessible to students. We use a research-based approach in our design—incorporating findings from prior research and our own testing to create sims that support student engagement with and understanding of physics concepts. We have two main goals for the PhET sims: increased student engagement and improved learning. Sims are specifically designed to support students in constructing a robust conceptual understanding of the physics through exploration.

According to [9], the experimental method is carried out by practicing recipe books which may be practical manuals or instructions in operating the tool. Students are required to experiment or observe a process and results. This method aims to equip students with scientific methods. According to [10], as a teaching method, simulations can be interpreted as ways of presenting a learning experience using artificial situations to understand certain concepts, principles, or skills. According to [11] states that in the simulation method, the subject matter is packaged in the form of animated learning simulations that explicitly describe the content, live, and integrate elements of harmonious text, image, audio, motion, and color combinations. Simulation is a computer program (software) that serves to mimic the behavior of a specific real system (reality).

The learning model used in the learning implementation plan in this study is the inquiry learning model. In [12] it is written that the inquiry model of learning is aimed at fostering the ability of learners in using process skills by formulating questions that guide investigative activities, formulating hypotheses, conducting experiments, collecting and processing data, evaluating and communicating findings in learning societies. the general syntax of the implementation of inquiry based learning as follows.

| Table 8. General Syntax of Inquiry-Based Learning Implementation |
|---------------------------------|-----------------|-----------------|
| Stage                           | Teacher activities                                           | Student Activities                                           |
| Identification and problem formation | Helping learners find and formulate problems                   | Identify and formulate issues that will guide the investigation |
| Formulation of hypotheses        | Guiding learners to formulate hypotheses                      | Formulate hypotheses to be tested through investigation       |
| Data collection                  | Facilitate learners in designing experiments to collect data  | Carry out experiments and collect data                        |
| Interpretation of data          | Guiding learners to analyze data and test hypotheses          | Compile arguments that support data and test hypotheses       |
| Development of conclusions       | Guiding learners to make induction or generalization          | Describes the relationship, making generalizations through induction |
| Repetition                       | Guiding and asking learners to prove the truth of generalization | Repeat the experiment, get new data, and revise conclusions   |

The results of the study [13] concluded that there is influence of inquiry learning model using the simulation media to the students physics learning result. The average value of the experimental class physics experimental test using inquiry learning model using the simulation media is higher than the control class using the conventional learning model. Other studies that applied inquiry-based learning models and experimental methods [14] found that there is influence of experimental based learning cycle 5E model to the critical thinking ability of physics students. The same is also found [15] that there is an influence of guided-inquiry learning model combined with the experimental method on
physics learning outcomes. The research from [16] showed that physical concept comprehension ability of students learning with virtual media-aided model of inquiry higher than those not using the model inquiry-aided virtual laboratory.

The physics learning device developed in this study has been revised based on input or suggestion of improvement proposed by 6 validators. There are several reasons in the selection of learning device validators in this study as follows. Validator 1 and 2 are lecturers at universities in the field of physics education. Both validators are capable of developing Physics Learning devices in Physics Education Study Program, Mataram University. Validator 1 has a course that deals with the development of physics learning devices since 1984, while the 2nd validator since 2005. Validator 3 and 4 are physics subject teachers in senior high school. Validator 3 has taught physics since 2009, and Validator 4 since 1999. Validator 5 graduated from Physics Education Degree in 2016 and has done research on learning tools with problem based learning model and experimental method using PhET media. The study [17] concluded that the PhET-aided problem-based learning model influenced the physics learning outcomes of grade X high school students. Validator 6 graduated from Physics Education Degree in 2016 and has done research on learning tools with problem based learning model and experimental method using three dimensional media. Research [18] concludes that: (1) There is influence of Problem Based Learning model with experiment method and discussion on physics learning result. Problem Based Learning model with discussion method gives better influence than using Problem Based Learning model with experimental method; (2) There is influence of student's scientific attitude toward physics learning result. The result of physics study of students who have high scientific attitude will give a much better effect than students who have low scientific attitude; (3) There is no interaction between Problem Based Learning model with experiment method and discussion with students' scientific attitude toward students physics learning result.

Conclusion

Physics learning devices for the subject matter of temperature, heat, and heat transfer by the methods of experiments and virtual experiments developed in this study consist of syllabus, learning implementation plan, learning subject matter analysis, student worksheet, instructional media and test result learn. In real experiments method used learning media in the form of three dimensional media, while in virtual experiments method used learning media in the form of computer simulation in PhET form. At the Validation stage, the Validator provides an assessment of the physics learning device generally in the category of good with the value 3. Thus, it can be concluded that the developed physics learning device can be used with little revision, that is in accordance with comments or suggestions of improvement of the Validator. The next step in this study is to conduct a limited trial of application of learning tools in the real classroom with research subjects are high school students Class XI in Even Semester Academic Year 2017/2018.

References


Acknowledgments
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Developing Learning Management System Moodle based on Behaviorism Theory

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Abstract. The purpose of this research is to get design from development design based Learning Management System (LMS) Moodle on behaviorism theory. This research method refers to the development model of ADDIE (Analyze, Design, Develop, Implement, Evaluation). Analyze stage yields problem analysis, needs analysis, and literature review of the product to be developed. Design stage yields the formulation of objectives, the preparation of product prototype or product conceptual design that will be developed by referring the results of needs analysis, problems, and literature review. Develop stage yields including product development according to the design that has been made and the validation process. After that, the product is repaired (the first revision) to make the product valid and ready for implementation. Implement stage yields the product in the field to know the achievement of product development goals. Evaluation stage yields the product is evaluated according to data obtained during field trials. From the evaluation results, the product is then revised (final revision) to produce products that suit your needs and goals. The result of this research is the form of LMS Moodle development design based on behaviorism theory.

1. Preface
Along with the development of technology and information, all components of education both teachers and learners should be able to integrate technology in the learning process. Some schools in Indonesia have integrated technology using web-based learning to support learning. The integration of web-based learning with face-to-face learning will build a blended learning. Blended learning is a learning that combines several learning methods such as web-based learning and face-to-face learning (Department of Education and Early Childhood Development, 2012). One example of a web-based learning tool is the Learning Management System (LMS). LMS is a software used to manage learning (Surjono, 2013). There are many types of LMS, one of which is Moodle, which is an open source LMS that provides various learning support features such as assignments, quizzes, and discussion forums.

Several studies have shown that the use of LMS Moodle has a positive effect on learning (Zyainuri and Marpanaji, 2012). The results of these studies reveal that the integration of LMS Moodle in learning can improve the effectiveness of learning and student motivation. However, few studies have highlighted the interactional aspects of learning using LMS. Based on the observations, lectures in the UPS Mathematics Education course have not integrated web-based or LMS-based learning. The use of technology in lectures is still rare. Some lectures, especially in pure mathematics courses, use only whiteboards. The interaction between lecturers with students and students with students is limited only during lectures.

In web-based learning, behaviorism theory generally emphasizes a structured deductive approach in an e-learning in the hope that learners can absorb concepts, skills, and materials quickly. More specifically, Modritscher (2006) describes the application of the principles of behaviorism theory in an e-learning platform as follows.

1.1 Learning materials should be divided into smaller learning units, starting with a definition, rule, formula, or principle, then examples to emphasize a concept and support understanding.
1.2 *Teachers must present instruction in order. Learning activities are organized on the level of difficulty and complexity, i.e., from the low difficulty level to the higher difficulty level.*

1.3 *The learner is given space to control the learning process, for example letting the learner choose the next unit to be studied.*

1.4 *Before asking the learner to practice a procedure or operation, the teacher should give a clear example of the operation, procedure, or skill.*

Teachers should also provide reinforcement to keep students motivated. Based on the above background, the purpose of this research is to obtain the design of the development of LMS Moodle based on Behaviorism theory.

2. **Research methods**

Research development in this research refers to the development model of ADDIE (Analyze, Design, Develop, Implement, Evaluation). According to Peterson (2003), the ADDIE model is a model often used in the development of instructional design and training programs. The framework of the ADDIE model can be seen in the following figure.

![ADDIE Model Diagram](image)

**Figure 1.** Development design of ADDIE

The ADDIE model includes the following steps:

2.1 *Analyze (Analysis)*, which includes problem analysis, needs analysis, and literature review of the product to be developed.

2.2 *Design*, which includes the formulation of objectives, the preparation of product prototype or product conceptual design that will be developed by referring the results of needs analysis, problems, and literature review.

2.3 *Develop (Development)*, including product development according to the design that has been made and the validation process. After that, the product in the original revision to make the product valid and ready for implementation.

2.4 *Implementation (Implementation)*, which is testing the product in the field to know the achievement of product development goals.

2.5 *Evaluation*, at this stage, the product is evaluated according to data obtained during field trials. From the evaluation results, the product is then revised final to produce products that suit your needs and goals.

3. **Research result**

Analyze stage (Analysis), obtained the information: The use of learning media is more understandable because it is easy. Very useful because it facilitates the learning process and the development of the times to find out all the learning using media, especially Internet/electronic media. The material that uses the media is more understandable because it is simple and direct to the point; more concise and clear for understanding. Use of media is very helpful for prospective teachers so that later after graduation can be applied to the school when starting to teach. The use of instructional media also depends on the course so it is helpful in understanding the students and improve the achievement. The use of media in understanding the material of the course is very much, but also must be adjusted with the material.

The existence of media use is quite limited because each lecture material uses learning media. Media helps to attract learning so that the focus of the students is more on the matter being explained. Can be used as a reference other than books but the media used must be in accordance with the material. Can be used as a reference other than books but the media used must be in accordance with the material. more efficient so as to facilitate teaching and learning activities. Sometimes the material
exposure needs to be practiced and visualized so that it is better understood. Media is very useful especially in the form of books and explained by lecturers so that students can understand, quickly complete the task, find out various information and other knowledge and easy to reason.

As often used in the lecture process, among others in the form of electronic media, calculator; laptop, LCD, mobile phone, props, abacus, books. Media using computer help with power point facility. Internet communication tools are also used in learning media such as whatsapp, email and google.

The use of telecommunication facilities also has various responses in the procedure of completion and task collection. Among others, some students opine that they prefer online tasks because they are easily collected online; the process is quite easy and does not bother. online tasks are easier to collect and more efficient; There is also a liking the task is not online because it is used, more simple not to open an email; help in training student handwriting for better. On the online tasks sometimes students just copy from other friend in other class especially if the task is in word; by doing the task in writing the student will write down the idea more quickly; the task is not online in easier in collecting, does not require wifi; prefer non-online tasks because to do online tasks usually there are obstacles, especially on the availability of computers; more clearly the task is not online because if there is not yet can be directly asked up and online tasks difficult to ask and the time limit is longer; written because with a written assignment then used to write; non online because it can freely in doing the task; non online because it can be collected instantly without upload, non online because it is more cost-effective without quota, non-online tasks easier in lectures of mathematics without difficulty in MS Word in online tasks eg take a long time in doing tasks such as making diagrams, writing fractions, limiting and others.

Implementation of quizzes directly or not online is favored by students because it is more assured of authenticity in the process because there is no chance to cheat. when the quiz is held online the students can cheat through the internet; non online quizzes take longer; non online quizzes may be more effective because if students do not master the computer it will affect the quiz results; non online quiz is more fun because it can see the competition directly; prefer a quiz directly or non online as it is straightforward and easy to understand; online quiz for having never tried; prefer to quiz directly or non online because lecturers can correct directly, online quiz because there is a time limit to work; prefer online quizzes faster and easier; online quizzes because it further summarizes the time; quiz directly because it is easier and more practical; online quiz because the collection time is relatively long; non online quiz because it is easier to answer if the essay form or description; online quiz because it is more effective in anticipating cheating; online quiz for doing it more calmly; quiz or non online duties as they are used to it. if the online duration of work faster and the answer can not be changed, the quiz directly or non online is pure with own ability and monitored by lecturers. If the online quiz can cheat or copy answers from other students.

According to information from students learning E-Learning is the process of teaching and learning with the online system can be done anytime and anywhere. We can communicate with students without meeting directly with learning using technology.

4. Stages of Design
Design, which includes the formulation of objectives, the preparation of product prototype or product conceptual design that will be developed by referring the results of needs analysis, problems, and literature review.

The website address for Moodle LMS access is pmtk.upstegal.com
Example display after login:

When Click Site Home in the left menu. On the homepage of the site, a choice of courses will appear in each semester.

Select the course that followed and choose according to the class that followed. For example, the course of Geometry Transformation Semester 6, as well as the class that followed let class A and then click. Then Click Enroll Me. Once in click Enrol Me, then you have registered on MK Geometry Transformation Class A. The appearance as follows. If there is an announcement from the lecturer about MK Geometry of Class A Transformation, it will appear in the Announcements column.
4.1 Accessing file and course task.
To access activities (tasks, quizzes, etc.) in a course, by opening or clicking the course you are taking. To access the files or materials in the course, just click the file icon to download. To see the assignment provided by the teacher and the detailed instructions, click the hand icon as shown in the example below (Task 1).

When the task icon is clicked, a display looks like the following. At the top will show details / details about the assigned task.
Submission status: status whether you have done the task or not
Grading status: the status of whether your assignment has been assessed or not
Due date: Deadline collection task
Time remaining: time left before deadline
To work or collect a task, click Add Submissions (Tasks / Reports)
Online text is used to write down the answer of the task (if indeed the task can be done on that column).
If not, then the task can be collected by uploading the file of the work in the field of File Submissions.
4.1.1. If you have done the task (in the Online text field or via File Submission), click save changes.
4.1.2. If it has been saved, it will display the Status of your task. If the submission status is written Submitted for grading, it means that your task has been entered in the Lecturers directory and ready to be assessed. If you’re still not sure or want to change / edit the task, click Edit Submission.
4.1.3. Then a confirmation dialog appears on the quiz’s query timeout. To get started, click Start Attempt.
4.2 Dashboard
If you have entered in a particular class of course, on Dashboard will appear the following display. Announcement / latest news on the right. All activities (assignments, quizzes, etc.) in the class that followed. To view the latest news / announcements details, click Recent News.

4.3 Value report (RAPOR)
To view the report (report card) value for each task, click the down arrow located in the top right corner. Select Grade.

5. Conclusion
Based on the above research results obtained the Design (Planning), which includes the formulation of objectives, the preparation of product prototype or product conceptual design that will be developed by referring the results of needs analysis, problems, and literature review.

References
Segmentation of HIV/AIDS Clinical Description using PATHMOX-PLS

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Abstract. Human Immunodeficiency Virus (HIV) is a virus that attacks the human immune system and causes the body's ability to susceptible to infection. Several factors suspected to affect the clinical picture of HIV/AIDS patients are predisposing factors, enabling factors and strengthening factors. HIV/AIDS patients have diversity with different backgrounds. The data used are secondary data derived from medical records of HIV/AIDS patients numbered 150 at the Health Center of the District of Pasuruan in 2017. The method used is SEM-PLS with assumption-free, more flexible and powerful in explaining the relationship between variables and then does the grouping with PATHMOX-PLS (Path Modelling Segmentation Partial Least Square). The results showed that predisposing factors, strengthening factors, and enabling factors influenced the clinical picture of HIV/AIDS patients and groupings using PATHMOX-PLS resulted in grouping with gender segmentation variables and patient education levels. So the variable that makes the heterogeneity in the clinical picture of HIV/AIDS patients is gender and level of education.

1. Introduction

Human Immunodeficiency Virus (HIV) is a virus that attacks the human immune system and causes the body's ability to susceptible to infection. Treatment of HIV disease has not been able to cure it. Early diagnosis and effective treatment of people living with HIV will not turn into AIDS (Acquired Immunodeficiency Syndrome) which is the final stage of HIV infection [1]. Transmission of HIV occurs through unhealthy sexual contacts, especially male sex, including transsexuals that reach 60% and transmission through needle of 30% [2].

The case of HIV/AIDS infection in Indonesia was first discovered in 1987 in Bali Province. Since it was first discovered until March 2016 HIV/AIDS had spread over 407 districts/cities from 507 districts/cities in Indonesia. East Java Province is the second highest province in Indonesia with 26,052 HIV infections [3]. High rates of HIV/AIDS infection make it necessary to improve health services for people with HIV / AIDS (PLWHA). According to Lawrence Green theory in 1980 there are three factors that can influence the specification of behavioural problems of a disease i.e. predisposing factors, strengthening factors, and enabling factors. A specific issues in the case of HIV/AIDS is a clinical picture of people with HIV/AIDS. HIV is an infection that attacks and weakens the immune system, leading to a decrease in Cluster Differentiation (CD4) levels and causing a high risk of opportunistic infections [4].

Researcher wanted to know the pattern of relationship between clinical features of HIV sufferers with predisposing factors, strengthening factors and enabling factors. Appropriate analysis to explain the association of predisposing factors, strengthening factors and enabling factors with clinical features of HIV/AIDS patients is a variance-based SEM that is Partial Least Square (PLS) that is assumption-free, more flexible (applicable to all data scales) and powerful in explaining relationship between variables [5]. In this study, medical record data’s assumption is not homogeneous, in other sense the data were extracted from each of the different patients. The purpose of this study is to analyze the factors that influence the clinical picture of HIV/AIDS patients with SEM-PLS approach and group patients based on factors affecting the clinical picture of the HIV/AIDS patients using PATHMOX-PLS.
2. Materials and Methods

2.1. Materials

This research is using PATHMOX-PLS as a method that can classify the samples with the existence of segmentation variables that cause data heterogeneity. The data used in this research is secondary data. Data obtained from medical records of HIV/AIDS patients in Pasuruan District in 2017 and amounted to 150 patients. The data taken are patients who experience HIV/AIDS pain in Pasuruan regency. The results of the analysis provide an overview of the factors that influence the clinical picture of HIV/IDS patients reviewed based on their indicators. The variables used in this study are listed in Table 1.

Table 1. Research Variables

<table>
<thead>
<tr>
<th>Latent Variable</th>
<th>Indicator</th>
<th>Category</th>
<th>Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical of HIV/AIDS (Y)</td>
<td>Quality of Live</td>
<td>1: score ≥ 40.5 (good)</td>
<td>Nominal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0: score &lt; 40.5 (less)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CD4 Levels</td>
<td>1: increase</td>
<td>Nominal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0: no increase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Opportunistic</td>
<td>1: IO</td>
<td>Nominal</td>
</tr>
<tr>
<td></td>
<td>Infections (IO)</td>
<td>0: no IO</td>
<td></td>
</tr>
<tr>
<td>Predisposing Factors (X₁)</td>
<td>Knowledge</td>
<td>1: less, if &lt; 50% right answer</td>
<td>Nominal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0: good, if ≥ 50% right answer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Attitude</td>
<td>1: negative</td>
<td>Nominal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0: positive</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concept of Self</td>
<td>1: score ≤ 25 (negative)</td>
<td>Nominal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0: score ≥ (positive)</td>
<td></td>
</tr>
<tr>
<td>Strengthening Factors (X₂)</td>
<td>Family Support</td>
<td>1: score &lt; 40.5 (no support)</td>
<td>Nominal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0: score ≥ 40.5 (support)</td>
<td></td>
</tr>
<tr>
<td>Enabling Factors (X₃)</td>
<td>ARV Therapy</td>
<td>1: treatment (ARV’s and mentoring)</td>
<td>Nominal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0: control (only have ARV)</td>
<td></td>
</tr>
</tbody>
</table>

2.1.1. HIV/AIDS

Human Immunodeficiency Virus (HIV) is the virus that causes the decline of the human immunity. Acquired Immune Deficiency Syndrome (AIDS) is a collection of symptoms of disease caused by Human Immunodeficiency Virus (HIV). The AIDS or so-called immune deficiency syndrome is a collection of symptoms of the disease due to the immune system’s decline because of a virus called HIV [6].

2.1.2. Predisposing Factors

These factors include community knowledge and attitudes toward public health, traditions and beliefs on matters relating to health, community value systems, educational level, and socioeconomic level [7].

2.1.3. Enabling Factors

These factors include the knowledge and attitudes towards health, tradition and public confidence in the matters related to health, society's values system, education level, socioeconomic level [7].

2.1.4. Strengthening Factors

These factors include attitudinal and behavioural factors of community leaders, religious leaders and health workers. Also included here is legislation, regulations from both central and local government that are related to health. To behave in a healthy way, society sometimes requires not only positive knowledge and attitude as well as facility support, but rather the behaviour of examples [7].

2.1.5. Clinical Picture

A person who has been infected with HIV, for the next 2-6 weeks (on average 2 weeks) will develop acute retroviral syndrome. After 2-6 weeks, the symptoms of the syndrome disappear with seroconversion. Furthermore, patients enter the asymptomatic phase, where there are no symptoms, for
an average of 8 years (5-10 years, occur faster in developing countries). In this phase, the patient looks healthy, and can perform normal activities. After an asymptomatic period, the patient enters the symptomatic phase, preliminary symptoms such as fever, lymph node enlargement, followed by opportunistic infections. With the presence of opportunistic infections, the course of the disease has entered the stage of AIDS [8].

2.2. Methods
The method that will be carried out to achieve the research objectives is to model the structural equations based on SEM-PLS, including the preparation of the theory-based conceptual model and construct the path diagram that explains the relationship pattern between the latent variable with the indicator or shows the causal relationship between the exogenous and endogenous variables. Results of analysis with SEM-PLS have been obtained, then do approach PLS PATHMOX with stages according PATHMOX algorithm.

3. Results and Discussion
3.1. Clinical Picture Characteristics
The results of descriptive analysis show a clinical picture of patients with predisposing factors, enabling factors and HIV / AIDS boosting factors. The following is the result of cross tabulation on indicators of the three latent variables with sex of HIV / AIDS patients.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD4 Levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>increase</td>
<td>37 (24.7%)</td>
<td>29 (19.3%)</td>
</tr>
<tr>
<td>no increase</td>
<td>42 (28%)</td>
<td>42 (28%)</td>
</tr>
<tr>
<td>Opportunistic Infections (IO)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IO</td>
<td>36 (24%)</td>
<td>25 (16.7%)</td>
</tr>
<tr>
<td>No IO</td>
<td>43 (28.7%)</td>
<td>46 (30.7%)</td>
</tr>
<tr>
<td>Quality of Life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>score ≥ 40.5 (good)</td>
<td>46 (30.7%)</td>
<td>36 (24%)</td>
</tr>
<tr>
<td>score &lt; 40.5 (less)</td>
<td>33 (22%)</td>
<td>35 (23.3%)</td>
</tr>
</tbody>
</table>

From Table 2 it shows that for a large percentage of CD4 cell indicator is presented in both male and female patients with conditions at which CD4 levels were administered but no CD4 percentage increase was 28%. In a large percentage of opportunistic infections indicator was present in female patients with no opportunistic infections of 30.7%. A large percentage of life quality indicators are present in male patients with a 33.3% lower quality of life.

3.2. SEM-PLS Analysis
3.2.1. Model Evaluation
Evaluation of measurement model (outer model) by using reflective indicator is done by doing the validity test (discriminant and convergence) and reliability on each variable of indicator to latent variable. The result of the validity evaluation for the indicator along with the latent variable can clearly be seen through the loading factor value where the correlation value between the indicator and the latent construct. The results of the evaluation indicate that there is an invalid indicator i.e. concept with the loading factor value <0.07 which causes the indicator to be excluded from the model because it is considered invalid in measuring the latent variable of the predisposing factor. AVE values obtained in latent variables when self-concept indicators are excluded from the model can be seen clearly in Table 3 below.
Table 3. AVE of Variable Latent

<table>
<thead>
<tr>
<th>Variable Latent</th>
<th>AVE</th>
<th>Valid/not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predisposing Factors ((X_1))</td>
<td>0.676</td>
<td>Valid</td>
</tr>
<tr>
<td>Strengthening Factors ((X_2))</td>
<td>1.000</td>
<td>Valid</td>
</tr>
<tr>
<td>Enabling Factors ((X_3))</td>
<td>1.000</td>
<td>Valid</td>
</tr>
<tr>
<td>Clinical Picture ((Y))</td>
<td>0.803</td>
<td>Valid</td>
</tr>
</tbody>
</table>

Table 3 shows that all latent variables have an AVE value greater than 0.50. The latent variable of the predisposing factor becomes valid when the insignificant indicator is not included in the model in this study. Thus the four latent variables that have shown good convergence validity and indicators have been met in measuring latent variables.

The discriminant validity test for reflective indicators is assessed on the basis of cross loading. Correlation of each indicator on latent variables and with other latent variables is the following. The correlation of indicators with their own latent variables is higher than with other latent variables. Thus latent variables can predict indicators on other blocks, so it says good discriminant validity. Reliability testing for each latent variable was assessed by conbrach’s alpha \(\geq 0.50\). The evaluation results show the four latent variables conbrach’s alpha \(\geq 0.50\), so it has good reliability as a measuring tool.

Evaluation of structural model (inner model) is determined by the coefficient of determination, \(R^2\), for endogenous latent variable that is clinical picture of HIV/AIDS with \(R^2\) value of 0.800. This means that the clinical features can be explained by latent variables of predisposing factors, strengthening factors and enabling factors of 80\%, and the remaining 20\% are explained by other latent variables that are excluded from this model.

3.2.2. Estimation

The parameters were estimated by using least squares method, and then were obtained through three models of parameter estimation. The model estimation was conducted to get \(\lambda\) as the coefficient value of measurement model, and \(\gamma\) as the coefficient of the structural model. Mathematical equations for the measurement model (outer model) are based on the values of loading factor and standard error, which can be described as follows.

1. Predisposing Factors: \(X_{1i} = 0.912\xi_{i1} + 0.0176\) and \(X_{12} = 0.720\xi_{i2} + 0.0710\)
2. Strengthening Factors: \(X_{2i} = 1.000\xi_{i2}\)
3. Enabling Factors: \(X_{3i} = 1.000\xi_{i3}\)
4. Clinical Picture \(Y_{1i} = 0.853\eta_i\), \(Y_{12} = 0.923\eta_i\) and \(Y_{13} = 0.903\eta_i\)

The model for inner model of clinical picture of HIV/AIDS is based on the influencing factors i.e. \(\eta_i = 0.341\xi_{i1} + 0.144\xi_{i2} + 0.554\xi_{i3}\).

3.3. PATHMOX-PLS

The PATHMOX tree formed by gender segmentation variables and educational level can be explained to investigate factors that influence the clinical picture of HIV/AIDS patients. The tree that is formed has each member on different segments and can be interpreted in accordance with the results obtained. The level of significance used is 5\% for each Node. The PATHMOX tree obtained is shown at Figure 1.
The Figure 1 shows that there are an internal node and one terminal node obtained from split PATHMOX with sample size on the root node of 150 samples. The first PATHMOX Split produced two different models namely the first model for male HIV / AIDS patients (node 2), and the second model for female HIV/AIDS patients (node 3). The first Split PATHMOX have significant level with a p-value of 0.0032. The significant level for the second split PATHMOX of education level variable is 0.0006, this is a higher significance. The second Split comprises of node 4 with education level of elementary, junior, and senior high school, and node 5 with patient’s education level.

Characteristics of the HIV / AIDS patients group can be described as follows. The female patients are characterized by poorer quality of life, no increase in CD4 levels when given antiretroviral therapy, having good knowledge about the illness without family support in terms of emotion and social support. The characteristic of the male patients with the education level of primary, junior, and senior high school have less quality of life, no experience in increasing CD4, less support of the family, and less ARV therapy since symptoms of pain. Meanwhile, the male patients of HIV / AIDS with college education level are characterized by poor quality of life, having opportunistic infections with other diseases suffered, having a good knowledge of HIV / AIDS, getting ARV therapy and assistance since illness suffered.

4. Conclusion

Based on the results and discussion above, it can be concluded that the predisposing factor only has two indicators, namely knowledge and attitude which significantly affect on the clinical picture of HIV/AIDS patients. The strengthening factor as well as the enabling factor has one indicator, and each factor gives a significant effect on the clinical picture of HIV/AIDS patients. The resulting SEM-PLS model meets the validity and reliability criteria for the measurement model, and the R-square value of 80% for the structural model, so the model meets the statistical criteria. Segmentation using the PATHMOX-PLS method generates two split nodes. The first split node have a significant level at p-value 0.0032, and then generates two different nodes. The second Split node is significant with p-value 0.0006, and produces two different nodes i.e. node 4 and node 5.

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References
Bayesian Network to Analyze the Relationship Amongst Motor Aspects in Daily Living Activities: A Case Study in People with Early Parkinson’s Disease

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Abstract. Parkinson’s disease (PD) is a second most common neurodegenerative disease worldwide that mainly affect motor system. Movement Disorder Society-Unified Parkinson’s Disease Rating Scale (MDS-UPDRS) is a golden standard in clinical assessment of people with PD. There have been many research on elaborating the association of total, or subtotal scores of the MDS-UPDRS and the severity of the disease. However, little attention is put on the inter-relationship amongst the measurements in MDS-UPDRS. Therefore, in this paper, we propose the mapping of network of measurements, particularly in MDS-UPDRS Part II measuring the activities of daily living in people with PD. We applied Bayesian network to understand the relationship amongst motor aspects in Parkinson disease. Bayesian network modelling is based on the probabilities of conditional aspects and the conformity of Directed Acyclic Graph (DAG). DAG consists of nodes, representing the variables and edges, representing the relationship between nodes. The relationship between activities is represented by nodes in the network. We identified that the tremor factor always gives a significant effect on the writing ability (handwritten) of Parkinson's patients.

1. Introduction
Parkinson's disease is one of neurodegenerative disease which is progressive. This disease is the most common neurodegenerative disease after Alzheimer's dementia[5]. The main factor behind the Parkinson's disease is, the lack of dopamine, which controls the body movement. In addition, the lack of oxidative stress, mitochondrial dysfunction, excitotoxicity, inflammation and the weakness of the proteasome ubiquitin system were also considered to be associated with Parkinson's disease[7]. People with PD tend to suffer from longevity. It is also found more prevalent in males than in females, white race in certain industrial areas[6]. It is approximately 4.5-19 new PD case per 100,000 population per year[10]. In Indonesia, RSCM Jakarta as the Indonesian government hospital reported that this disease is one of the top 10 most frequent disease in the society. Moreover, there are 40 to 50 case of Parkinson's every month[1]. Considering the prevalence of the disease, further research is required, in order to gain insight of the disease. The relationship among factors characterizing the disease is of the interest. One of the methods to accommodate this objective is Bayesian network. Bayesian network model is a Probabilistic Graphic Model (GPM), base on Bayesian theory principle and data modeling based on probability. The model represents a set of variables and a conditional dependency through a Directed Acyclic Graph (DAG). A DAG is a directed graph that consist of nodes and edges. Graph having a Conditional Probability Table (CPT). CPT is also known as the probability of an event Y provided that event X has occurred, denoted by P (Y | X). In addition to CPT, Bayesian Network model also produced a Joint Probability Distribution (JPD) that is the joint probability for all possible of the variables of interest[8].

51
2. Classification Method
This section will describe the statistical methods used in this study.

2.1. Bayesian Network
Bayesian Networks (BNs) is one of the simple Probabilistic Graphic Model (PGM) that built on Bayesian probability theory and graph theory. The probability theory is related to the data, while the graph theory is related to the form of representation among the variables. BNs used the assumption that the effects of random variables can be joint conditionally independent with others random variables. Joint conditionally independent is the condition where random variables which connected through edges do not affected one another, those variables have the same parent node. BNs consist of Bayesian Structure (Bs) and Bayesian Parameters (Bp)[2]. Bs is a Direct Acyclic Graph (DAG) that describes the dependencies among variables and it consists of nodes (random variables) and edges. Nodes represent variables, and edges represent relationships between nodes. Bp is the set of parameters that state the conditional probability distribution of each variable based on a graph and is represented in the form of a Conditional Probability Table (CPT).

2.1.1. Conditional Independence
Bayesian network method can handle multiple source of measurement, that is a high number of variables are considered in the model. Conditional independence ensure that a node is independent of the other nodes even though they have the same parent node. This condition results in the reduction of the number of parameters estimate.

2.1.2. D-Separation
D-separation identifies whether there is a conditional independent relationship in the graph. For two separated node X and Y, in graph G, node Z is given, there is no active paths between node X and node Y in the graph G[4]. The independence relationship between nodes in Bayesian networks can be of a direct or an indirect relationships. A direct relationship is a condition when node X and node Y are directly related through arrows, X → Y. Whereas the indirect relationship between nodes is when node X and node Y are not directly connected, yet there is a path that connect the two nodes in the graph. D-separation can be of the form: indirect causal effects, indirect effect of evidence, common causes, and/or general effects[3]. Conditional independence and D-separation is presented in Figure 1.
**Figure 1.** Example of Bayesian Network with 5 random binary variable smoking (S), lung cancer (C), bronchitis (B), x-ray (X), dyspnea (D).

There are $2^5$ possible relationship among the five variables illustrated in Figure 1. However, with the designed network, and assuming the conditional independence holds, the possible relationship is reduced to 13. The model for network in Figure 1 is.

$$P(S, C, B, X, D) = P(S)P(C|S)P(B|S)P(X|C, S)P(D|C, B)$$

3. **Parameter Estimation of Bayesian Network Model**

Determine the Prior and Posterior Distribution

- Given a Bayes Theorem:

$$P_{\theta|D}[\theta|D] = \frac{P_{D|\theta}[D|\theta]P_{\theta}(\theta)}{P_{D}[D]}$$

With:

- $P_{D}[D]$ is the marginal distribution of data D.
- $P_{\theta}(\theta)$ is the Prior distribution of $\theta$.
- $P_{D|\theta}[D|\theta] =$ the likelihood function, and
- $P_{\theta|D}[\theta|D]$ is $the$ Posterior distribution of $\theta$.

Since $P_{D}[D]$ does not depend on the parameter $\theta$, then equation (1) can be rewritten as follows:

$$P_{\theta|D}[\theta|D] \propto P_{D|\theta}[D|\theta]. P_{\theta}(\theta)$$

(2)

$P_{\theta|D}[\theta|D]$ , the posterior distribution of $\theta$ is of interest. In order to do this, the prior distribution of $\theta$ must be specified, and the likelihood function of the model must be constructed.

3.1. **Formation of the likelihood function**

In general the likelihood function has the following form\cite{9}:

$$L(\theta; D) = \prod_{m=0}^{M} P[(x[m], y[m]); \theta]$$

$$= \prod_{m=0}^{M} P[x[m]; \theta] \cdot P[(y[m]|x[m]); \theta]$$

$$= \prod_{m=0}^{M} P[x[m]; \theta] \prod_{m=0}^{M} P[(y[m]|x[m]); \theta]$$

(3)

With:

- $\theta =$ is the set of parameters.
- $D =$ is the data
- $(x[m], y[m]) =$ are categories in parent and child nodes, respectively.
\[ m = 0, 1, 2, ..., M \rightarrow \text{state the number of categories in a data (all variables that will be observed).} \]

### 3.2. Prior Distribution Determination

Determining the prior distribution for \( \theta \) is required in order to determine the posterior distribution. As \( \theta \) represents the proportion of data being in each of the category within variables, or nodes, then Dirichlet distribution could be the prior distribution for \( \theta \). Dirichlet is a conjugate prior so that the posterior distribution can be easily determined, that is also follows a Dirichlet distribution\(^{[11]}\). The prior for \( \theta \) is as the following.

\[
p(\theta) = \frac{\prod_{i=1}^{K} \Gamma(\alpha_i)}{\Gamma(\sum_{i=1}^{K} \alpha_i)} \prod_{i=1}^{K} \theta_{\alpha_i}^{\alpha_i - 1}
\]

With:

\[
(\alpha_1, ..., \alpha_K) = \text{Parametric} \\
(x_1, ..., x_K) = \text{Random Variable} \\
\Gamma(t) = \int_{0}^{\infty} x^{t-1} e^{-x} dx \rightarrow \text{Gamma Function}
\]

### 3.3. Posterior Distribution Determination

Provide the likelihood as in Equation (3), and the prior distribution as in Equation (4), the applying relationship as given in Equation (5). The posterior distribution is obtained:

\[
P[\theta|D] \propto (\prod_{m=0}^{M} P[x[m]; \theta] \prod_{m=0}^{M} P[y[m]|x[m]; \theta]) \left( \frac{\Gamma(\sum_{i=1}^{K} \alpha_i)}{\prod_{i=1}^{K} \Gamma(\alpha_i)} \prod_{i=1}^{K} \theta_{\alpha_i}^{\alpha_i - 1} \right)
\]

(5)

### 4. Data Analysis

Data on early stage of Parkinson’s disease, taken from the PPMI database, download on [www.ppmi-info.org on Mei 24 2018 was analyzed](http://www.ppmi-info.org). Furthermore, the focus is on the motor aspect of daily activities, so examinations on the Movement Disorder Society-Unified Parkinson Disease Rating Scale (MDS-UPDRS) Part II were considered. These motor aspects consist of 13 types of NP2SPCH, NP2SALV, NP2SWALL, NP2EAT, NP2DRESS, NP2HYGN, NP2HWRT, NP2HOBB, NP2TURN, NP2TRMR, NP2RISE, NP2WALK, NP2FREZ.

Data used in this paper were from observations in 6 time points: baseline (BL), and at the end of 1st year (V04), 2nd year (V06), 3rd year (V08), 4th year (V10), 5th year (V12) giving 293 observations. Measurement on items of Part II of the MDS-UPDRS are in 5 ordered categories, from 0 representing normal condition, to 4 representing severe condition.
5. **The Result and Discussion**

Table 1 summarizes the relationship that identified among items measuring daily activities in people with PD. Among others, at baseline, speech with level 2 will most affect the tremor with level 1 where the resulting probability value is the largest. After 1 year of observation, in V04 turn with level 2 most affect the activity up from the chair in level 2 where the patient with Parkinson's need more than one try to get up or need occasional help. In the second year of observation, V06 speech ability with level 3 most affect saliva and drooling in level 4 where the patient with Parkinson's most or all of speech cannot be understood. In the third year of observation, V08 hobbies with level 4 most affect the handwriting in level 4 where the patient with Parkinson's most or all words cannot be read. In the fourth year of observation, V10 tremor with level 4 will affect the handwriting in level 4 where the patient with Parkinson's most or all words cannot be read. In the fifth year of observation, V12 tremor with level 4 most affect the handwriting in level 4 where the patient with Parkinson's most or all words cannot be read.

<table>
<thead>
<tr>
<th>Observation Time</th>
<th>Aspect observed</th>
<th>Probability</th>
</tr>
</thead>
</table>
| **BL**           | P(NP2TRMR|NP2SPCH,NP2HWRT) | $\begin{align*}
P(NP2TRMR=1|NP2SPCH=2,NP2HWRT=0) &= 0.99 \\
P(NP2TRMR=1|NP2SPCH=0,NP2HWRT=2) &= 0.97 \\
P(NP2TRMR=1|NP2SPCH=2,NP2HWRT=2) &= 0.74
\end{align*}$ |
| **V04**          | P(NP2RISE|NP2TURN,NP2WALK) | $\begin{align*}
P(NP2RISE=2|NP2TURN=2,NP2WALK=0) &= 0.95 \\
P(NP2RISE=2|NP2TURN=0,NP2WALK=2) &= 0.33 \\
P(NP2RISE=2|NP2TURN=2,NP2WALK=2) &= 0.33
\end{align*}$ |
| **V06**          | P(NP2SALV|NP2SPCH,NP2HOBB) | $\begin{align*}
P(NP2SALV=4|NP2SPCH=3,NP2HOBB=0) &= 0.96 \\
P(NP2SALV=4|NP2SPCH=0,NP2HOBB=3) &= 0.3 \\
P(NP2SALV=4|NP2SPCH=3,NP2HOBB=3) &= 0.3
\end{align*}$ |
| **V08**          | P(NP2HWRT|NP2DRESS,NP2HOBB) | $\begin{align*}
P(NP2HWRT=4|NP2DRESS=0,NP2HOBB=1) &= 0.0003 \\
P(NP2HWRT=4|NP2DRESS=0,NP2HOBB=2) &= 0.0095 \\
P(NP2HWRT=4|NP2DRESS=0,NP2HOBB=3) &= 0.0095 \\
P(NP2HWRT=4|NP2DRESS=0,NP2HOBB=4) &= 0.02
\end{align*}$ |
| **V10**          | P(NP2HWRT|NP2SPCH,NP2TRMR) | $\begin{align*}
P(NP2HWRT=4|NP2SPCH=0,NP2TRMR=1) &= 0.02 \\
P(NP2HWRT=4|NP2SPCH=0,NP2TRMR=2) &= 0.083 \\
P(NP2HWRT=4|NP2SPCH=0,NP2TRMR=3) &= 0.125 \\
P(NP2HWRT=4|NP2SPCH=0,NP2TRMR=4) &= 
\end{align*}$ |
6. Conclusion

The severity of the Parkinson's disease in a motor variable has been influenced from one of the motor variable aspects even more. The strong influence between aspect motor variables is calculated based on the probability value. The probability value in this case represents the frequency of patient's Parkinson disease occurs in a stage or a category in a motor variable aspect.

Reference


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The use of Computer-Based Test (CBT) on Moodle as platform in formal education

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Abstract: The development of Information and Communication Technology (ICT), especially computers and supporting applications, can support to conduct learning evaluations toward students’ learning process. In this case, the evaluation of learning is meant as a technological development which generally uses Paper-Based Test (PBT). Since 2015, Computer-Based Test (CBT) has been applied in the National Examination in Indonesia because its use is more credible. When using CBT applications, each student has experiences such as getting different questions from each item of questions. This study aimed to design learning evaluation using CBT on Moodle as platform. This research used a Research and Development (RnD) Methodology. To conduct CBT on Moodle as platform, the researcher made a framework design of activities before doing the evaluation in the field, and the purpose was that the activities could be run smoothly. The network architecture used in the use of CBT is offline or Localhost network. The result of the research was that Computer-Based Test on Moodle could be applied as one of the effective ways to evaluate teaching and learning process in formal education.

1. Introduction
Learning process is the synergic result from three main learning components consisting of learners, teachers’ competences, and learning facilities. The three prerequisites ultimately lead to learning processes and models. The effective learning models in the framework improve the quality of learning mathematics such as it should have relevance value with the attainment of thinking power and provide opportunities for students to build their creativities and also build teacher’s creativities [6].

A learning process is required to attract learners’ attention, and as much as possible to be able using the benefits of technological developments. The survey results in Indonesia showed that 13.70% of the total sample used computers while 83.30% did not use computers so that mostly, people in Indonesia did not use computers in the learning process. In addition, the other survey results stated that the use of computers in schools had a percentage of 12.12% [7]. In this case, there is a very high influence of a treatment-treated group using a learning of Computer Based Training compared to traditional learning [9]. Therefore, the real challenge in learning demands the teachers to be able to educate and train learners to achieve learning objectives of mathematics by following the development of technology.

Assessment of National Computer Based Test (NCBT) serves as an evaluation material in reforming and enhancing the quality of learning in schools. In addition, it can be used as a consideration for continuing to the higher level of education [3, 6]. Through CBT technique, the implementation of a test is believed to be more credible. The reason is that CBT is able to minimize a cheating in the distribution of the questions in the exam, and can minimize fraud among examinees. The questions given through CBT are randomized by the program so that it can minimize to appear a set of identical questions. This test can be done after students are given the subject matter. Therefore, educators should prepare a CBT test one week before by telling students to prepare for the CBT test.

57
Learning evaluation is an activity that is done after the process of teaching and learning activities. The evaluation is given to learners in order to measure their learning outcomes in understanding the knowledge gained in formal education. The learning evaluation in formal education generally uses Paper Based Test (PBT). PBT has many weaknesses in its implementation such as the questions given to all learners are alike and there is also a tendency to cheat during the exam. Therefore, to anticipate this problem, the Indonesian government made some groups of questions in the implementation of PBT.

The aim of this study is that CBT using Moodle (Modular Object-Oriented Dynamic Learning Environment) application can be applied in the evaluation of learning in formal education. This is one of the efforts to improve the quality of learning in formal education. In addition, it is expected to apply CBT as an effort in preparing students in the face of National Computer Based Test (NCBT). Therefore, the researcher designs the required activities in applying Computer Based Test (CBT) to formal education.

2. Method
This study used Research and Development (RnD) methodology. The researcher used 4 main stages: (1) preliminary study, (2) product development, (3) product efficacy test, and (4) product dissemination and implementation [3]

2.1 Preliminary Study
A school generally has computer labs that can be used by both teachers and learners. To utilize the facilities, a computer laboratory can be used as media in the application of CBT. Although available computers are limited, the teacher can create a group of participants that use CBT customized to the number of available computers. Therefore time management in the computer labs should be managed effectively.

2.2 Product Development
Computer Based Test (CBT) is a test using a computer in its implementation. CBT can be applied to devices connected to the internet network or localhost network (Offline). CBT in Indonesia has been implemented since 2015, the Indonesian government hopes that CBT can change National Exam Based Paper and Pencil (PBT). This is done to improve the quality of education. Regarding to the use of CBT, there are several things that can be done as follows:

(1) Web Server has a function to transfer files based on a user request through HTTP or HTTPS communication protocol. The packaging in a web page can be text, image, video, or other. In addition, the web server allows providing dynamic website services through a web browser.
(2) The Moodle Application (Modular Object-Oriented Dynamic Learning Environment) is a software package which is created for learning activities or learning evaluations. Internet-based activities and websites that use the principle of Social Constructionist Pedagogy. This application is one of applications from the concepts and mechanisms that utilize technology information. This learning evaluation is also known as the concept of electronic learning evaluation or Computer Based Test (CBT). Moodle can be used freely as an Open Source product under the GNU license. Moodle can be implemented on any computer and any operating system that can run PHP and support SQL databases.

3. Result and Discussion
Information Communication Technology (ICT) can be interpreted as a means of communication, supporting information, processing information, and dissemination of information more quickly and accurately for its use in various areas of life [1, 9]. The positive impact of ICT integration in learning is closely related to the increased professionalism of the teachers in the mastery of technology and the use of computers to promote higher-order thinking [8]. Based on the
explanation, computer and internet is one of ICT devices that can be used as an assessment in learning to see the learners’ achievement.

To implement a learning assessment, it should use assessment standards and execution guidelines to maintain Quality Control (QC) to improve efficiency and accuracy in assessment, analysis, and assessment reports [4]. Computer Based Test (CBT) is not only seen as a simulation in formal education. But CBT can be used for assessment standards in learning evaluations. Therefore, the change of technology should be adapted to its era in order to be able to improve the quality of education.

Many factors besides mastery of material that can influence the learners in doing National Computer Based Test (NCBT). One of the factors is the readiness of the learners in facing NCBT. Simulations offer the learners an opportunity to learn about the various behavioral assessments and treatment strategies that are available when working with special behavior problems [5]. The learners also assume the simulation is useful in developing the skills necessary for the application of appropriate behavioral techniques. The learners are required to simulate or try out before the implementation of NCBT [2]. One of the real efforts that can be done to improve the readiness of learners is to familiarize learners exposed to CBT in every learning.

![Chart 1. The level of average score toward NCBT in a certain area in Indonesia.](image)

The impact of CBT usage can be seen from the NCBT in an area in Indonesia on Chart 1. Of the 10 schools attending the NCBT, it was found that the 1st ranked school has implemented CBT in the learning evaluation process. This indicates that the readiness of learners in formal education brings it to the highest value.

As the basis of the use of technology or in particular the computer in the analysis implementation at the school, it associated with all parties in utilizing the application of computer technology. There are several things that need to be considered to apply computer technology, namely:

1. Environmental factors, including institutions of education and community providers.
2. Learners covering age, background, language acquisition, and various learning styles.
3. Educators, who include background, age, style of teaching, experience, and personality.
4. Technological factors that include computers, software, networks, connections, and the various capabilities that support it. [1]

These four elements become the initial foundation in implementing computer technology, so that the implementation of CBT activities can run smoothly if it is supported by all related parties.

![Figure 1. Computer Based Test Server Creation](image)
can use XAMPP as Apache and SQL to create Web Server, Moodle application, and Web Browser, so that CBT Server can be used by educators.

**Figure 2. Network Computer Server – Client.** CBT server can be used if Apache and SQL on XAMPP in operation mode. Furthermore, educators can configure independently moodle application on computer browser. Theme on model, however, should be on user friendly to support implementation of CBT. After setting up, Computer Based Test ready to access within the scope of localhost with the help of Wired Local Area Network (LAN) or Wireless LAN to create Network Computer Server-Client. During the coverage of the area, the Client computer may access CBT using the Browser Client through the IP address of the Server Computer Address.

4. **Implementation**

The implementation of Computer Based Test (CBT) is the next step after the analysis implementation. Educator and learners become the main role which cannot be separated on implementation process. It is plausible that they will face some obstacles in implementation process. In such condition, they can ask technician assistance to help them. There are three important stages in the implementation of CBT as follows:

4.1 **Preparation**

Before beginning, educators with the help of technicians should prepare some of the following:

1. Create user learners. In this step, educators or technician must create a user for the students, so that students have the required access in using CBT.
2. Make a Course. In this step, educator or technician makes the courses in accordance with the categories of class and class materials.
3. Make a Questions. In this step the educator makes the questions that must be made in accordance with the indicators of subjects. To implement this, the educator can follow these steps:
   a. Creating Categories of Problems. Educators should make some package of questions that are each given a category for the time of test execution, learners get the problem with the same category, but get a different question.
   b. Making Problems. Problem making can be done directly on CBT, then put into the appropriate category of questions. Educators make arrangements when the problem can be done and how many times the problem can be done by the learners, beside that it can be arranged time processing.
   c. Set the Model Role. Role models are applied so that learners have access to work on prepared questions. Without the Role model, the user will not have access to the prepared questions.

4.2 **Practice**

Practice of CBT can be conduct after the previous stage has been applied. Furthermore, educator and learners have their own role in CBT process. Educator as a supervisor, while learners have responsible to answer question given in CBT. The activities that must be done is by doing some steps as follows:
(1) Learners Login. In order to access CBT, learners must open IP address server on browser. Subsequently, learners login on their user to starting the test that have been made previously on CBT.

(2) Learners do the test. In such step, learners start answering question given by educator. Questions given use random questions method in a predetermined category or same questions for every student. Random question based on category is more recommended to support learner’s competences such as responsibility, honest, and creativity in answering question. Learners have limit time to answer every question given. The timing of the test begins since the learners open the first question. When the given time has been finished, the result will be saved automatically in CBT database and saved as an assessment materials.

(3) Learners Logout. In this step learners are required to logout after practice CBT. This is done In order to avoid misuse by other people.

4.3 Evaluation

At this stage educators are required to provide evaluation of the assessment and activities that have been done by learners. There are several steps that must be done by educators are as follows:

(1) Retrieving CBT results report. After the learner performs CBT, the educator can directly obtain the test result on CBT. Test results can be downloaded from CBT applications, or educators can do so in accordance with the wishes of learners.

(2) Create assessment materials. Once educators get CBT assessment results from mathematics subjects, learners can process them by combining the previous test results. In this step the educator must process it manually because some assessments still have to be done manually for example is an assessment of attitudes and skills of learners. This is done as an assessment material but as an evaluation material for CBT activities.

(3) Evaluate the results of activities. This step is important so that the implementation of CBT can be known shortcomings and advantages. Apart from the results of the assessment, input from various parties can be used as an evaluation material for further implementation of CBT is even better.

After applying these 3 steps, the application of the Test on CBT can be done. The following author gives an example of the problem that has been applied to CBT on screenshot at Figure 3.

Figure 3. Screenshot Question on Computer-Based Test.

5. Conclusion
The use of Computer Based Test (CBT) on Moodle as a platform can be applied to formal education if it can manage its education management effectively. Implementation of CBT will run effectively and efficiently if education provider analyze need education provider analyze material need before implementation starting. The application of CBT should be operate in a computer lab.

Computer Based Test on Moodle as a platform using the web browser in the implementation of its activities.

In running the program, educators must use Apache web server. Network architecture used in the use of Computer Based Test is offline network or Local host. The result of the research is Computer Based Test on Moodle as a platform can be applied in formal education as learning evaluation material.

6. References
Study of The Low Students’ Mathematical Connection Ability

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Abstract. This study aims to examine students' mathematical connection ability based on existing literature materials. This research uses qualitative method which is literature (library research). Based on the result of the study about the mathematical connection ability of students from the literature materials or the existing literature, it can be concluded that the mathematical connection ability of students is still relatively low, it is apparent on the unmet achievement of mathematical connection ability indicators. To overcome this problem, teachers are expected to design learning that can improve students' mathematical connection ability.

Introduction
Mathematics is one of the important subjects taught in every level of education. One of the functions of mathematics is as the formation of the mindset and the development of reasoning to overcome various problems, either in subject matter or in everyday life. This is in line with the objectives of mathematics learning in the curriculum of 2013, namely: (1) problem-solving ability; (2) the ability to communicate; (3) ability to make connections; (4) reasoning ability and (5) representational ability. One of the capabilities to be developed is the mathematical connections ability. According to [1], mathematical connection is a cognitive process in which one connects two or more ideas, concepts, definitions, theorems, procedures, representations and meanings among mathematics itself, with other disciplines or with real life. If students have not been able to connect concepts in mathematics, then students will have difficulty in understanding the mathematics themselves, however, if students can connect mathematical ideas, then their understanding will be deeper and longer [2].

But in fact, students' mathematical connection ability is still low. This is reinforced from the results of research conducted by [3] which shows that students' mathematical connection ability is still low, this can be seen from the percentage in indicator of mathematical connection ability of students in relating mathematics with daily life is 51.11% and is in the category less, while the indicator of mathematical connection ability of students in relating objects and mathematical concepts is 17.78% and are in very less category.

According to [4] the low ability of mathematical connections of students will affect the quality of student learning which can lead to low mathematics learning achievement. In fact, when learning mathematics students still have problems in connecting the material learned with prerequisite materials they have previously acquired. Based on Bruner's connectivity theorem, that in mathematics every concept is related to other concepts. Similarly, between arguments, theories, topics and branches of mathematics are each related. Therefore, to be successful in learning mathematics, learners should be given the opportunity to make math connections. With the development of mathematical connection ability, students will have broad insight into mathematics, so that students can solve mathematical problems in a reasonable, profound, accountable, and intelligent way of thinking [5].

This study aims to examine the mathematical connection ability of students, matters relating to the causes of low mathematical connection ability of students, as well as things that can improve students' mathematical connection ability.

Method
The type of this research is qualitative with the literature (library research), which is a series of activities related to library data collection methods, reading, record and processing of research
The materials of this study were obtained from library books and other sources all based on bibliography. Data were collected by relying on bibliographic data without empirical tests. This study aims to examine the literature materials related to students' mathematical connection ability.

Results and Discussion

Mathematical Connection means the activity of connecting between mathematical concepts; connecting mathematical concepts with other learning concepts; applying mathematical thinking and modeling to solve problems that arise in other disciplines, as well as activities linking mathematical concepts with everyday life [6]. This agrees with [7] that connection involves connecting mathematics with the real world, with other disciplines and other concepts in mathematics. According to [8] the ability of mathematical connections is the ability of students in connecting various problems related to mathematics. These connections are included in mathematics and between mathematics and things beyond mathematics, connecting mathematics with other disciplines and everyday life. Meanwhile, according to [4] the ability of mathematical connections is a ability that helps students learn how to connect mathematical ideas that enable them to formulate and verify deductive assumptions among modern mathematical topics, concepts and procedures that can be applied to solve other problems in mathematics as well as disciplines others.

According to [9], activities related to mathematical connections are activities: (1) understanding appropriate representations of mathematical concepts, processes or procedures, (2) searching for relationships among various representations of concepts, processes, or mathematical procedures, (3) topics in mathematics, (4) applying mathematics in other disciplines of study or in everyday life, (5) searching for relationships between procedures with other procedures in equivalent representation, (6) applying relationships between mathematical and other discipline topics.

The ability of mathematical connections is needed students in learning mathematics, because the concepts in mathematics itself are related to each other. That is, the concept that students have learned before will be the basis for mastering the concept in the next material. Thus, students are required to develop the ability of mathematical connections to be able to connect mathematical concepts that will be useful in solving math problems. According to [3], if the topic is given individually then the lesson will miss a very valuable moment in an effort to improve student's mathematics learning achievement. However, if students can make many mathematical connections, then learning will be meaningful and optimal [10]. Therefore, mathematical connection ability is very important for students in learning mathematics.

According to [6] the purpose of the mathematical connection is intended to broaden students' knowledge, view mathematics as an integral whole that does not stand alone and knows the relationships and benefits of mathematics both at school and beyond school. Whereas, the usefulness of mathematical connection ability is (1) to help students to connect mathematical ideas that will facilitate them to formulate and verify deductive assumptions between topics; (2) modern mathematical concepts and procedures can be applied to solving problems in mathematics as well (3) students can rebuild their previous understanding of knowledge, (4) mathematical connections help students to memorize skills and concepts and apply them appropriately when they are faced with problem-solving situations. (5) were able to view mathematics as a basic science that has many relevance and benefits to other fields, both at school and beyond school [11].

There are two general types of mathematical connections according to [2] namely modeling connections and mathematical connections. Modeling connections are the relationships between problem situations that arise in the real world or in other disciplines with their mathematical representation, whereas mathematical connections are relations between two equivalent representations, and between the completion processes of each representation. While based on its kind, according to [12] mathematical connections can be classified into three types, namely, the relationship between mathematical topics, connections with other disciplines and real-world connections with students or connections with everyday life. Furthermore, according to [13] the mathematical connection consists of two aspects, namely the relationship between mathematical concepts related to mathematics itself (internal connection) and the relationship between mathematics and outside mathematics or daily life (external connections).
In measuring the mathematical connection ability of students required an indicator. According to [2] Indicators of the ability of mathematical connections are: (1) Recognizing and exploiting the relationship between ideas in mathematics; (2) Understand how ideas in mathematical interconnection and underlie each other to produce a unified whole; (3) To recognize and apply mathematics in contexts outside mathematics. Meanwhile, according to [14] indicators of mathematical connections, among others: (1) Finding relationships from various representations of mathematical concepts and procedures. (2) Understanding the relationship between topics in mathematics. (3) Able to use mathematics in solving problems in everyday life. (4) Understanding representations equivalent to concepts (5) Finding relationships between other equivalent procedures.

Based on some opinions above, it can be concluded that the mathematical connections ability is the ability to create mathematical relationships, both relationships between mathematical topics, mathematics with other disciplines and mathematics with everyday life.

Based on the studies that have been done, obtained the fact that the low ability of mathematical connections of students are still widely found. One indication of the students' mathematical connection ability is still low is based on several studies. Based on research conducted by [3] shows that the mathematical connection ability of class IX students of SMP Muhammadiyah-22 Kisaran is still low, this can be seen from the percentage indicator mathematical connection ability of students in relating mathematics with daily life is 51.11% in the category of less, while the indicator of mathematical connection ability of students in relating objects and concepts of mathematics is 17.78% and are in very less category. This is because most students have not understood the relationship between objects and mathematical concepts to meet the indicators of mathematical connection ability.

Likewise research [15] showed that the average mathematical connection ability of students is low, that is 34.96%. In more detail can be seen in table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Indicator of Mathematical Connection Ability</th>
<th>Score Average</th>
<th>Score Maximum</th>
<th>Percentage (%)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Relationship between mathematical concepts in one material</td>
<td>7,523</td>
<td>8</td>
<td>94</td>
<td>High</td>
</tr>
<tr>
<td>2.</td>
<td>Relationship between mathematical concepts in one material</td>
<td>14,52</td>
<td>26</td>
<td>55</td>
<td>medium</td>
</tr>
<tr>
<td>3.</td>
<td>The relationship between Mathematical concepts and other concepts of science</td>
<td>12,16</td>
<td>30</td>
<td>40</td>
<td>Low</td>
</tr>
<tr>
<td>4.</td>
<td>The relationship between mathematics and everyday life</td>
<td>0,694</td>
<td>36</td>
<td>2</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Average Total</td>
<td>34,96</td>
<td>100</td>
<td>34</td>
<td>Low</td>
</tr>
</tbody>
</table>

Saminanto and Kartono [15] writes analysis of the causes of mathematical connection ability based on mathematical connection ability indicators, as follows: (1) Mathematical connection ability between concepts in a single material is 94% because: teacher involves students in learning process, teacher explains with answers and questions from concept in detail, students are involved to build their own knowledge. (2) The ability of interconnection between topics in mathematics is 55%. Interconnection topics between abilities in mathematics are not optimal because the teacher is slightly contextualize with other science, the implementation of learning is still using the lecture method, as well as the students do not build their own knowledge. (3) The average ability of inter-concepts of
mathematics with other science is low, that is 40%. This is because of the monotonous learning with the lecture method, the teacher carries out the lesson by giving a large amount of practice, the teacher does not challenge the students to find problems related to other science. (4) The average ability of math connection with daily life is very low, only 2%. Because teachers use speech methods, teachers do not encourage students to recognize problems in everyday life and then apply in the material they are learning, the teacher does not instruct on small group discussions or individuals. Therefore, students are free and not focused in solving the problems given.

Furthermore, research conducted by [6] states that the average mathematical connection ability of students is also still low that is equal to 36.77%, this is because students can not be able to understand the problem, students can not apply the concepts of mathematics in everyday life -day, an error in performing the operation and can not create the symbol correctly.

The study conducted by [11] the result is largely the learning barrier of identifying that students still can not relate concepts in mathematics, whether the concept is the same or with other concepts. So it can be said that students' mathematical connection ability is still low.

Another study, ie research [16], writes that students' mathematical connection ability is related to the level of mathematical ability. Students with high mathematical abilities can link well mathematical concepts, students with math skills are not able to link mathematical concepts well, whereas students with low mathematical ability have difficulty in connecting mathematical concepts.

Based on the study of some research results about the ability of mathematical connections above, it can be said that students' mathematical connection ability is still low. This is apparent in the unavailability of indicators of mathematical connection ability, so that researchers conduct a deeper study of the things that affect the low ability of mathematical connections in students.

According to [4], the difficulties students experience in linking mathematics can be due to: (1) student learning styles, students applying different learning styles have different levels of mathematical connection ability, (2) appropriate learning models to apply. Meanwhile, according to research [14] in addition to conventional learning that is still used by teachers, students' assumptions about the lack of importance in learning mathematics also affect the ability of students' mathematical connections today.

Furthermore, the research [7] writes that based on the students' view of the difficulties they encounter when linking math and the real world, 47.2% of students express difficulties due to the learning process, 27.7% because they can not fully understand the material, 16 , 6% due to teacher approach and 8.3% of students stated that they had no difficulty. Difficulties in relating mathematics to the real world including problems arising from the learning process, can not fully understand the material and the teacher's approach. Therefore, it is clear that difficulties in relation to connections to the real world generally arise from learning. Mathematics teachers should teach mathematics through concrete concepts in the students' private lives [17]. If mathematical concepts are given by the teacher abstract without being connected to real life, then the student will face many problems that he can not solve if the student does not have sufficient mathematical connection ability.

Another study [8] writes that in general, learning is organized in the classroom. Whereas learning in the classroom has many weaknesses in inculcating mathematical concepts for students. The weaknesses among other things, teachers are not flexible in connecting mathematical concepts to everyday life. Similarly, students are limited in observing the real objects of everyday life related to mathematics. This leads to the ability to understand mathematical concepts, especially the students' ability of mathematical connections not well developed.

To solve the problem of the low mathematical connection ability, an effort is needed to improve students' mathematical connection ability. According to [18] to improve the mathematical connection ability of learning must have a representative media that can connect between students' knowledge in real situations and learning materials. In addition, there should be models that can develop new and old knowledge from students as well as facilitate their math connection ability. In order to fulfill all competencies, teachers should be able to become facilitators and mediators in meeting the needs of students related to 21st century competencies. Therefore, teachers should be able to choose appropriate learning models to meet their competencies.
Meanwhile, according to [15], (1) learning is done as an effort to build or build knowledge from their own experience, (2) prioritize active process, (3) learn in experience of social context, (4) give priority to real learning in relevant context or contextual.

Based on the results of a study of efforts to improve the ability of mathematical connections that have been obtained. It is expected that the ability of mathematical connections in students can grow and increase along with the efforts made by both teachers and students themselves, so later with the development of mathematical connection ability, students are able to solve all problems that exist in mathematics.

Conclusions
The use of sections to divide the text of the paper is optional and left as a decision for the author. Where the author wishes to divide the paper into sections the formatting shown in table 2 should be used.

Based on the results of the study of students' mathematical connection ability of existing literature or literature, it can be concluded that the mathematical connection ability of students is still relatively low. This is seen in the indicators of mathematical connection ability that have not been achieved. One of the causes of low mathematical connection ability in students is less precisely the selection of learning models used. To overcome these problems, teachers are expected to design lessons that can improve students' mathematical connections, including the selection of appropriate learning models and connecting students' knowledge with the real world, teachers must also be facilitators and mediators in facilitating students' mathematical connections.

References

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Analysis of Mathematical Critical Thinking Ability Based on FRISCO Indicator

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Abstract. Critical thinking and problem solving ability are very helpful in educational psychology courses to train student teachers in solving complex problems of education, especially in classroom. Both of them have been identified as desirable outcomes for students. Educators recognize that students need a well-designed critical thinking curriculum that promotes problem solving, creative learning, and critical analysis of information. Ennis develops FRISCO indicator as the basis for the criteria of critical thinking ability that must be possessed by individuals. This study aims to review mathematical critical thinking ability in problem solving based on FRISCO indicator from several related literatures. This type of research is library research and the method used is library data collection whose research object is explored through various library information. The data obtained from the results of research that has been done by previous researchers. The final results show that not all students can reach critical thinking criteria based on FRISCO indicator. The dominant student has difficulty reaching the indicator of Inference and Overview. This suggests that students' mathematical critical thinking ability have not met expectations. This is apparent in the non-achievement of all FRISCO indicator on student test results.

1. Introduction

Along with the development of world civilization, the life problems complexity demands a reliable human resources to compete. In addition, the world of education is also faced on the challenges to create individuals who can conquer the global demands. In the 21st century, it is predicted that there will be more work which require high-level ability that involve critical thinking, problem solving, conveying ideas, and effective cooperation [1, 2]. The rapid development of information and communication technology has spread to every aspect of life. Rapid development in the field of information and communication technology today is based on the mathematics development, so to dominate and create technology in the future require strong mathematical mastery early.

In mathematics learning, students not only learn math materials but also learn to deal with the problems and the challenges in social life. One of the provisions that must be possessed by students when facing the problems and the challenges in social life is critical thinking. It causes mathematics lessons are given to equip learners with logical, analytical, systematic, critical, creative, and cooperative ability. In addition, mathematics is also given to develop the ability in problem solving and communicating ideas, helping learners to develop various aspects within themselves, and being able to become individuals who are useful in their lives later [1, 3, 4].

In mathematics learning, learners who have mathematical ability will enjoy mathematical problem solving, fast in learning mathematics and get good result [5], so mathematical critical thinking ability is needed so that students can develop their concept and knowledge to solve a problem. Improvement in critical thinking tendencies will allow students to look at everything from different aspects and will give them a chance to discover where the formulas and rules come from, how they can arise, and can increase the level of academic success of mathematics that is considered a difficult subject and frightening [6].

In teaching mathematics today is also characterized by an increasing “focus on developing thinking skills”. This can be understood by considering all the more tangible trends in teaching mathematics where students can not only be used and relevant but should allow, perhaps, for knowledge applications, for the critical attitude and efficiency required in all processes. That is, they should be
“research, problem solving, creativity, information processing, logical punishment and evaluation results” [13]. Teachers should be enlightened as to how critical thinking and logical thinking skills can be implemented using various practices, such as seminars, conferences, in-service training, critical thinking skills, tendencies and logical thinking skills. These can be used as an effective way to increase achievement and make this situation permanent [6].

The demand for development of critical thinking in mathematics education is not new. Critical thinking ability was a part of the reasoning in mathematics teaching in which students, on a daily basis, find themselves in a position to conclude, find solutions and make assumptions that must be critically evaluated.

The FRISCO indicator was developed by Ennis (1996) as the standard criteria for supporting critical thinking processes, providing guidance for structured reasoning and problem analysis; it is also used to encourage individual learning abilities under structured pedagogical situations [7]. FRISCO consists of six criteria, the acronym stands for Focus, Reason, Inference, Situation, Clarity, and Overview [8]. Ennis [9] set six criteria of critical thinking can be used as a mental checklist for critical thinking and ensuring final decisions can be summed up as the most important. The six criteria of critical thinking are shown on Table 1.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus</td>
<td>Figuring out the problem.</td>
</tr>
<tr>
<td></td>
<td>- Looking for reasons for and against the decision in a certain way (pro and contra reasons).</td>
</tr>
<tr>
<td>Reason</td>
<td>- Looking for evidence.</td>
</tr>
<tr>
<td></td>
<td>- Identifying and judging the acceptability of the reasons.</td>
</tr>
<tr>
<td>Inference</td>
<td>Making a reasonable conclusion that suits the reason.</td>
</tr>
<tr>
<td>Situation</td>
<td>Identifying the thing which is relevant to the significance of the thinking activity and some of the rules that guide it.</td>
</tr>
<tr>
<td>Clarity</td>
<td>Clarifying the meaning of terms and the way that is used.</td>
</tr>
<tr>
<td>Overview</td>
<td>Checking what have decided and inferred.</td>
</tr>
</tbody>
</table>

These six basic criteria of critical thinking are interrelated elements and not a series of steps, but rather the ones used to ensure that we have done the same. “Focus” means we should be able to know the main points, issues, questions or problems in the situation. This ability affects a person to be able to identify and formulate questions and criteria to consider possible answers. “Reasons” means the reasons offered in support of the conclusions and decide whether they are acceptable before we make a final judgment. This indicator is directly related to the ability to analyze a person, someone who is able to give the right reasons to answer a question can be ascertained he also has a high analytical ability. “Inference” according to us explore whether the support of the reasons we have received it. An important part of this step is to identify assumptions and seek solutions or considerations of situations and evidence. “Situation” focused on beliefs and decisions. This ability to understand images and always keep people in thinking to find the most appropriate answer. “Clarity” explained what we had said. If students are able to express an understanding of the things that exist then they still have the ability to clarity in critical thinking. “Overview” review all actions or decisions that have been taken. Students are involved to have “overview” criteria in critical thinking if they can decide on a course of action that is believed and able to reinvent what has been said before [14, 24].

In solving problems, a person needs critical thinking skills. Troubleshooting is an attempt to overcome obstacles when answers are not yet apparent. In mathematics learning, critical thinking ability is indispensable in solving problems or solutions and completing tasks [10]. When students do problem-solving, the student has been doing mental activities, such as trying to understand the problem faced, thinking of the settlement plan, and applying it to find a solution.
Mathematics has a universal language that requires reading comprehension ability to solve word problems. With the application of thinking strategies such as reading problems and searching for meaningful information, underlining key words and by visualizing problems, students stimulate their learning process and become critical thinkers on understanding mathematical word problems. These strategies tend to increase students' confidence on solving word problems and become more competent mathematicians [11].

2. Research Methods
This type of research is library research, which examines the literature materials related to the students' mathematical critical thinking ability based on FRISCO indicator. The method used is to collect library data related to students' mathematical critical thinking ability based on FRISCO indicator without empirical test.

The data used in this research is secondary data. Secondary data is data obtained not from direct observation. However, the data obtained from the results of research that has been done by previous researchers. The author examines theories, opinions, or findings in the literature that provide theoretical information related to mathematical critical thinking ability. The author uses about 18 journal articles and proceedings relevant to the topics.

Data collection method used in this research is documentation method. Documentation method is a method of collecting data by searching or exploring data from the literature related to what is intended in the formulation of the problem. The data that have been obtained from various literature are collected as a unified document used to answer the problems that have been formulated.

Data analysis technique used in this research is bibliography annotation analysis. The data analysis phase is independent with mathematical critical thinking ability which is then reviewed to gather more information. The results of the studies have been obtained and adapted to FRISCO indicator.

3. Result and Discussion
High-skilled students may not necessarily have high critical thinking ability too, but students with high spatial thinking ability possess high critical thinking ability. The reality today, students have low critical thinking ability can still develop their ability by practicing many spatial problems. High-thinking students reach the six criteria of FRISCO in critical thinking ability. Students with medium-thinking ability have only Reason and Clarity criteria, whereas students with low-thinking ability only have Situation criteria [12]. But the three students have the same critical thinking ability that is on the average stage. Critical thinking strategies are ways that lead students to connect and understand what they are learning, it is an important role to develop in the students’ abilities to understand and solve word problems. Students should be taught methods to reason and think critically about a problem, through the identification of key words and phrases and by drawing visual aids that enable them to decide what to do. When reading the question and simplify the word problem by highlighting the main words or an important idea, or drawing the situation of the problem, they are generating critical thinking skills that can be used in any other academic subject taught in a school [11].

In a different study, some students expressed difficulties in reaching the criteria of FRISCO, particularly on Inference (33%) and Overview (23%) indicating the need for strengthening support on these criteria [7]. With a choice of appropriate content, students' critical thinking if viewed as a whole can be developed, and in the process can significantly influence the development of each student's ability, that is in problem formulation, problem reform, evaluation, and sensitivity to the problem [13].

High and medium mathematics subjects exhibit similarly critical thinking profiles [14]. Subjects with high and medium mathematics ability do not reach the Clarity and Overview indicators, the difference is that subjects with high mathematics do not show clarity at the stage of carrying out the plan and do not show an overview of the re-examination stage, while the high-mathematics subject does not show Clarity and Overview on re-checking stage. In a low-math subject, the subject does not meet the Situation, Clarity, and Overview indicators in the re-examination stage. Students have very few skills when dealing with understanding word problems. They seem to have difficulty to comprehend the “situation” which forms the context of the problem. Reflecting upon their own thinking process will help those not only in the mathematical field but also these abilities can be
transfer to any subject. Therefore for students to become critical thinkers in the comprehension of mathematics word problems, they are required to develop understanding about the words in the problem which will benefit by functioning productively in their classes and help them to be critical problem solvers [11].

This is in contrast to the study [15] which concludes that in students with high mathematics skills not meeting Inference indicators, mathematics students are not meeting Reason and Inference indicators, while low math students only meet Focus and Clarity indicators. In this case, the student should increase the intensity of the exercise problem solving in order to get used to working on the problem. For students who still have difficulty in solving the problem should multiply the exercise questions by writing down what is known, what is asked, plan the completion, and check back to make it easier to understand and solve the problem.

Ennis calls the FRISCO approach that standard in the Informal Logic and Critical Thinking (ILACT) tradition, when first teaching students how to understand and produce arguments, to get them to ask questions about conclusions (what he calls an argument’s “focus”), reasons, inferences, clarity and so on, but using the mnemonic FRISCO with its attendant explanations is new and rich, and students respond to it very well. They find the mnemonic easy to remember and the general process very helpful. Ennis is right to insist that understanding and evaluating an argument requires us to take into account the context in which it is presented – the “situation” as he calls it; this element is often omitted in the ILACT tradition [16].

In one study [17] who took the subjects of high school class XII with the interval age of 16 years to 18 years showed that the difference in achievement of FRISCO indicator on their critical mathematical thinking ability. In a 16 year old subject capable of achieving 5 indicators, the subject is incapable of reaching Inference indicators. In a 17 year old subject can reach 5 indicators, the subject is not able to meet the Focus indicator. While the subject is 18 years old, the subject is able to achieve the six indicators of FRISCO well.

Silva [18] argues that there is no single age when children are gradually ready to learn more complex ways of thinking. Empirical research [19] shows that people begin to develop critical thinking competencies at a very young age. Although adults often show poor reasoning, in theory everyone can be taught to think critically. Although critical thinking ability appears to improve with age, even students can benefit from critical thinking instruction.

Critical thinking and logical thinking are not characteristics that form during university years and developed over this period. In order to enable students to acquire these characteristics at an early age, curriculum development specialists and teachers must acquire and gain these skills. Activities related to enabling students to acquire critical thinking skills in the curriculum started to be implemented in 2006 in our country. The effects of this curriculum on students’ critical thinking tendencies and skills should be studied. After determining the teachers’ awareness, success in students’ attitudes and in their achievement may be indirectly obtained. Mathematics course books should be revised to consider critical thinking and logical thinking ability. It is only then that the desired skills can be acquired [6]. Critical thinking instruction can include teaching students to:

- value reason and truth;
- respect others during discussion;
- be open-minded;
- be willing to see things from another’s perspective;
- perceive the difference between definitions and empirical statements;
- use cognitive strategies, such as asking for examples when something is unclear; and
- use principles of critical thinking, such as considering alternatives before making a decision.

From the explanation above seen that at a time when the process of solving the problem required an appropriate capability that is one of the critical thinking ability. To know the difference in critical thinking skills can be seen from the process of solving the problem [20]. When students understand the problem, then they will make a plan to solve their problems. Great ideas needed to find a solution
that is effective and accurate. The ideas gained if students want to understand the critical thinking on every issue.

Critical thinking is used as a means in solving problems, making decisions, to seek answers, to enrich the meaning and desire to know us something. Critical thinking ability can help a person in proper decision-making, systematic, logical and consider from a variety of viewpoints. In developing problem solving students need for critical thinking ability in analyzing information. Critical thinking is not a method to be learned, but rather a process, an orientation of the mind and so, includes both the cognitive and affective domains of reasoning. A researcher asserted that the learning method which is based on problem solving will make progress in critical thinking [21].

In the study [18] explained that the low ability of critical thinking because students cannot formulate problem points and detect mistakes with different points of view. In this case, when students are given questions and interviews, there is no seemingly critical thinking indicator. The students' lowest thought level is when students do not understand the problem and only remember the thought [22]. Moreover, learning models and methods used have an impact on students' critical thinking ability who have low optimal critical thinking ability. The fact of students’ critical thinking ability as a whole at low critical thinking criteria is 80.9%. In details, the indicator of the highest critical thinking ability in the indicator of formulating the problem is 65.9%, the indicator of the lowest critical thinking ability in the indicator of making deductions is 54.6%. The lack of students’ critical thinking can also be seen on the students’ argument where their reasons are not appropriate, provides less logical assumptions, and provides less evaluation based on facts [23].

The big difference in students’ mathematical critical thinking ability possibility because most students try to solve problems with the critical thinking test different ways of thinking that is using its own experiences. In addition there is the impression that students are afraid to work on the problems outside the way they have been taught teachers. As a result, the way of thinking has changed in test-taking led to the students' answers are less precise. The above findings when linked with constructivism theory that students must actively construct their own knowledge by answering questions raised and students can explore new ideas or different ways to find the concept and break it [10].

The degree of mastery of students' critical thinking ability other than by the input of students is also directly by the learning profile. Selection and application of an applicable learning model or strategy will influence the students' critical thinking ability level. Basically the model or strategy used should be able to establish the categories of students, determine the problem, and create a supportive environment in order to improve students' critical thinking skills [24].

4. Conclusion
Based on some library data related to students' mathematical critical thinking ability in solving word problem based on FRISCO indicator, it can be concluded that dominant students do not meet Inference and Overview indicators. However, students meet the Focus, Reason, Situation, and Clarity indicators quite well.

The low critical thinking ability because students cannot formulate problem points and detect mistakes with different points of view. Students cannot meet the Inference criteria because the subject has not been able to draw a logical conclusion in doing problem solving. Students cannot meet the Overview criteria because the subject is not re-examining or checking whether the calculation makes sense to solve the problems encountered and check whether the strategy implementation steps that have been made make sense to solve the problem.

Acknowledgments
The author would like to thank the references for improving the quality of this article.

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The Ability of Students’ Mathematical Representation to Solve Linear Program’s Problems Reviewed Gender Differences

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Abstract. This research aims to describe the ability of students’ mathematical representation to solve linear program’s problems reviewed from gender differences. The subjects of this research are one male and one female student of the fourth Semester of Mathematics Education in Majapahit Islamic University. The subjects are selected based on the highest mathematics ability which is assessed from their previous assignments and tests. In addition, the communication ability of the subjects is also considered in order to facilitate the researcher in conducting interviews. Based on the result of the tests and interviews, it can be concluded that (a) the female subject can present information into the table representation, while the male subject does not present the information into the table representation or incomplete; (b) The female subject makes graph representation completely and precisely, whereas the male subject makes a mistake in making a graph representation; (c) the male and female subjects write symbol representations in the solution of the problem completely and precisely, but in the simplex method, male student is incomplete in her symbol representation; (d) the female subject solves problems with written words completely, but the male subject does not write verbal representation or incomplete.

Keywords: female, male, mathematical, representation

1. Introduction

Representation is one of the most important abilities to be developed and owned by students. According to the National Council of Teachers Mathematics (NCTM) (2000: 29), it is stated that the objectives of learning mathematics that must be achieved in school students include process standards such as problem solving, reasoning and proof, communication, connection and representation. In addition, the importance of mathematical representation is also reinforced by Wahyuni's statement (in Hanifah, 2015: 192) which states that the importance of mathematical representation of students is helpful in understanding the mathematical concepts such as images, symbols and written words. The use of right representation will help students make concrete mathematical ideas to more concrete.

Given the importance of mathematical representation, Goldin (2002) states that Representation is the disclosure of mathematical ideas, written language, symbols, pictures, diagrams, models, charts, or using physical members. Hwang et al (2007) states in general psychology, representation means the process of making concrete models in the real world into abstract or symbolic concepts.

More details, NCTM (2000: 27) explains that a) the process of representation involves translating problems or ideas to new forms; b) the process of representation including the conversion of diagrams or physical models to symbols or words; and c) the process of representation can also be used in translating or analyzing verbal problems to make its meaning clearly.

According to Villages (2009: 287) the assessment of mathematical representation is based on three main aspects including pictorial representation, symbolic representation, and verbal representation of the word problem. Again according to Villages (2009: 294), he argues that verbal representation consists of basic words as stated, both written and oral, pictorial representation consists of pictures,
diagrams or graphs and all kinds of related acts, symbolic representation consists of numbers, operation and relation signs, algebraic symbols, and the type of action that refers to these things.

Meanwhile, Yudhanegara and Kurnia (2014, 77) state the form of mathematical representation of students are diagrams, graphs, tables, expressions or mathematical notations with their own language. In this research, mathematical representation is focused on table, symbol, verbal and graph representation.

See the importance of mathematical representation that is not appropriate to the ability of mathematical representation of students in Indonesia is still low. It is evidenced by the research results of Minggono, Sugiatno and Jamiah (2013); Herlina, Yusmin, and Nursangaji (2017); Feriyanto (2015). Minggono, Sugiatno and Jamiah (2013) state that the ability of mathematical representation of students to solve the problem of inequality fractions of one variable is still less, because students tend to use only symbols, rarely use graphs and number lines. In addition, based on previous research by researcher which found that students have difficulty to present information into mathematical models appropriately, including: making variable, determining coefficient and constants in linear inequality in two variables, understanding the sign of inequality, and understand variable constraints (Feriyanto, 2015).

Mathematical representation is one component of mathematical ability. In addition, one of the factors affecting mathematical ability is gender differences. Keitel (1998) states that Gender, social, and cultural dimensions are very powerfully interacting in the conceptualization of mathematics educations, ... Additionally, it’s reinforced by the statement of Susento (2006) who states that gender differences not only result in differences in math skills, but how to obtain knowledge of mathematics. Gender is a visible difference between male and female by value in society (Marmawi, 2009).

There is no research on the mathematical representation to solve linear program's problem to gender differences. Fuad (2016) examined mathematical representation to solve quadric equation's problem. Rusminati (2018) examined mathematical representation to solve decimal problem in elementary school. Therefore, it is important to examine mathematical representation to solve linear program's problem reviewed gender differences.

2. Method

This research aims to describe the ability of students’ mathematical representation to solve linear program’s problem reviewed from gender differences. The subjects of this research are one male and one female student of the fourth Semester of Mathematics Education in Majapahit Islamic University. The subjects are selected based on the highest mathematics ability which is assessed from their previous assignments and tests. In addition, the communication ability of the subjects is also considered in order to facilitate the researcher in conducting interviews. The result of selecting subjects is ES (female student) and MH (male student). Futhermore, ES and MH were given the first linear program test and interview. This research uses a time triangulation which compares the first test and the second test, and it’s accompanied by interviews. Therefore, ES and MH student were given the second linear program test and interview. Finally, students’ work results are analyzed.

3. Results

The following data is the description of linear program test results done by ES and MH student.

3.1 The description of the first linear program test.
Table 1. The Description of Student’s Mathematical Representation in Solving the First Linear Program Test.

<table>
<thead>
<tr>
<th>Representation Aspect</th>
<th>Indicator of Mathematical Representations</th>
<th>ES Student</th>
<th>MH Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Representations</td>
<td>Students present back data or information from a representation to a table representation.</td>
<td>✓ On the graph method, ES presents information into the table to draw graphs.</td>
<td>✓ On the graph method, MH does not present information into the table to draw graphs.</td>
</tr>
<tr>
<td>a) Table</td>
<td></td>
<td>✓ On the simplex method, ES presents information into the table completely and precisely.</td>
<td>✓ On the simplex method, MH presents information into table but it is incomplete.</td>
</tr>
<tr>
<td>b) Graph</td>
<td>Students create graphs to clarify the problem and facilitate the settlement.</td>
<td>✓ ES creates a graph to show the solution set from all of the three linear inequalities of two variables appropriately.</td>
<td>✓ MH makes a mistake in making the line of the third inequality. In addition, MH also makes a mistake in determining the solution area.</td>
</tr>
<tr>
<td>Symbolic Representation</td>
<td>Students operate a symbol and verify how to solve it.</td>
<td>✓ On the graph method, ES writes down what is known, what is asked, and solves the problem by operating symbols.</td>
<td>✓ On the graph method, MH writes down what is known, what is asked, and solves the problem by operating symbols.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ On the simplex method, ES operates the symbol in solving solution completely and precisely.</td>
<td>✓ On the simplex method, MH operates symbols in problem solving incompletely.</td>
</tr>
<tr>
<td>Verbal Representation</td>
<td>Students answer questions with explanations of written words or texts; language used by students to explain something.</td>
<td>✓ On the graph method, ES writes down what is known, asked and solves the problem with the written word completely and precisely.</td>
<td>✓ On the graph method, MH writes down what is known, asked and solves the problem with the written word precisely but incomplete.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ On the simplex method, ES solves problems with written words and appropriate language.</td>
<td>✓ On the simplex method, MH does not write written words and language in solving problems.</td>
</tr>
</tbody>
</table>

Based on the above table, it can be concluded that (a) the female subject can present information into the table representation in both the graphical and simplex methods, while the male subject does not present the information into the table representation on the graph method, and is incomplete in writing the table representation on the simplex method; (b) The female subject makes graphical representation
completely and precisely, whereas the male subject makes a mistake in making a graphical representation and determining the solution area; (c) the male and female subjects write symbol representations in the solution of the problem completely and precisely on the graph and simplex method, but in the simplex method male student is incomplete in her symbol representation; (d) on the graph method, the female subject solves problems with written words completely, while male subject is incomplete. While on the simplex method, the female subject solves the problem with written words and appropriate language, but the male subject does not write verbal representation.

3.2 The description of the second linear program test.

Table 2. The description of Student’s Mathematical Representation in Solving the Second Linear Program Test.

<table>
<thead>
<tr>
<th>Representation Aspect</th>
<th>Indicator of Mathematical Representations</th>
<th>ES Student</th>
<th>MH Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Representations</td>
<td>c) Table</td>
<td>Students present back data or information from a representation to a table representation.</td>
<td>✓ On the graph method, ES presents information into the table to draw graphs</td>
</tr>
<tr>
<td></td>
<td>d) Graph</td>
<td>Students create graphs to clarify the problem and facilitate the settlement.</td>
<td>✓ ES draws a graph to show the solution set from all of the three linear inequalities of two variables appropriately.</td>
</tr>
<tr>
<td>Symbolic Representation</td>
<td>Students operate a symbol and verify how to solve it.</td>
<td>✓ On the graph method, ES writes down what is known, what is asked, and solves the problem by operating symbols.</td>
<td>✓ On the graph method, MH writes down what is known, what is asked, and solves the problem by operating symbols, but it is incomplete (without condition).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ On the simplex method, ES operates the symbol in solving solution completely and precisely.</td>
<td>✓ On the simplex method, MH operates the symbol in solving solution completely and precisely.</td>
</tr>
<tr>
<td>Verbal Representation</td>
<td>Students answer questions with explanations of</td>
<td>✓ On the graph method, ES writes down what is known, asked and solves the</td>
<td>✓ On the graph method, MH writes down what is known, asked and</td>
</tr>
</tbody>
</table>


Based on the above table, it can be concluded that (a) the female and male subject can present information into table representations in both the graphical and simplex methods; (b) The female and male subject make the graphical representation full and precisely; (c) the female subject writes symbol representations in complete and correct solution to the method of graph and simplex method, but the male subject doesn’t write subject in condition of problems; (d) on graphical methods and simplex methods of female and male subject solving the problem with complete written words.

Based on the above data, it can be concluded that in the table representation, female subject writes more complete and exact than male students. In graph representation, female subject writes more precisely than male subject. In the symbol representation, female subject operates the symbol in solving the problem more fully and accurately than the male subject. This is contrary to Fattah, Zawawi, and Midjan (2018: 133) who state that male students are more superior in using symbolic representation than female students. In verbal representation female subject more often use written words and language than male subject. This is consistent with Fuad (2016: 151) who state that female's verbal abilities are higher than male.

4. Conclusions
Based on the results above, it can be concluded that.
(a) the female subject can present information into the table representation in both the graphical and simplex methods, while the male subject does not present the information into the table representation on the graph method, and it is incomplete in writing the table representation on the simplex method; 
(b) The female subject makes graphical representation completely and precisely, whereas the male subject makes a mistake in making a graphical representation and determining the solution area; 
(c) the male and female subjects write symbol representations in the solution of the problem completely and precisely on the graph and simplex method, but in the simplex method male student is incomplete in her symbol representation; 
(d) on the graph method, the female subject solves problems with written words completely, while male subject is incomplete. While on the simplex method, the female subject solves the problem with written words and appropriate language, but the male subject does not write verbal representation.

5. References


Profile of Students’ Metacognitive Skills on Chemistry Subject in the XI Grade High School

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Abstract. One important aspect of chemical problem solving is metacognitive skills. This study aims to determine the metacognitive skills of students in the study of chemistry, especially the acid base titration material in science class. This research was conducted in SMA Muhammadiyah 4 Surabaya in the academic year 2017/2018. Data collection techniques used questionnaires for students and interview sheets for teachers. Interview results show that teachers have trained metacognitive skills in students. However, based on the results of the questionnaire it is known that students are still difficulties in understanding the problem, and determine the steps of completion. The students’ metacognitive skills that are still low and poorly trained. It is hoped that this research can be a reference to trained students’ metacognitive skills on chemistry subject.

Keywords: Metacognitive skills, problem solving, acid base titration material.

1. Introduction

Chemistry is a study of the nature of the compound and its accompanying changes. Chemistry is the largest and most knowledgeable science research that emerges from laboratory research. There are three levels in studying chemistry: observation, representation and interpretation. Observations relate to macroscopic events. Representation is an explanation of research conducted with symbols and chemical equations. Interpretation is a knowledge of atoms and molecules possessed by chemists to explain observed phenomena [1].

Chemistry is a subject that studies everything about matter. They include the composition, structure and properties, changes, dynamics and energetics of matter by involving skills and reasoning. Chemical learning in accordance with the 2013 curriculum emphasizes the application of scientific approaches and scientific process skills [2].

The scientific approach in chemistry learning can be applied by the steps of the scientific method. Meanwhile, science process skills are integrated in aspects of the scientific approach. Process skills need to be developed through direct experience as a learning experience [2]. Therefore, chemistry cannot be understood without any problem solving. The key to success in problem solving is practice [1].

One important aspect of chemical problem solving is metacognitive skills. Metacognition can be broadly defined as his own cognition or knowledge of his own way of thinking [3]. Metacognitive skills are indispensable for successful learning, given that metacognitive skills allow students to be able to manage their own cognitive abilities and be able to see their cognitive weaknesses so that improvement can be made in subsequent actions [4].

Improvement of metacognitive behavior in chemistry learning can be done by designing and arranging class activities in constructivist environment so that learning becomes meaningful [5]. Metacognition is also an important factor in problem solving. Metacognitive skills consisting of planning, monitoring, and evaluating, should be incorporated by the problem solving method [6].
Problem solving steps is effective in metacognition process in learning. The applied learning needs to be developed by emphasizing the flexibility of students to develop their thinking independently. Students are also expected to always practice solving problems in every step there metacognition process. The advantages to be gained when problem solving is done by involving awareness of the thinking process and self-regulatory ability, which enables a strong and comprehensive understanding of the problem with logical reasoning [7].

Students have different metacognitive characteristics. While the learning of teachers only provide a problem that is not a matter of solving the problem. Thus, students have less experience and skills in solving problems. Therefore, it is necessary to identify the characteristics and the metacognitive level of the students in solving the problem on chemistry subjects [8]. Therefore, the purpose of this study was to know the metacognitive skills of students in chemistry learning.

2. Methodology
This research was conducted in SMA Muhammadiyah 4 Surabaya in the academic year 2017/2018. The subjects were 32 randomly selected in XI science students and one chemistry teacher. Data collection techniques used questionnaires for students and interview sheets for teachers.

The questionnaire sheets and interview sheets used for the study contain questions about learning activities, metacognitive skills and problem solving learning models. On the questionnaire sheet there was also a problem about acid base titration material. This problem aims to know the metacognitive skills of students on chemistry subjects. The data obtained were analyzed descriptively.

3. Results and Discussion
The study was conducted in the even semester of the academic year 2017/2018, on acid base titration material. Material related to acid-base material, buffer solution, and salt hydrolysis. Before studying acid-base titration materials, students must understand the three materials. Here are the results of teacher interviews and student questionnaires conducted at SMA Muhammadiyah 4 Surabaya.

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Number of Questions</th>
<th>Aspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaires</td>
<td>25 questions</td>
<td>Learning, Problem solving, and</td>
</tr>
<tr>
<td>Interview sheets</td>
<td>17 questions</td>
<td>Metacognitive skills</td>
</tr>
</tbody>
</table>

3.1 Interview Results
The results of teacher interviews showed that materials salt hydrolysis, buffer solution, and acid-base titrations were have some difficulties for students. The students' difficulties with hydrolysis matter were differentiated strong and weak acids, strong and weak bases, if the molecular formula was mentioned, or Ka and Kb were unknown. The students' difficulties in buffer material materials were distinguished weak acid / base solutions from their salts, and if strong weak-base or weak strong base acids known, students have difficulties to distinguish between hydrolysis and buffer solutions. In acid-base titration materials students have difficulties read the titration curve. Students have difficulties because they are only fixated on the teacher's explanation. In addition, students' creativity is needed to improve concept understanding [9].

According to the teacher interview, students worksheets used in the current learning has been supportive of learning, especially with the exercise of questions. Based on the observation result, the student's students worksheets only contains the material summary, as well as the questions as contained in chemistry books. However, students worksheets that can support the learning of chemistry is students worksheets which contains theory, lab work and exercise questions. Learning methods that were equipped with students worksheets can increase student activity and learning achievement. Students worksheets help students understood lessons in chemical materials and improve students' learning spirit [10].
Teachers felt that they have metacognitive skills in students. Metacognitive skills are trained by the way teachers always convey the purpose of learning and check the achievement of learning objectives. Teachers also provide questions according to the students’ abilities. Teaches students to solve the problem coherently by making the settlement step and checking the step.

As per the above results, teachers must designed and structured learning in a constructivist environment to improved students’ metacognitive behavior and meaningful learning in chemistry. Class activities designed in a constructivist environment produce many advantages for students to demonstrate the behavior of planning, monitoring, and evaluation clearly. So that students' metacognitive skills will increase [5].

3.2 Questionnaire Results
The results of the questionnaire show that, the way of learning 31.375% of students simply listen to the explanation of the teacher, 34.375% underline the important concept, and 18.75% make a summary. 87.5% of students feel the way of learning used affects the success of studying chemistry. As many as 84.38% of students think that students worksheets used can help in learning, while 15.62% disagree. According to 60% of students, students worksheets is in accordance with the learning of chemistry that is students worksheets that can help students to gain knowledge with direct experience related to the concept learned.

In fact, students often have difficulty resolving questions that have moderate and high difficulty levels. When solving a problem, students only follow the steps given by the teacher so that in the application the questions often experience difficulties. In addition, student knowledge is only limited to what has been conveyed by the teacher [11].

This statement supported by the questionnaire results. 87.5% of students find it difficult to work out the questions on hydrolys materials, buffer and titration solutions. The cause were 46.88% students find it difficult to determine what steps should be done in working on the problem. A total of 18.75% of students found it difficult to evaluate the steps and outcomes, and 15.625% of students found it difficult to understand the words in the problem to solve the problem.

These results demonstrate metacognitive skills and problem solving abilities of students [12]. Activities that students can do to improve metacognitive skills and problem solving abilities are reading the title and subheadings, scanning the text to get an overview, activating prior knowledge, getting hold of test expectations, reading the problem statement, and establishing what is given and what is asked for [13]. It is known that, answering metacognitive questions results in benefits for students to reflect on their thinking and develop their metacognitive [5].

![Students Metacognitive Skills Chart](image)

Figure 1. Metacognitive skills results of 32 students
SMA Muhammadiyah 4 Surabaya

Based on the description above and accordance with Figure 1 which shows that, metacognitive skills of 47% of students are middle categorized, 31% of students are in the low category, and 22% of...
students are in very low categories. Students also answer about just write down the monitoring steps, while the planning and evaluating steps are not. These results suggest that students' learning methods are less effective, and the students metacognitive skills of poorly trained.

The results above were evidenced by students' answers to a metacognitive question. These metacognitive questions were included in the cognitive domain of C5 from revised Bloom Taxonomy. These questions included high order thinking, because higher order thinking includes critical, logical, reflective, metacognitive, and creative thinking [14]. If students can solve the problem, students become aware of their thinking processes [15].

Assessment of metacognitive skills is carried out according to the rubric with a score of 1-6, and the value of students' metacognitive skills is calculated by the following formula:

\[
Metacognitive\ skill\ score = \frac{\text{number\ of\ obtained\ score}}{\text{maximum\ score}} \times 100\%
\]  

The values obtained are interpreted into the categories of metacognitive skills according to Table 2 below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Percentage (%)</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 – 20</td>
<td>Very low</td>
</tr>
<tr>
<td>2</td>
<td>21 – 40</td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>41 – 60</td>
<td>Middle</td>
</tr>
<tr>
<td>4</td>
<td>61 - 80</td>
<td>Good</td>
</tr>
<tr>
<td>5</td>
<td>81 – 100</td>
<td>Very good</td>
</tr>
</tbody>
</table>

4. Conclusion

Metacognitive skills of 32 students were 47% of students are middle categorized, 31% of students are in the low category, and 22% of students are in very low categories. This was because students have difficulties in understand the problem, and determine the steps of completion. In addition, students' learning methods were less effective to train metacognitive skills. It is hoped that teachers can design and organize learning in a constructivist environment to improve students' metacognitive behavior and meaningful learning in chemistry.

References


83


[14] King, Goodson, and Rohani 2013 High Order Thinking Skills (The Center for Advancement of Learning and Assessment) p 7-117


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Improvement Of Mathematical Connections Using A Scientific Approach On Students Of Class X Vocational High School

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Abstract. This research aims to prove that scientific approach is better than the conventional to improve students mathematical connections abilities. Methods used qualitative design with control group pretest-postest. The population of the research are the students of 10th grade in all vocational high school in Sukoharjo, Jawa Tengah, Indonesia. The sample are students of 10th grade at SMK Pelayaran Pancasila. The instruments used in the form of a question of mathematical connections, ability test. The results of it that significance level α = 0.05 shows learning that scientific approach is better than conventional learning mathematical connection.

1. Introduction

National Council of Teachers of Mathematics (NCTM, 2000) mentioned that mathematics learning of students should be encouraged to have reasoning skill, connection skill, problem solving skill, communication skill, and representation skills [1]. Mathematics is a science with characteristics such as structured, hierarchical and systematic which means that concept and principles contained in it have interconnectedness to each other (Permana and Sumarmo, 2013) [2]. In learning a new concept, a student needs prior experience and knowledge related to a concept to discuss. Mousley (2004) stated that "making of connection" is an important activity for teacher and students if the mathematics learning is aimed at building a mathematical understanding [3]. If students are able to make connections between mathematical ideas, then they will have more profound and lasting understanding of mathematics (Wahyudin, 2008) [4]. Student with a good "connected knowing" will be more consistent in understanding a mathematical topic. Skill of mathematical connection is an ability to associate concepts, principles or procedures contained in mathematics with mathematics itself, with other fields of science as well as with everyday life (Sumarmo, 2013) [5].

Mathematics is a field of study with topics that are integrated to each other. Students with good mathematical connection skill are able to see a broad interaction between mathematics topics, so that they learn math more meaningfully. The most useful connection to improve mathematical skill of students is one that able to relate relevant concepts in the proper way (Killpatrick et al., 2001) [6]. After students have been able to observe correct relationship between concepts, principles or procedures and to provide arguments to explain it, they will gain a deeper understanding and also, increase their self-confidence. In general, an individual who learns always wants to acquire...
knowledge. Such knowledge may be scientific and unscientific knowledge. A scientific knowledge can only be acquired by using scientific method. A scientific method basically views special (unique) phenomena with a specific and detailed study and then, formulates a conclusion, so that reasoning is necessary in the searching (discovery). A method can be called scientific if the searching is based on the evidence of observable, empirical, and measurable objects with specific principles of reasoning. Therefore, a scientific method generally contains a series of data collection activity through observation and experiment, and then a hypothesis is formulated and tested. Therefore, for students to be more optimal in learning mathematics, they should be given opportunity to better understand and use these relationships.

The importance of developing mathematical connection skill of students has been not accompanied by reality. Some findings of researches indicated low skill of mathematical connections acquired by students. Ruspiani (2000) stated that achievement of mathematical connection skill of high school students was still inadequate, namely below 60% [7]. A research by Saminanto and Kartono (2015) also showed that average skill of mathematical connection among high school students was still low, namely only at 34% [8].

2. Theory

Process of learning by using mathematical connection skill is part of a learning process of mathematical thinking ability which can be interpreted as relationship between concepts of mathematics internally that is related to mathematics itself as well as external relationships that is mathematics with other fields, both other fields of study and daily life (Kusumah, 2008:19) [9]. In the present study, researcher takes indicators of mathematical connection as follow: problems of other fields relating to mathematical concepts, relationships between concepts or ideas in mathematics, application of mathematics in non-mathematics contexts (daily life problems), mathematical concepts underlying problem-solving procedures, and interconnected mathematical concepts. In addition to mathematical connection skill, students also need to use approaches in a learning process. In the present study, appropriate approach is scientific one.

This scientific approach requires main steps, namely observation, asking, gathering information, associating and communicating, stages in scientific approach as follow.

<table>
<thead>
<tr>
<th>No</th>
<th>Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>observed;</td>
</tr>
<tr>
<td>2</td>
<td>ask yourself;</td>
</tr>
<tr>
<td>3</td>
<td>collect information</td>
</tr>
<tr>
<td>4</td>
<td>associate</td>
</tr>
<tr>
<td>5</td>
<td>to communicate.</td>
</tr>
</tbody>
</table>

3. Method

Qualitative method of the present study is to explain effect of students with mathematical connection skill on their scientific approach. The study was conducted during first semester of 2017/2018 at SMK Pelayaran. Random sampling technique was used to select subjects based on category of mathematical connection skill of students in class XNA, XNB, XNC. Based on results of sampling, three subjects were obtained to represent each category of high, moderate and low mathematical connection skill. Subjects are given by tests to determine level of mathematical connection skill of each student. Subject 1 was symbolized with (S1) is class XNA, subject 2 with (S2) is class XNB, and subject 3 with (S3) is
class XNC. Table 1 presents a method of determining level of mathematical connection skill of students and scientific approach.

Table 2. Measuring the scale of mathematical connections skill

<table>
<thead>
<tr>
<th>No.</th>
<th>Interval</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>( x_i &gt; \bar{x} + 0.5s )</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>( \bar{x} - 0.5s \leq x_i \leq \bar{x} + 0.5s - s &lt; X &lt; \bar{X} + s )</td>
<td>Moderate</td>
</tr>
<tr>
<td>3</td>
<td>( x_i &lt; \bar{x} - 0.5sX \leq \bar{X} - s )</td>
<td>Low</td>
</tr>
</tbody>
</table>

Where:
- \( X_i \): Scores of mathematical connections of each student
- \( \bar{x} \): Interpersonal students score of intelligence of the sample
- \( s \): Standard deviation in sample

4. Results And Discussion

Category of mathematical connection skill derives from total value of measurement scale of mathematical connection. Based on the results, it has been found that Score \( x_i > 48 \) means a high mathematical connection, \( 40 \leq x_i \leq 40 \) is a moderate mathematical connection, and \( x_i < 40 \) is low mathematical connection. An open-type essay test was used in the study to measure mathematical connections of the students.

4.1 Respondents with high skill of mathematical connection

Based on analysis of answer data, it was found that respondents with category of high mathematical connection skill used scientific approach with good strategy in learning, namely by listening to music in doing activity, completing learning tasks by using their own ability without asking for help to others, to learn by using various sources such as books or the internet.

Respondents with high skill of mathematical connection had a targeted achievement during an academic year of study and what they had will fit the target. It will also always motivate them to keep getting the best of what they do. Thus, subjects with high learning attitudes are able to reflect

4.2 Respondents with moderate skill of mathematical connection

Based on analysis of answer data, it was obtained that respondents with category of moderate skill of mathematical connection used scientific approaches that can be applied in to complete tasks without help from others, and to learn by using more than one reference.

Respondents had confidence with results they obtained, but sometimes the results had not in accordance with their target. When there were differences of opinion with other subjects, self-regulated media learning can reveal what their beliefs, and complete the maximal task with their abilities.

They were independent of others. They believed in their own ability. They had consciousness in learning, but respondents had no belief that the current learning will have a positive impact on life change. The changes of learning outcomes were not important to them. Any results they obtained were not important because the most important for them was to learn.
4.3 Respondents with low skill of mathematical connection

Subjects with low skill of mathematical connection were always relying on others in learning activities. They can determine learning strategies applied, to learn under control of others, and had no other reference in learning, they got material from notes obtained as teacher provided explanations in class.

They depended on answers from others when they got a task because they did not have confidence in their own skill. Respondents with inferior confidence in learning often asked permission to leave the class for various reasons. They did not try to do a good learning plan. They did not focus on learning. In addition, they never changed their time of learning time.

5. Conclusion

Based on findings of studying mathematical connection skill, researcher can conclude that:

a. Most students of class X of SMK Pelayaran Pancasila Kartasura had an average mastery of 66.54 in category of low mathematical connections.

b. Most students of class X of SMK Pelayaran Pancasila Kartasura had an average of 67.37 in category of moderate mathematical connection.

c. Most students of class X of SMK Pelayaran Pancasila Kartasura had an average of 69.86 in category of high mathematical connection.

d. Students with high mastery in quadratic equations also had a high mathematical connection as well as vice versa for students with low mastery of low quadratic equations.

e. In solving a problem, precision is necessary in addition to mathematical connection. It affects process of finding a set of problem solving, if an error occurs in initial step, it will affect answer of the problem.

Reference


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Designing of Assessment on Learning Evaluation and Process Course Based on KKNI

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Abstract. This research is the second stage of development research (plump model), namely the prototyping stage which is limited to the designing stage. The purpose of this research is to design assessment that is based on KKNI in the process evaluation and learning outcomes subject. The designing of assessment which based on KKNI has the subject matters such as bebehaviour assessment and value system which are formed as behaviour observation which has the indicator such as: respect, work collaboration, responsibility and communication. The knowledge assessment here is by giving the task in the questions form. The psycho motor assessment here is by using the product. The designing was done by formulating the aspects or the indicators, arranging the clue of the instrument, and arranging the components that is contained in the instrument. The result of this designing is the prototype from the assessment which is based on KKNI and after that the validity was done.

1. Introduction

The course of process evaluation and learning outcomes have used mandatory learning resources in the form of guided invoices based on valid discovery and has been in accordance with the needs and characteristics of students, but the assessment used to measure the ability of students in accordance with the demands of the assessment based on KKNI has not been tested feasibility. It is therefore necessary to design an assessment appropriate to the lecture process using guided discovery-based handouts. Assessment of learning outcomes done to see the process and progress of student learning and students’ understanding of the material being studied. This assessment can be performed using appropriate assessment instruments in accordance with lecture activities. Assessment instruments are an integral part of the assessment process in learning. Assessment serves as a process assessment program, learning progress, and student learning outcomes. Assessment must be in accordance with the process of lecturing activities so that it can measure all attitudes, knowledge and skills of students during the lecture [1].

The problem that was found in the process evaluation and learning outcomes was the instruments that had been used as long as this way could not measure the behaviour and the value system perfectly, the knowledge and the psycho motor of the students that were appropriate with the learning process by using the handout which was based on guidance finding. This is suitable with the result of the interview with the lecturer who has taught the process evaluation and learning outcomes subject, namely the result that had been done as long as the learning, had measured behaviour and value system, knowledge and psycho motor of students but the instruments that had been used just focused toward the content validation by the lecturer who has taught that subject. Assessment is a process for making decisions based on measurement results, using a set of instruments and guided by the intended purpose [4]. The accuracy of the instruments used to measure students’ ability is very influential on
student learning outcomes. In accordance with the curriculum used STKIP PGRI West Sumatra is the KKNI-based curriculum. Therefore, the assessment should include an assessment of attitudes and values, knowledge and skills that use valid instruments. Therefore, it is necessary to design an assessment based on KKNI in the subject of process evaluation and learning outcomes, so that the lecturer can measure all attitudes, knowledge and skills of the students in the lecture by using guided discovery based handout. KKNI-based assessment is a competency-qualification skill that can match, integrate and integrate between education and job training and work experience in the framework of giving job competence recognition in accordance with the structure of employment in various sectors [2].

2. Methodology

This research is a research development with research method used is Plomp which consists of preliminary stage, phase prototype phase, and phase assessment phase [5]. This research is the second phase of plomp research that is prototype phase. At this stage designed prototype assessment based assessment of KKNI include assessment of attitudes and values, knowledge and skills in accordance with product specifications that have been planned. The KKNI-based assessment assessment procedure has several stages: 1) formulating the aspects or indicators of the instrument to be developed, 2) arranging the instrument grille and 3) arranging instrument items [3]. The design results are analyzed descriptively.

3. Result and Discussion

Assessment based on KKNI in the course the process evaluation and learning outcomes were designed with grading and attitude assessment instruments (Tables 1 and 2), grid and knowledge assessment instruments (Tables 3 and 4) as well as grid and skill assessment instruments (Table 5 and Table 6). The following is a snapshot of the KKNI-based assessment prototype that was designed.

Grid and Instrument Assessment of Attitudes and Values

| Institution | STKIP PGRI West Sumatera |
| Department | Biology Education |
| Courses | Process Evaluation and Learning Outcomes |
| Code/SKS | BIO 010024/3 SKS |
| Semester | Genap 2017/2018 |

Table 1. Design Grid Assessment Attitudes and values

<table>
<thead>
<tr>
<th>Achievement of Program</th>
<th>Learning Outcomes</th>
<th>Indicator</th>
<th>Description</th>
<th>An Acquisition Score</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bersponsibility on the work itself and can be given responsibility for the achievement of the work of the organization</td>
<td>1. Reserving cultural diversity, views, religion and beliefs as well as the opinions or original findings of others</td>
<td>1. Appreciate</td>
<td>1. Pay attention to the friend presenting the results of the group discussion 2. Responding / asking questions 3. accept opinions or criticism and friend suggestions 4. pay attention to the lecturer giving affirmation</td>
<td>4 : if it meets 4 descriptors 3 : if it meets 3 descriptors 2 : if it meets 2 descriptors 1 : if it meets 1 descriptors</td>
<td>The appreciative indicator is done during the presentation process of the discussion result and the affirmation of the material by the lecturer</td>
</tr>
<tr>
<td>2. Able to work together in teams, peers, communities and</td>
<td>2. Working together and having social sensitivity and</td>
<td>2. Cooperate</td>
<td>1. Involved in group discussion activities by giving</td>
<td>4 : if it meets 4 descriptors 3 : if it meets 3 descriptors 2 :if it meets 2 descriptors</td>
<td>Indicators work together during group</td>
</tr>
<tr>
<td>Multicultural Environments</td>
<td>Caring for Others</td>
<td>An Argument</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------</td>
<td>-------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Demonstrate a responsible attitude towards the tasks assigned to the students independently.</td>
<td>3. Responsible</td>
<td>1. Reading the literature (Handout)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Answer questions given through literature studies (handout)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Summing up answers to questions based on literature study results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Create a group discussion report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Demonstrate a responsible attitude towards the tasks assigned to the students independently.</td>
<td>4. Communication</td>
<td>1. Present results discussion in accordance with the purpose of learning objectives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. The discussion results are relevant to the theory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Master the material in the presentation of the results of the discussion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Use good language in complaining, receiving and responding to questions / suggestions from other groups</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discussion Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: if it meets 1 descriptors</td>
</tr>
<tr>
<td>2: if it meets 2 descriptors</td>
</tr>
<tr>
<td>3: if it meets 3 descriptors</td>
</tr>
<tr>
<td>4: if it meets 4 descriptors</td>
</tr>
</tbody>
</table>

Instrument Assessment of Attitude

Institution: STKIP PGRI West Sumatera
Department: Biology Education
Courses: Process Evaluation and Learning Outcomes
Code/SKS: BIO 010024/3 SKS
Semester: Genap 2017/2018
The grading of attitudes and values assessment (Table 1) is a guideline used by lecturers in conducting assessments of student attitudes and values during the process of lecturing and facilitating the preparation of instruments. Facilitate the preparation of instruments, then used the instrument grille [6]. There are 4 attitudes observed that are respect, cooperation, responsibility, and communication. Each aspect of attitudes and values has four descriptors to be observed. If the students meet all the descriptors then given a score of 4, if it meets three descriptor then given a score of 3, if it meets two descriptor then given a score of 2, if it meets one descriptor then given a score 1. It is designed so that the measurement of attitudes and student values can be done whole. The writing of an instrument statement is based on a grid that has been created. For the measurement scale used likert scale 1-4.

### Grid and Instrument Knowledge Assessment

#### Lattice of Knowledge Assessment

| Institution : STKIP PGRI West Sumatera |
| Department : Biology Education |
| Courses : Process Evaluation and Learning Outcomes |
| Code/SKS : BIO 010024/3 SKS |
| Semester : Genap 2017/2018 |

#### Table 3. Grades of Knowledge Assessment One Outcome of Learning

<table>
<thead>
<tr>
<th>Course Achievement</th>
<th>Learning Outcomes Course</th>
<th>Indicator Question</th>
<th>Question Number</th>
<th>Level Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Understand and design the assessment of learning outcomes in the implementation of the evaluation</td>
<td>9. Understanding and designing lattice matter</td>
<td>44. Students are able to explain the meaning of lattice matter</td>
<td>58</td>
<td>C1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45. Students are able to explain the function of lattice matter</td>
<td>59</td>
<td>C2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>46. Students are able to explain the terms of the lattice matter</td>
<td>60</td>
<td>C2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>47. Students are able to explain the lattice component of the problem</td>
<td>61</td>
<td>C2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48. Students are able to explain the steps of preparing the lattice problem</td>
<td>62</td>
<td>C4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>49. Students are able to design the preparation of lattice problem</td>
<td>63</td>
<td>C3</td>
</tr>
</tbody>
</table>

#### Knowledge Assessment Instrument

| Institution : STKIP PGRI West Sumatera |
| Department : Biology Education |
| Courses : Process Evaluation and Learning Outcomes |
| Code/SKS : BIO 010024/3 SKS |
| Semester : Genap 2017/2018 |

#### Table 4. Instrument Knowledge Assessment One Learning Achievement

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Question</th>
<th>Answer</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>59</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>60</td>
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<td></td>
<td></td>
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<tr>
<td>61</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 3 is a grid of knowledge appraisal that lecturers use as a guide in designing questions to measure students’ knowledge ability in understanding the material they have learned. Thereafter, a problem corresponding to the grid of question (Table 4) was made.

**Grille and Skill Assessment Instruments**

<table>
<thead>
<tr>
<th>Skill Assessment Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institution: STKIP PGRI West Sumatera</td>
</tr>
<tr>
<td>Department: Biology Education</td>
</tr>
<tr>
<td>Courses: Process Evaluation and Learning Outcomes</td>
</tr>
<tr>
<td>Code/SKS: BIO 010024/3 SKS</td>
</tr>
<tr>
<td>Semester: Genap 2017/2018</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Achievement</th>
<th>Learning Outcomes Course</th>
<th>Aspects of the assessment</th>
<th>Descriptor</th>
<th>Acquisition Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Understand and design the assessment of learning outcomes in the implementation of the evaluation</td>
<td>9. Understanding and designing lattice matter</td>
<td>The result of the lattice plan design</td>
<td>1. According to Lattice Component matter. 2. Indicator questions in accordance with indicators of achievement of competence 3. Questions in accordance with the indicator matter 4. One indicator of at least 3 questions</td>
<td>4 : if it meets 4 descriptors 3 : if it meets 3 descriptors 2 : if it meets 2 descriptors 1 : if it meets 1 descriptors</td>
</tr>
</tbody>
</table>

**Table 5. Grid Assessment Skills One Achievement of Learning**

<table>
<thead>
<tr>
<th>NO</th>
<th>NIM</th>
<th>Name</th>
<th>Aspect of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Design Results of Question Problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Table 5 is a grading skill grid and based on the prepared grid of the skills assessment instrument (table 6). The designed instrument is one example of the 9th learning achievement on the lattice sub topic. The assessment aspect is the result of the lattice design made by the students. This is a student skill in designing a lattice problem after studying the soup of the topic. The description of the aspects assessed is 1) in accordance with the components of the lattice problem, 2) the indicator of the problem in accordance with the attainment of competence achievement, 3) the problem in accordance with the indicator questions and 4) an indicator of at least 3 questions.

4. **Conclusion**

Assessment design based on KKNI in process evaluation and learning outcomes courses on attitudes and values assessment in the form of attitude observation. Knowledge assessment in the form of a description and skill assessment in the form of products.
5. Acknowledgments
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References
The prototypes of mathematical knowledge for teaching based on teacher’s conceptual on quadrilateral

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Abstract. Mathematical knowledge for teaching is part of knowledge that mathematics teachers must possess. This article aimed to describe the prototype of mathematical knowledge for teaching based on teachers’ conceptual (MKT-C) on quadrilaterals. This study used descriptive qualitative method. The subject of the research was a mathematics teacher of SMP class VII. Data were obtained using vignette that had been validated by the expert. The result showed that the teacher’s MKT-C prototype on quadrilateral was not yet ideal. Because the findings indicated that prototype of CCK-C was a quadrilateral category: false and true (incomplete), whereas CCK-C classification was quadrilateral: false. Prototype of SCK-C was a quadrilateral category: false and true (incomplete) while SCK-C was quadrilateral classification: incomplete and complete. KMH-C prototype quadrilateral categories: did not know and complete, KMH-C quadrilateral classification: not found. Mathematical Knowledge for teaching based on teacher’s conceptual needed to get serious attention because it had not led to an ideal outcome. To achieve the mathematical knowledge for teaching based on the ideal conceptual, the main process was required through teachers individually because knowledge was strongly influenced by existing schemes and beliefs owned by teachers. This research can be used as a model for the development of professional teachers.

1. Introduction

Mathematical knowledge for teaching (MKT) is very important for teachers [1,2,3,4,5]. Teachers who have mathematical knowledge to teach will be able to answer students’ questions about the meaning behind symbol manipulation, explain why certain procedures (algorithms) can or cannot be used, and be able to explain the relationship between the concepts [4]. On the other hand, teachers who lack understanding concept tend to emphasize facts, rules (formula), and procedures. The opinion implies that teachers are required to have knowledge of the material content to be taught and the knowledge of how the material or topics are organized, represented, adapted to the interests and learners’ ability to be presented in learning. Therefore, teachers are expected to combine mathematical content knowledge that is taught and knowledge on how to teach it. Teachers require knowledge of the subject matter which consists of an understanding of how to represent a particular material topic in an appropriate way for students [3].

Teachers’ knowledge for teaching practice is suggested by [1,7]. It is divided into three different categories of content namely: subject matter content knowledge (SMCK), pedagogical content knowledge (PCK), and curriculum knowledge (CK). In Figure 1, it appears that MKT is divided into two main domains, subject material knowledge and pedagogical content knowledge. A strong matter content knowledge is indispensable as a foundation for teachers to teach. MKT domain subject matter knowledge includes common content knowledge (CCK), specialized content knowledge (SCK) and knowledge at the mathematical horizon (KMH) [1]. The geometry materials selected in this study included quadrilateral category and classification.
At this time there are a lot of researches on MKT. [6] explains that Figure 1 developed [1] is more detailed than other frameworks, and it provides meaningful guidance. However, there are some problems in categorization [1] that have not been fully reviewed. [6,7] suggest that, is it not possible to accommodate a combination of knowledge content with other knowledge? This study focused on domain subject matter knowledge developed by [1] based conceptual. Based on the results, conceptual knowledge is a very important component in mathematics because conceptual knowledge involves an understanding between concepts and principles including the existing scheme in concept [8,9]. Conceptual knowledge is knowledge related to classification and category [10]. In this study, MKT and conceptual knowledge integrated is known as MKT knowledge based on conceptual (MKT-C).

A previous research has revealed teacher’s content knowledge in generalizing quadrilateral concept maps. Therefore, the purpose of this study was to describe the prototype of mathematical knowledge for teaching based on teachers’ conceptual on quadrilateral.

2. Method

1.1. Participants and Setting

This case study was conducted in the academic year 2017/2018 in Southeast Sulawesi, Indonesia. School sampling was done by purposive sampling technique. Three subjects were taken representing and having various characteristics, either sex, level, or teaching experience. The first subject was teaching at SMP 16 Baubau, male, middle-school teacher, 20 years of service and passing certification 2011. The second subject was teaching in MTs Baubau, female, young teacher, 9 years working period, passing certification in 2015. The third subject was teaching at SMP 2 Lakudo, female, young teacher, 11 years of service and passing certification in 2014.

1.2. Data Collection

Vignette method was used for data collection. Vignette given to teachers was prepared by the researcher according to the components of CCK-C, SCK-C and KMH-C. Before being used, vignette was validated by three experts and correction was made. Table 1 shows a vignette consisting of three questions and time to work on a maximum of 90 minutes.

<table>
<thead>
<tr>
<th>Vignettes MKT-C to quadrilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCK-C</td>
</tr>
<tr>
<td>1. In learning a quadrilateral material, you, as a junior high school mathematics teacher, teach about convex quadrilateral elements. At the end of the lesson, you assign the task to measuring the level of understanding of the students that you teach about the characteristics of parallelogram, rectangle, rhombus, square, trapezoid and kite based on quadrilateral elements.</td>
</tr>
<tr>
<td>a. According to your knowledge, write down the elements of a quadrilateral!</td>
</tr>
<tr>
<td>b. Write down the characteristics of parallelogram, rectangle, rhombus, square, trapezoid, and kite!</td>
</tr>
</tbody>
</table>
c. Make a classification based on the side elements depicting a quadrilateral relationship in part (b) above!

**SCK-C**

2. You, a junior high school mathematics teacher in Baubau City, teach quadrilateral. Convex quadrilateral here includes: parallelogram, rectangle, rhombus, square, trapezoid, and kite.
   a. Write a quadrilateral definition according to your knowledge!
   b. According to your knowledge, write the definition of parallelogram, rectangle, rhombus, square, trapezoid, and kite!
   c. Make a classification that describes the relationship among parallelogram, rectangle, rhombus, square, trapezoid, and kite!

**KMH-C**

3. From the reference books picture geometry structures can be found as below.

   ![A](image1) ![B](image2) ![C](image3) ![D](image4)

   a. Check each image above, which one is quadrilateral? Give your reason!
   b. Do you know convex quadrilateral?
   c. Do you know concave quadrilateral?
   d. Explain the difference between convex quadrilateral and concave quadrilateral!
   e. Make a classification that describes the relationship of convex quadrilateral in general!

1.3. Data Analysis

Content analysis is used to analyze the data obtained in the study. Data analysis is done in three stages. The first stage, data reduction is analyzing the answers given by the teacher including: attributes, necessary terms and sufficient requirements [6,11]. The second stage is the analysis of category and classification. Category includes the economical definition: stating necessary conditions and sufficient requirements with minimal encoded cₐᵣ; true: stating necessary conditions and sufficient requirements encoded cₐᵣ; and false: improperly declares the good nature of some or all of the attributes; stating the necessary conditions but does not state sufficient conditions encoded cₐₜ. The third stage, is interpretation of categorization and classification results.

3. Result and Discussion

The findings in this survey were illustrated by the subjects P1, P2 and P3. The description of CCK-C, SCK-C and KMH-C on P1, P2 and P3 on quadrilateral category and classification are presented below. Table 2 shows that on the CCK-C sub domain two types of categories were found respectively, called cₐₜ-wrong category by P2 and P3. The two subjects did not correctly write the quadrilateral elements (sides, angles, diagonals, and vertex). While the cₐᵣ-category true was not written completely by P1 (did not write the vertex). In contrast to the previous CCK-C sub domain, in SCK-C two categories were obtained, each named the cₐₜ-wrong category by P1 and P3. The two subjects presented an unqualified statement of necessary and sufficient terms of a quadrilateral definition. For subject P2, cₐᵣ-category true was incomplete. Definition of quadrilateral is a simple closed curve consisting of four line segments. Sub domain KMH-C generated two types of categories cₐₜ-category: did not know by P1 and P3, and category cₐₜ-complete category by P2.

<table>
<thead>
<tr>
<th>Table 2. Answer of MKT-C category</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKT-C</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>CCK-C</td>
</tr>
</tbody>
</table>

a. Quadrilateral elements are plane figures that have angles, sides, diagonals, dot.
I. a. Quadrilateral elements are:
- having 4 sides.
- mempunyai 4 sudut kecuali layang-layang - having 4 angles except kites.

a) Quadrangle Elements are:
- having four sides
- having four angles

The definition of a quadrilateral is a polygon which has four sides and four angles. A quadrangle is a basic form in geometry that is the most popular.

In my opinion, a quadrangle is a plane figure that has 4 sides.

A quadrangle is a plane figure that has four sides and four angles.

A quadrilateral is convex if each line segment connecting the two dots in the inner quadrangle is completely contained in the quadrangle.

Table 3 shows that on SCK-C sub domain: the definition of parallelogram, rectangle, rhombus, square, trapezoid and kite was generally found in two categories, category.ca - wrong category by P1 and category.ca - true category incomplete by P2 and P3.

Table 3. Definition of parallelogram, rectangle, rhombus, square, trapezoid and kite

<table>
<thead>
<tr>
<th>Subject</th>
<th>Definition</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td></td>
<td>ca_w</td>
</tr>
<tr>
<td>P2</td>
<td>b. The definition of parallelogram is a two-dimensional plane shape formed by two pairs of edges, each of which is equal in length and parallel to the pair and it has two pairs of angles which are equal to the angle in front of each.</td>
<td>ca_w</td>
</tr>
<tr>
<td>P3</td>
<td>c. The definition of rectangle is a two-dimensional plane figure formed by two pairs of edges, each of which is equal in length and parallel to the pair and it has four angles, all of which are right angles</td>
<td></td>
</tr>
</tbody>
</table>

Table 3 shows that on SCK-C sub domain: the definition of parallelogram, rectangle, rhombus, square, trapezoid and kite was generally found in two categories, category.ca - wrong category by P1 and category.ca - true category incomplete by P2 and P3.
d. The definition of rhombus is a two-dimensional plane figure formed by four edges that are equal in length and have two pairs of angles instead of right angles, each of which is equal to the angle in front of it.

e. The definition of square is a two-dimensional plane figure formed by four edges that are equal in length and have four angles, all of which are right angles. This figure was formerly called *bujur sangkar*.

f. The definition of trapezoid is a two-dimensional plane figure formed by four edges, two of which are parallel but not equal in length. A trapezoid whose third edge is perpendicular to parallel edges is called right-angled trapezoid.

g. The definition of kite is a two-dimensional plane figure formed by two pairs of edges, each of which is the same length and it forms kite angles with all four edges that are the same length that is called rhombus.

b. Parallelogram is a plane figure which has corresponding, parallel and equal lengths sides.

c. Rectangle is a parallelogram which has right angles.

d. Rhombus is a parallelogram that all sides are the same length.

e. Square is a rhombus in which each angle is right angle.

f. Trapezoid is a quadrangle that has a pair of parallel sides.

g. Kite is two isosceles triangles with two bases that are same length and coincide.
b. Parallelogram is a plane figure which has two pairs of sides that are parallel to each other and the parallel sides have the same length, the corresponding angles are the same size.

c. Rectangle is a plane figure that has two pairs of parallel and the same length sides and all angles are $90^\circ$.

d. Rhombus is a plane figure that has four sides of equal length and corresponding angles that have the same size and have two diagonals.

e. Square is a plane figure that has four equal length sides and all angles are $90^\circ$.

f. Trapezoid is a plane figure that has corresponding angles and they are not the same length.

g. Kite is a plane figure that has two pairs of equal length sides and the number of corresponding angles = $180^\circ$.

Table 4 shows that the type of CCK-C teacher classification of quadrilateral was called the wrong hierarchical ch$_{w}$-classification by all subjects. Subjects could not construct relationship by side or angle appropriately. The SCK-C classification of teachers was found two, each named ch$_{c}$-incomplete hierarchical classification by P1 and P3, while P2 was in ch$_{c}$-complete hierarchical classification. Classification was closely related to the definition. Due to the definition of parallelogram, rectangle, square, rhombus, trapezoid and kite resulted in a quadrilateral classification. The classification type on KMH-C sub domain was not found because P1, P2, P3 did not answer.

Table 4. Answer of CCK-C classification

<table>
<thead>
<tr>
<th>MKT-C</th>
<th>CCK-C Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td></td>
</tr>
<tr>
<td>P2</td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td></td>
</tr>
</tbody>
</table>
Table 5 shows the teacher’s MKT-C prototype in the quadrilateral category and classification. Teacher's prototype sub domain CCK-C in quadrilateral was into false category and true category (incomplete), as well as hierarchical (wrong) classification. Teacher’s Prototype sub domain SCK-C in quadrilateral was classified as false category and true (incomplete) category, as well as true hierarchical (incomplete) and hierarchical (complete) hierarchical classification. Teacher’s prototype sub domain KMH-C in the quadrilateral was classified as false category (do not know) and true category (complete), as well as partitions (do not know) classification.

Table 5. Prototype MKT-C on quadrilateral

<table>
<thead>
<tr>
<th>MKT-C</th>
<th>CCK-C Classification</th>
<th>True</th>
</tr>
</thead>
<tbody>
<tr>
<td>MKT-C</td>
<td>False</td>
<td>True</td>
</tr>
<tr>
<td>CCK-C</td>
<td>do not know</td>
<td>yes</td>
</tr>
<tr>
<td>SCK-C</td>
<td>do not know</td>
<td>yes</td>
</tr>
</tbody>
</table>

From the results it has been pointed out that teacher’s MKT-C in quadrilateral is not ideal and needs serious attention. Sub domain CCK-C, SCK-C and KMH-C are still problematic in the category.
of elements, definition and quadrilateral types. Similarly, the classification of elements, the definition and type of quadrilateral also need to be developed by teachers [12,13].

The characteristics of parallelogram, rectangle, rhombus, square, trapezoid and kite can be written completely enough by the teachers. However, the quadrilateral element which is the basic material for introducing a quadrilateral is still the teacher's problem [14]. Similarly, classification based on side elements is also a problem.

The quadrilateral definition presented by the teacher indicates that the teacher does not have knowledge of the necessary terms and sufficient terms in the definition. This results in the teacher being wrong and defining quadrilateral incompletely [15,16]. The same thing is also experienced by teachers in defining parallelogram, rectangular, rhombic, square, trapezoidal and kite [15,16]. For rectangular classification, although the teacher's answer is incomplete, the teacher has been able to arrange the classification hierarchically.

4. Conclusion

Teacher MKT on quadrilateral aspects of category material can appear in four prototypes, namely: (a) correct - complete; (b) true - incomplete; (c) wrong; and don't know. Furthermore, teacher MKT on the classification aspect can appear in four prototypes, namely: (a) hierarchical - complete; (b) hierarchical - incomplete; (hierarchical wrong; and don't know. Knowledge relating to advanced mathematical is also a problem for teachers. So far, teachers only know the common quadrilateral picture in textbooks or convex quadrilateral. Rarely or even never learnt and introduce unusual quadrilateral pictures or concave quadrilateral. Thus, it is found that teachers do not recognize the picture or definition of convex and concave quadrilateral. Similarly, in making the classification of quadrilateral by convex and concave type, teachers cannot solve the problem. Based on this condition, then to obtain the ideal results teachers still need a process. The process is not instant because it is influenced by several factors such as schemes and beliefs that already owned by the teachers.

This knowledge will always evolve with interaction with mathematical teaching. This is certainly influenced by teaching experience. Teachers’ MKT-C in the category of elements, definitions and types of quadrilateral are still dominated by mistakes. Similarly, some teachers still do not know the classification of elements, definitions and types of quadrilateral. Teachers still have the opportunity to develop their knowledge both independently and collectively based on their motivation and beliefs.

References

[2] Chick L 2003 Pre-Service Teachers’ Explanation of Two Mathematical Concepts Australian Association for Research in Education


[16] Turnuklu E, Akkas E N and Gundogdu F 2012 Eighth Congress of European Research In Mathematics Education (CERME 8)
Validity of Student Activity Sheet Based on 4C with CORE Learning Model on Students

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Abstract. Currently one of the teaching materials used in the learning process, namely the student activity sheet (LKPD) has not been able to develop all the competencies possessed by students optimally, thereby causing the average score of daily test is low, especially on the material of the Nervous System in Human. It is necessary to develop LKPD that can develop all the competencies possessed by the students optimally, so that the average value of student's daily repetition can be increased, that is by developing LKPD based on 4C skills (which consists of critical thinking and problem solving, communication, creativity and innovation, collaboration) with CORE learning model. This study aims to produce a LKPD based on 4C with CORE learning model that is valid to improve student learning outcomes in SMA. The research was conducted in SMA Negeri 18 Surabaya in grade XI IPA students. In the development of this student activity sheet also developed other learning tools needed, which include syllabus, learning implementation plan (RPP), and test instrument. This research used 4D development model. Validity test data obtained from the validation by three validators by using the validity test sheet instrument. Result of validity test about LKPD based on 4C with CORE learning model and learning sets as a whole get valid and very valid category. Based on the result of validity analysis, it is concluded that LKPD based on 4C with CORE learning model developed valid and can be used to improve student learning outcomes in SMA.

1. Introduction
Currently, the current curriculum of the Curriculum 2013 requires that the learning process be emphasized on all aspect of knowledge, skill, attitude, literacy skill, and mastery of technology. Aspect of skills is that includes critical thinking and problem solving, communication, creativity and innovation, collaboration (4C) is one of the goals in the learning process that must be owned by students (Nea, 2012). Based on the results of observation and interview that have been done in one of the school, namely in SMA Negeri 18 Surabaya to the process of learning Biology in students of class XI IPA, showed that the average value of daily test of students, especially material on the nervous system in human is still low. This is because student find it difficult to understand the material is abstract, so students are difficult to understand the structure and work processes of the nervous system that occurs in the body. In the learning process is also known that one of the means of learning that is used students activity sheet (LKPD), it has not been able to actively involve students in the learning process. LKPD is also not able to training and develop all the competencies possessed by students optimally both from aspect of knowledge, skill, and also the attitude of students. This causes students to be passive in the learning process, the circumstances that cause students have not been able to process and develop all the competencies it has, and resulted in the average value of daily test is low.

Based on the problems that have been proposed, need an effort or solution to handle the problems that have been proposed, it is necessary existence of development of LKPD which can training and develop all competence possessed by students actively, and can be used as teaching material to assist students in understanding material of the Nervous System in Human, so that students learning outcomes can be increased. Prastowo (2012), explained that LKPD has several function, namely as teaching materials that can minimize the role of educators and more activate the role of students, as teaching materials that make it easier for students to understand the material given, as a
Based on one of the learning objectives in the Curriculum 2013 which requires students to have aspects of skills critical thinking and problem solving, communication, creativity and innovation, collaboration (4C). 4C skills are chosen as a reference in developing LKPD in this research. In order for the development of LKPD based on 4C skills can be well conceived, it is necessary to have an appropriate learning model and in accordance with the 4C skills. One of the learning model that match the 4C skills is Connecting, Organizing, Reflecting, Extending (CORE) learning model. Relawati and Nurasi (2016), explained that the CORE learning model is an innovative learning model that can develop all the competencies possessed by students in the learning process. Thus, the CORE learning model not only focuses on the development of students knowledge but also on other aspects such as students' skill and attitude. The 4C skills aim to enable students to actively construct all their abilities (knowledge, skill, and attitude) through their active involvement in the learning process. So hopefully through this 4C skills students can learn and understand the subject matter easily. In its application, 4C skills with CORE learning model have relevance and equation, that is reviewed based on the purpose of its application, 4C skills and learning model CORE aims for students to play an active role in the learning process to direct and guide students to build and develop all the competencies it has to be able to understand a subject matter easily, so the final goal is expected in the learning process, ie students learning outcomes can increase or become better than ever (Azizah, 2012). Based on the description of the problems that have been described, then developed LKPD based on 4C with CORE learning model on material of the Nervous System in Human for grade XI students in SMA.

2. Research Methods
This type of research is a research development by following the flow of thinking Thiagarajan, Sivasailam, Dorothy, S. Semmel & Melvyn, I (1974) by using 4D model (four D model). This study aims to develop a LKPD based on 4C with CORE learning model to improve student learning outcomes in SMA. In the development of LKPD is also developed other learning tools that are needed, which includes syllabus, lesson plan (RPP), and test instrument. In this research LKPD development stage and learning tools required using 4D model development consisting of four stages, namely define, design, develop, and disseminate (Ibrahim, 2002). In this study, the results of the research were not disseminated to other schools (other than research sites), so this study only carried out three stages, namely the define, design, and develop.

The defining stage aims to set and define the requirements required in the lesson. This stage consists of needs analysis, student analysis, task analysis, concept analysis, and the formulation of learning objectives. The design stage aims to prepare and design LKPD prototype and learning tools to be developed. The steps undertaken at this design stage include: preparation of tests, media selection, and preliminary design. While at the development stage aims to produce the initial design LKPD and learning tools developed. Development stage consists of validation phase and LKPD test phase and learning tools developed. Validation aims to determine the validity of LKPD and learning tools before being applied in the learning process in the classroom. LKPD and learning tools that have been created are validated by qualified experts validators in their fields for advice and feedback. Advice and feedback from validators is used to revise LKPD and learning tools that have been developed. LKPD and learning tools that have been validated further revised so as to obtain LKPD and learning tools that are valid and can be used in the process of learning in the classroom, namely the students of class XI IPA in SMA Negeri 18 Surabaya.

3. Results and Discussion
Validity test data from LKPD based on 4C with CORE learning model and learning tools developed were obtained from validation by three validators who reviewed and assessed LKPD and learning tools developed from content, format, and language aspects used validity test sheet instrument consisting of on the instrument of validity test of syllabus, learning implementation plan (RPP), LKPD, and test instrument. LKPD based on 4C with CORE learning model and learning tools that have been declared valid can then be used in the learning process. The following outlines the results of
validation LKPD based on 4C with CORE learning model and learning tools developed. The result of validation syllabus is described in Table 1, the result of validation RPP are described in Table 2, the result of validation LKPD are described in Table 3, and the result of validation test instrument are described in Table 4 below.

Table 1
The Results of Validation Syllabus

<table>
<thead>
<tr>
<th>No</th>
<th>Aspects of Assessment</th>
<th>Validator Assessment</th>
<th>x Value of Validation</th>
<th>C (%)</th>
<th>R (%)</th>
<th>C</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>The identity of the syllabus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a. Contains education unit, subjects, class, semester,</td>
<td>4 3 4</td>
<td>3.6</td>
<td>Very valid</td>
<td>86</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>subject matter, and time allocation.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>b. Core Competencies (KI) is written in accordance to</td>
<td>4 4 4</td>
<td>4</td>
<td>Very valid</td>
<td>100</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>the Curriculum 2013.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>c. Basic Competence (KD) ini accordance to the</td>
<td>4 4 4</td>
<td>4</td>
<td>Very valid</td>
<td>100</td>
<td>R</td>
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<tr>
<td></td>
<td>Curriculum 2013.</td>
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<td>2.</td>
<td>Indicator</td>
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</tr>
<tr>
<td></td>
<td>a. Indicator are formulated in accordance with Basic</td>
<td>3 3 4</td>
<td>3.3</td>
<td>Valid</td>
<td>86</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>Competence (KD).</td>
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<tr>
<td></td>
<td>b. Indicator are formulated with clearly defined and</td>
<td>3 3 4</td>
<td>3.3</td>
<td>Valid</td>
<td>86</td>
<td>R</td>
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<tr>
<td></td>
<td>operational.</td>
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<tr>
<td>3.</td>
<td>Learning materials</td>
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</tr>
<tr>
<td></td>
<td>a. Learning materials refer to Basic Competence (KD).</td>
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<td>3.6</td>
<td>Very valid</td>
<td>86</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>b. Depth of the material in accordance with the level</td>
<td>4 4 4</td>
<td>4</td>
<td>Very valid</td>
<td>100</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>of student development.</td>
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<td>4.</td>
<td>Learning activities</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>a. The learning strategy used is appropriate.</td>
<td>4 3 3</td>
<td>3.3</td>
<td>Valid</td>
<td>86</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>b. Suitability of learning activities with indicator.</td>
<td>3 4 4</td>
<td>3.6</td>
<td>Very valid</td>
<td>86</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>c. Suitability of learning activities with the material</td>
<td>4 4 4</td>
<td>4</td>
<td>Very valid</td>
<td>100</td>
<td>R</td>
</tr>
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<td></td>
<td>nervous system in human.</td>
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<tr>
<td></td>
<td>d. Learning activities developed based on 4C.</td>
<td>3 3 4</td>
<td>3.3</td>
<td>Valid</td>
<td>86</td>
<td>R</td>
</tr>
<tr>
<td>5.</td>
<td>Time allocation</td>
<td></td>
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<tr>
<td></td>
<td>Suitability of the time allocation used with the</td>
<td>4 3 4</td>
<td>3.6</td>
<td>Very valid</td>
<td>86</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>indicator to be achieved.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Assessment</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Determination of the strategy and the scoring form is</td>
<td>4 4 3</td>
<td>3.6</td>
<td>Very valid</td>
<td>86</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>clearly written in accordance with the indicator.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Learning resources</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Learning resources are written complete and in</td>
<td>4 4 4</td>
<td>4</td>
<td>Very valid</td>
<td>100</td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>accordance with the learning activities to achieve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>indicator.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Information:

C = Category
R (%) = Percentage of agreement
R = Reliable
x = Average value.

---

Table 2
The Results of Validation RPP

<table>
<thead>
<tr>
<th>No</th>
<th>Aspects of Assessment</th>
<th>Validator Assessment</th>
<th>x Value of Validation</th>
<th>C (%)</th>
<th>R (%)</th>
<th>C</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<td>2</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Format

<table>
<thead>
<tr>
<th>No.</th>
<th>Aspects of Assessment</th>
<th>Validator Assessment</th>
<th>Value of Validation</th>
<th>C</th>
<th>R (%)</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a. The numbering system used is appropriate.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Setting the appropriate paper margins.</td>
<td>4 4 3 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. The type and font size used accordance.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Space used in accordance.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Content

<table>
<thead>
<tr>
<th>No.</th>
<th>Aspects of Assessment</th>
<th>Validator Assessment</th>
<th>Value of Validation</th>
<th>C</th>
<th>R (%)</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a. Identity is written complete and correct.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. Write down Core Competencies (Kl).</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Write down Basic Competence (KD).</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Write down the indicator.</td>
<td>4 3 4 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. Write down the learning objectives.</td>
<td>3 4 4 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>f. The accuracy of the indicator with KD.</td>
<td>3 3 4 3.3</td>
<td>Valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>g. The accuracy of the indicator with learning objectives.</td>
<td>3 3 4 3.3</td>
<td>Valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>h. The truth of the content/subject matter in accordance with the basic competence in Curriculum 2013.</td>
<td>4 3 4 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. Write down learning strategies that include methods and learning model.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>j. Learning activities are written clearly and using the operational verbs, so easily implemented in the learning process in the classroom.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>k. 4C based learning steps using the CORE learning model.</td>
<td>4 3 4 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>l. The suitability of the subject matter sequence.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>m. The suitability of time allocation used.</td>
<td>4 3 4 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>n. Write the source, tools/ materials, and media used.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o. Write down the assessment technique.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p. Feasibility as a LKPD based on 4C with CORE learning model in high school students.</td>
<td>4 3 4 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. Language

<table>
<thead>
<tr>
<th>No.</th>
<th>Aspects of Assessment</th>
<th>Validator Assessment</th>
<th>Value of Validation</th>
<th>C</th>
<th>R (%)</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a. The truth of grammar.</td>
<td>4 4 3 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. The truth sentence structure.</td>
<td>4 4 3 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. The language used is easy to understand.</td>
<td>4 4 3 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. The language used is communicative.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Information:
- C = Category
- R (%) = Percentage of agreement
- R = Reliable
- \( \bar{x} \) = Average value.

Table 3
The Results of Validation LKPD

<table>
<thead>
<tr>
<th>No.</th>
<th>Aspects of Assessment</th>
<th>Validator Assessment</th>
<th>Value of Validation</th>
<th>C</th>
<th>R (%)</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>a. The type and font size used in accordance.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b. The numbering system used is clear and appropriate.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c. Setting space/layout accordance.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d. Suitability of the physical size LKPD with students.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e. Write down the learning objectives.</td>
<td>3 4 4 3.6</td>
<td>Very valid 86</td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continuation of the table 3

<table>
<thead>
<tr>
<th>No.</th>
<th>Aspects of Assessment</th>
<th>Validator Assessment</th>
<th>Value of Validation</th>
<th>C</th>
<th>R (%)</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>f. Clarity division of the material on each LKPD.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>g. It has appeal.</td>
<td>4 4 4 4</td>
<td>Very valid 100</td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Language
Based on the results of validation syllabus in Table 1, the results of validation RPP in Table 2, the results of validation LKPD in Table 3, and the results of validation test instrument in Table 4 are known that the LKPD based on 4C with CORE learning model and the learning tools developed generally obtained a score of 3 to 4. This shows that the score of validation results obtained 3 to 4 has valid and very valid categories (Ratumanan and Laurens, 2011). Revita (2017), stated that a valid learning tools indicates that the learning tools has been in accordance with the aspects of assessment and can be implemented in the learning process. Percentage of agreement obtained on the percentage of matching assessment of three validators against LKPD based on 4C with CORE learning model and learning tool developed that is 86% to 100%. This suggests that the LKPD based on 4C with CORE learning model and learning tool has a reliable category, since it obtains a percentage of agreement value of ≥ 75% (Borich, 1994). Miller, et al (2009), stated that a learning tools is reliably expressed as
a consistent learning device for obtaining the same results if used in subsequent learning. Based on the validation results that have been done on the LKPD based on 4C with CORE learning model and learning tools developed there are some suggestions from the validator, namely the validation RPP validator provides suggestions for some sentence writing needs to be adjusted again with a good spelling and correct. While the validation results LKPD validator provides suggestions to add time allocation to the discussion activities and some information on the image should be more clarified. Based on the validation results indicate that LKPD based on 4C with CORE learning model and learning tools developed can be used with little revision in the learning process.

4. Conclusion
Based on the result of the validity test that has been done on LKPD based on 4C with CORE learning model and learning tools that developed overall get score of 3 to 4 with valid and very valid value category. Based on the result of validity analysis, it is concluded that LKPD based on 4C with CORE learning model developed can be valid used to improve student learning outcomes of XI IPA grade in SMA.

5. Acknowledgments
The author wishing to acknowledge the help of various parties who have been involved in this research. Acknowledgments are submitted to validators who have been willing to validate LKPD based on 4C with CORE learning model and learning tools that have been developed and all teaching staff and students of grade XI IPA in SMA Negeri 18 Surabaya who have assisted the author in conducting the research.

References
Misconception of Basic Algebraic Concept of Junior High School

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Abstract. Basic algebraic concept that must be understood by the students, one of them was number and numerical operation. Wrong understanding of basic concepts can lead to misconceptions in students. This research aims to describe students’ misconception of junior high school on the basic algebraic concept, namely the concept of fractional operations. This research was qualitative descriptive research using diagnostic test method and interview. There were three students as subjects in this research, who were identified to have the most numerous and varied misconceptions among students in the class. The results showed the subjects of research misconception on the basic algebraic concept, namely the concept of fractional operations. The part of the misconception experienced by the subject occurs in the concept of addition of fractions with fractions and integers with fractions, subtraction of fractions with fractions and integers with fractions, multiplication of fractions with fractions, division of fractions with fractions, integers with fractions and improper fractions with integers. The suggestions for this research were the teachers should recognize misconceptions to minimize misconceptions, the factors that cause misconceptions and alternatives to overcome misconceptions experienced by students.

1. Introduction

Mathematics learning in schools is inseparable from the construction of the concept of students [1]. Algebra is one of the competencies in mathematics that must be mastered by students from elementary school to high school and even college. Algebra is considered a "gatekeeper" in mathematics learning [2, 3, 4, 5]. Algebra can help students in understanding other mathematical materials [6, 7, 8, 9] and other lessons [6, 7, 8].

In understanding algebra, it is necessary to understand the basic algebraic concept which is the concept of algebraic prerequisite. There are nine algebraic prerequisite concepts (1) numbers and numerical operations, (2) ratios and proportions, (3) the order of operations, (4) equality, (5) patterning, (6) algebraic symbolism and letter usage, (7) algebraic equations, (8) functions, and (9) graphing [10]. The concept of number operations has begun to be taught in primary school and is a major prerequisite in understanding the concept of algebra in the next stage.

The students’ understanding of algebra is still low. Based on data from the 2005 National Assessment of Educational Progress (NAEP), only 6.9% of 17-year-old American students are above the average in algebra [3]. In addition, 61% of students in Pennsylvania in 2011 scored below the mean in algebra, 64% of students were less proficient in California’s final algebra exams 2014 and 30% of students in Michigan in 2008 failed in algebra [4]. Students in South Africa are also lacking in algebraic competencies [6], so a global understanding of student algebra concepts is lacking. The lack of understanding of the concept of algebra can be a barrier for students in learning mathematics [7, 11].

The lack of understanding of student concepts in algebra can lead to misconceptions. Misconceptions are wrong ideas or views that a person has toward a concept that is different from the concepts agreed upon by experts [3, 12, 13, 14, 15]. Misconception is an idea of a concept that deviates from the general opinion agreed upon by scientists. Misconception in algebra is still widely experienced by students. For example, misconceptions by high school students and college students in Navrongo, Ghana in understanding the form \( \frac{1}{2} - \frac{3}{2x} \) as \( \frac{1-3}{2} \) [16]. High school students in Kenya
simplify the expression $\frac{a+x}{b+x}$ as $\frac{a}{b}$ and understand about $\frac{1}{3x} + \frac{2}{x}$ as $7x$ [17]. Misconceptions are also done by Junior High School 2 Kebumen students who understand the form of $\frac{1}{y}$ as $y$ [18]. These findings indicate that students have not mastered the basic algebraic concept, one of which is the concept of fractional operations.

The misconceptions of fractional operations are still widely found in students, such as research conducted by [19] of 4332 students from 114 SMA in Edo (State of Nigeria). A total of 20.4% of students misconceptions in the concept of division of integers with fractions and 44.5% of students misconception in the concept of addition of fractions. In addition, students are still experiencing misconceptions of fractional subtraction operations, i.e. $\frac{2}{5} - \frac{1}{2} = \frac{2}{3}$. The student operates the numerator by means of $3 - 1$ yields 2 and operates the denominator by means of $5 - 2$ yields 3 [20]. 33% of grade XI students in Brunei Darussalam understand the $2\frac{1}{4}$ form as $2 + 4 + 1 = 7$, thus solving the problem $2\frac{1}{4} \div 6 = 7 \div 6 = 1 \frac{1}{6}$, and 25% students think $6 + 1$ as opposed to 6 so as to solve the problem $2\frac{1}{4} \div 6 = \frac{2 \times 6}{4 \times 1} = \frac{27}{2} = 13 \frac{1}{2}$ [21]. Research conducted by [22] to 23 5th graders in one primary school in Bandung, West Java found as many as 73.91% of students experiencing misconception in the concept of addition of fractions with the same denominator, 73.91% of students experiencing misconception in the concept of addition of fraction with the different denominator, 26.09% of students experiencing misconception in the concept of subtraction of fraction with the same denominator, as many as 91.87% of students experiencing misconception in the concept of subtraction of fraction with the different denominator.

Based on the above description, we need to know the misconception of the basic algebra concept, namely the concept of fractional operation experienced by junior high school students so that this research aims to describe the misconception of the basic algebraic concept, namely the concept of fractional operation experienced by junior high school students. This information is expected to be utilized by teachers to improve the quality of learning and used as a reference for other researchers.

2. Method
This research was a qualitative descriptive research. This research was conducted on students of SMP 1 Koba, selected the students of VIIIA class of the SMP 1 Koba. This class consists of 32 students, chosen purposively from six available classes. All students had completed a diagnostic test. Three students were chosen based on the most numerous and varied misconceptions among students in the class are subjected to the study. The semi-structured interview was selected to reveal misconception that experienced by students. The diagnostic test given is a test of the concept of fractional operations. The diagnostic test provided consisted of 10 questions. Table 1 below shows the possible misconceptions that occur in students on the concept of fractional operations.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Possible Misconceptions that Occur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition and subtraction of</td>
<td>1. Adds the numerator with the numerator and the denominator with the denominator (without first</td>
</tr>
<tr>
<td>fractions</td>
<td>equating the two denominators).</td>
</tr>
<tr>
<td></td>
<td>2. Could not find the least common multiple.</td>
</tr>
<tr>
<td></td>
<td>3. Finding least common multiple from different denominations but after finding the least common</td>
</tr>
<tr>
<td></td>
<td>multiple does not change the fractions into an equivalent form.</td>
</tr>
<tr>
<td></td>
<td>4. Wrong in turning the fractions into an equivalent form.</td>
</tr>
<tr>
<td></td>
<td>5. Incorrectly change the whole number to the $\frac{a}{b}$ form when adding the whole numbers with</td>
</tr>
<tr>
<td></td>
<td>fractions.</td>
</tr>
<tr>
<td>Multiplication of</td>
<td>1. Multiply the fractions incorrectly by multiplying cross (as in proportion).</td>
</tr>
<tr>
<td></td>
<td>2. Equate the denominator just as in addition and subtraction of fractions.</td>
</tr>
</tbody>
</table>
3. Multiply the fractions by finding the opposite of the multiplier first.

<table>
<thead>
<tr>
<th>Division of fractions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Incorrectly change the whole number to the ( \frac{a}{b} ) form when dividing the whole numbers with fractions.</td>
</tr>
<tr>
<td>2. Divide fractions incorrectly by dividing the numerator with the numerator and then dividing the denominator with the denominator.</td>
</tr>
<tr>
<td>3. Understand to change the division operation into multiplication, but forgot to reverse the second fraction.</td>
</tr>
<tr>
<td>4. Understanding that the result of the division of the whole number with the fraction of one numerator is the division of the whole number with the denominator of the fraction.</td>
</tr>
<tr>
<td>5. Understand that the answer to the division operation should be smaller.</td>
</tr>
<tr>
<td>6. Incorrectly change improper fraction into ( \frac{a}{b} ) form when dividing the improper fraction with the whole number.</td>
</tr>
</tbody>
</table>

3. Results

Based on the diagnostic test answers followed by 32 students, three students were chosen perform the most numerous and varied misconception as research subjects. Selected students were given initials S1, S2 and S3.

1.4. Misconception made by S1

The misconceptions made by S1 can be seen in Figure 1.

![Figure 1. The Answer of S1 in Diagnostic Test](image)

Snippets of interview results of researchers (Q) with the first student (S1).

Q: Please explain how you solved number 1 problem?
S1: This is the addition of the fractions so just add up. \( 7 + 3 = 10, 12 + 8 = 20 \). So the answer is \( \frac{10}{20} \).

Q: Now that's number 2, how do you solve it?
S1: Because the subtraction of the fraction is reduced immediately. \( 5 - 4 = 1, 12 - 15 = -3 \). So \( -\frac{1}{3} \).

Q: How did you solve number 3?
S1: I turn 8 into a fraction. Since the denominator of the second fraction is 5, the denominator for the first fraction is also 5, ie \( \frac{8}{5} \). So \( \frac{8}{5} - \frac{3}{5} = \frac{5}{5} = 1 \).

Q: How did you solve number 5?
S1: Directly divided, \( 2 \div 1 = 2, 3 \div 6 = 2 \). So the answer is \( \frac{2}{2} \) equals 1.

Q: Number 6 problem, how do you solve it?
S1: Since the division of integers with fractions whose numerator is 1 then the way directly divides the integer number with the denominator of the fraction yields $\frac{3}{4}$.

Q: Next, how do you solve number 7 problem?
S1: $2\frac{2}{4}$ is changed into a fraction, ie $\frac{2\times 4 + 1}{4} = \frac{9}{4}$. So $\frac{9}{4} \div \frac{6}{1} = \frac{9 \div 6}{4 + 1}$. I am confused $9 \div 6$ result how many. The answer to that point is $\frac{9 + 6}{4 + 1}$.

Q: Number 10 problem, how do you solve it?
S1: Same as number 3, I change $\frac{2}{5}$ to fraction. The denominator of the second fraction is 5, then the denominator for the first fraction is also 5, ie $\frac{2}{5}$. So, $\frac{2}{5} + \frac{1}{5} = \frac{3}{5}$.

Based on Figure 1 and interview results it can be said that S1 still does not understand the addition and subtraction of fractions. S1 adds the numerator with the numerator, ie $7 + 3 = 10$ and adds the denominator with the denominator, ie $12 + 8 = 20$ without equating both denominators and turning the fractions into equivalent forms. S1 subtracts the numerator with the numerator, ie $5 - 4 = 1$ and subtracts the denominator with the denominator, ie $12 - 15 = -3$ without equating both denominators and turning the fractions into equivalent forms. S1 still does not understand subtraction of integers with fractions. S1 knows to change integer $8$ into $\frac{a}{b}$ form, but it is wrong to change the integer into $\frac{a}{b}$ form. S1 thinks the denominator for the first fraction equals the second number, ie $5$ so that the first fraction becomes $\frac{8}{5}$. Since the denominator is the same, S1 directly subtracts the numerator with the numerator and the denominator with the denominator obtained $\frac{5}{5} = 1$. S1 also experienced misconception division of fractions with fractions. S1 directly divides the numerator with the numerator, ie $2 \div 2 = 1$ and divides the denominator with the denominator, ie $3 \div 6 = 2$. S1 is wrong in dividing $3$ by $6$, ie $2$. In addition, S1 also experienced misconception division of integers with fractional numbers. S1 directly divide the integer, ie $3$ with the denominator fractions, ie $4$ without changing integer $3$ into $\frac{a}{b}$ form because the students understand the numerator of the fraction is $1$ so that the students directly divide $3$ by $4$. S2 correct in changing the improper fraction into a fraction, ie $\frac{1}{4} = \frac{2 \times 4 + 1}{4} = \frac{9}{4}$. S2 continues to divide the numerator with the numerator and denominator with the denominator, ie $\frac{9}{4} \div \frac{6}{1} = \frac{9 \div 6}{4 + 1}$. S2's confused about how many results from $9 \div 6$ so that assuming $\frac{9 \div 6}{4 + 1}$ is the final result of the problem $2 \frac{1}{4} \div 6$. S2 does not understand the addition of integers with fractions. S2 knows to change $2$ into $\frac{a}{b}$ form but is wrong in changing it. S2 thinks the denominator for the first fraction equals the second number, ie $5$ so that the first fraction becomes $\frac{2}{5}$. Since the denominator is the same, S2 directly subtracts the numerator with the numerator and the denominator with the denominator, obtained $\frac{2}{5} + \frac{1}{5} = \frac{2 + 1}{5} = \frac{3}{5}$.
1.5. Misconceptions made by S2

The misconceptions made by S2 can be seen in Figure 2.

Figure 2. The Answer of S2 in Diagnostic Test

Snippets of interview result of researcher (Q) with second student (S2).

Q : How did you solve number 3?
S2 : First change 8 to $\frac{8}{8}$. Thus, $\frac{8}{8} - \frac{3}{5} = \frac{40-24}{40} = \frac{16}{40}$
Q : Now for question number 4. How?
S2 : First the second fraction is reversed. The opposite of $\frac{1}{4}$ is $\frac{4}{1}$, so $\frac{1}{2} \times \frac{4}{1} = \frac{4}{2} = 2$.
Q : Please explain how you solve number 5 problem?
S2 : I solve it directly divided only. $2 ÷ 1 = 2$, $3 ÷ 6 = 2$. So the answer is $\frac{2}{2}$.
Q : Number 6 problem, how do you solve it?
S2 : Directly divided only $\frac{3+1}{4} = \frac{3}{4}$. The result is $\frac{3}{4}$.
Q : How did you solve number 7 problem?
S2 : The improper fractional is changed into a fraction, ie $\frac{2\times4+1}{4} = \frac{9}{4}$, so the result is $\frac{9}{4} ÷ 6$.
Q : How did you solve number 10?
S2 : I first change 2 to $\frac{2}{2}$. Thus, $\frac{2}{2} + \frac{1}{5} = \frac{10+2}{10} = \frac{12}{10}$. The answer is $\frac{12}{10}$.

Based on Figure 2 and the interview result it can be said that S2 still does not understand the subtraction of integers with fractions. S2 knows to change 8 into $\frac{a}{b}$ form but is wrong in changing it. S2 change 8 to $\frac{8}{8}$. S2 correct in equating both denominators and turning the fractions into equivalent forms but incorrect in change 8 into $\frac{a}{b}$ form. Since the denominator is not the same, S2 equates the denominator to 40 and then change the fraction to an equivalent form, obtained $\frac{8}{8} - \frac{3}{5} = \frac{40-24}{40} = \frac{16}{40}$.

S2 also has not understood the multiplication of fractions. S2 looks for the inverse of the multiplier, ie finding the opposite of $\frac{1}{4}$ is $\frac{4}{1}$. Multiplication of fractions is done by multiplying the numerator with the numerator and the denominator with the denominator, obtained $\frac{1}{2} \times \frac{4}{1} = \frac{4}{2} = 2$. S2 still does not understand the division of fractions. S2 divides fractions such as dividing integers, dividing the numerator with the numerator, ie $2 ÷ 1 = 2$ and dividing the denominator with the denominator, ie $3 ÷ 6 = 2$ without changing the division operation into multiplication and looking for the inverse of the second fraction. S2 student is still wrong in dividing the integer, which is wrong in dividing the denominator, ie $3 ÷ 6 = 2$. In addition, S2 also experienced misconception division of integers with fractional numbers. S2 directly divide the integer, ie 3 with the denominator fractions, ie $\frac{4}{1}$ without changing integer 3 into $\frac{a}{b}$ form because the students understand the numerator of the fraction is 1 so that the students directly divide 3 by 4. S2 correct in changing the improper fraction into a fraction, ie
\[
\frac{2\frac{1}{4}}{4} = \frac{2\times4+1}{4} = \frac{9}{4}.
\]
S2 does not continue to solve the problem and considers \(\frac{9}{4} \div 6\) is the final answer to the problem \(2\frac{1}{4} \div 6\). S2 still does not understand the addition of integers with fractions. S2 knows to change 2 into \(\frac{b}{b}\) form but is wrong in changing it. S2 change 2 to \(\frac{2}{2}\). Since the denominator is not the same, S2 equates the denominator to 10 and then change the fraction to an equivalent form, obtained \(\frac{2}{2} + \frac{1}{5} = \frac{10+2}{10} = \frac{12}{10}\).

1.6. Misconceptions made by S3
The misconceptions made by S3 can be seen in Figure 3.

![Snippets of interview result of researcher (Q) with third student (S3).](image)

**Figure 3.** The Answer of S3 in Diagnostic Test

Snippets of interview result of researcher (Q) with third student (S3).

Q : Now for question number 4. How?
S3 : I solved it by looking for least common multiple from both denominators. Least common multiple of 2 and 4 is 4. Then I change the fraction into equivalent form obtained \(\frac{2}{4} \times \frac{1}{4}\) yielding \(\frac{2}{4}\).

Q : How did you solve number 5 about dividing fractions?
S3 : Because of that fractional division, I changed the division operation into multiplication \(\frac{2}{3} \times \frac{1}{6}\) obtained \(\frac{2\times1}{3\times6} = \frac{2}{18}\).

Q : How did you solve it number 6?
S3 : Firstly change the division operation into multiplication. So the answer is \(3 \times \frac{1}{4} = \frac{3}{4}\).

Q : How did you solve this number 7 problem?
S3 : I change the improper fraction into a fraction first, ie \(\frac{2+4+1}{4} = \frac{7\times1}{4\times1} = \frac{42}{4}\).

Based on Figure 3 and the results of interviews can be said S3 still do not understand the multiplication of fractions. S3 multiply fractions such as adding and subtracting fractions, ie looking for least common multiple from both denominators, 2 and 4 obtained 4, then changing fractions into equivalent forms obtained \(\frac{2}{4} \times \frac{1}{4}\) yielding \(\frac{2}{4}\). S3 also has not understood the division of fractions. In this case, S3 has correctly thought that in dividing the fractions first it must change the division operation into multiplication but S3 does not seek the opposite of the second fraction, like \(\frac{2}{3} \times \frac{1}{6}\), obtained \(\frac{2\times1}{3\times6} = \frac{2}{18}\). S3 also has not understood the division of integers with fractional numbers. S3 has correctly thought that in dividing the fractions first it must change the division operation into multiplication but S3 does not seek the opposite of the second fraction, like \(3 \times \frac{1}{4}\), obtained \(\frac{3}{4}\). The S3 student is wrong in
changing the improper fraction into a fraction. S3 adds all the numbers of 2, 4 and 1 to the numerator fraction, ie $\frac{2+4+1}{4} = \frac{7}{4}$.

4. Discussion

In the journal, the misconception of the basic algebraic concept, namely the concept of fractional numbers by students is discussed and there are expert opinions that support each of the conceptual misconceptions discussed. First, the misconception on the division of integers with fractional numbers comes from the thought that the numerator of the fraction is 1 so that the student instantly divides the integer, ie 3 with the denominator of the fraction, ie 4, obtained $\frac{3}{4}$. Students think that if the divisor is a fraction with numerator 1, integers can be divided by the numerator of divisor [19]. Misconceptions division of fractions by fractions dividing the numerator with the numerator and then dividing the denominator with the denominator [23].

Second, the misconception of the student in adding the numerator with the numerator and the denominator with the denominator and subtracting the numerator with the numerator and the denominator with the denominator derives from the student’s belief that adding and subtracting the fractional numbers is equal to add integers [24]. Students do not look for the least common multiple from the denominator and do not change the fraction to an equivalent form first.

Third, the student misconception on the multiplication of fractions comes from the idea that multiplying fractions is equal to adding and subtracting fractions [24, 25] and looking for the inverse of the multiplier first [26]. Students solve the problem $\frac{7}{12} + \frac{3}{8} = \frac{10}{20}$ and $\frac{5}{12} - \frac{4}{15} = \frac{1}{3}$. Students search the least common multiple from both fractions first and changing fractions into equivalent forms as adding and subtracting fractions.

5. Conclusion

Based on the results of the research, it can be concluded that S1 performs misconceptions: the students added up and subtracted the fractions with fractions whose had different denominator with adding and subtracting the numerator with the numerator and the denominator with the denominator or did not turn the fraction into equivalent forms, the students were wrong in changing the whole number into a fractions when adding and subtracting integers with fractions, the students divide the numerator with the numerator and the denominator with the denominator when divided fractions and the students understood that the result of the division of the whole number with fractions whose one numerator was the division of the whole number with the denominator of the fraction. S2 performs misconceptions: the students were wrong in changing the whole number into a fractions when adding and subtracting integers and fractions, the students multiplied fractions by finding the opposite of the multiplier first and the students divide the numerator with the numerator and the denominator with the denominator when divided fractions. S2 only changes improper fractions into the fractions and does not continue to solve the problem when divided improper fractions with the integers. Furthermore, S3 performs misconceptions: the students multiplied fractions as fractions adding and subtracting concept. Firstly, the student equated the denominator of both fractions and turned the fractions into equivalent form then multiplied the fractions, the students understood to multiply the fractions when divided the fractions but did not search the opposite of the second fraction and the students were wrong in changing improper fractions into the fractions when divided improper fractions with the integers and not looking for the opposite of the second number.
6. Suggestions
In this research, there are some misconceptions of the basic algebraic concept, namely the concept of fractional numbers experienced by students. Some suggestions put forward by researchers in the journal are: (1) Teachers should recognize the misconceptions in algebra and try to find the cause of the misconceptions, (2) the teacher needs to take action that can help in examining and identifying misconceptions of students, (3) teachers need to develop conceptual change teaching strategies in mathematics, and (4) teachers provide opportunities for students to actively participate in solving mathematical problems and link new concepts to existing student knowledge or make connections with the environment.

References


The Effectiveness of Guided Inquiry Model to Improve the Scientific Process Skills of High School Students

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Abstract. Guided Inquiry Model is a learning model that stimulates students to find problems or questions, where the topic or learning material has been determined by the teacher. This study aims to analyze the effectiveness of guided inquiry model to improve the science process skills of high school students. This research is pre-experiment with research design using pre-test and post-test design that is tested to 30 high school students, which is divided into two groups. Prior to the learning with the guided inquiry model the students were given a test of science process skill and after the student’s learning were re-given the same test. Data were analyzed using paired t-test and n-gain. The results showed that: there was a significant improve the science process skills in terms of $\alpha=5\%$, the average of n-gain was $0.72\%$ and was not different in both groups. Thus, the guided inquiry model can effectively improve the science process skills of High School students.

1. Introduction

Physical learning is closely related to scientific work, it is appropriate for teachers to apply inquiry learning models. For teacher-specific materials it is necessary to free the students to develop their curiosity and provide the students with an opportunity to find their own answers to their curiosity rather than allowing students to want to know. Growing a sense of curiosity and student skills in finding the answers to these questions, teachers need to guide the students first before students are able to perform scientific work steps.

Inquiry is derived from the word "to inquiry" to ask which means to particScienScie ete or engage, in asking questions, seeking information, and conducting an investigation. The demand model is a model that emphasizes the search process or discovery information. Through inquiry, students can think systematically, logically, and critically. Students can develop abilities as part of mental processes [1]. In addition, according to Bruner (Elliot et al., 1996) in [1], inquiry learning allows students to become active in seeking knowledge increase the meaning of what they learn. Thus the students can find more of themselves or in the form of group solve the problem. In addition to the selection of learning models, things to note in the learning is the selection of learning media. Learning nowadays many who use information and communication technology or often called ICT (Information Technology and Communication). The use of information and communication technology becomes an effective and efficient way to convey information. A virtual experiment can be done using simple programs to embed and generate concepts in students to solve problems faced by students. One of the virtual labs that provide
interactive interaction is interactive PhET. The guided inquiry model (stimulates students to find problems or questions, where the topic or learning material has been determined by the teacher) using PhET is expected to attract students to learn physics and make it easier for students to understand the concept of physics.

Observations in MAN 3 Bojonegoro can be described that, not yet the availability of learning devices Physics-based scientific approach, the implementation of learning Physics only emphasizes the understanding of concepts, mastery of theory, and discussion of problems. The teacher's salon also gives less opportunity to the students to develop the skill of science process through experimentation process; this is because the unavailability of Student Activity Sheet (LKS) to trace the skill of science process of students and school that could not perform practice is influenced by several factors. Factors affecting the school could not carry out the lab because of the lack of equipment used to carry out practicum and operational costs, so that the condition of teachers are required to find other alternatives in order to continue to implement the process of practicing to skill the skill of science process, one of the alternatives is by using a virtual laboratory.

Virtual learning can be done using interactive simulations PhET (Physics Education Technology) is an experimental simulation developed by University Of Colorado. The advantages of using PhET interactive simulation is to replace the actual laboratory and expected to help students to have better understanding towards the concept of Physics, since the learning process involved some simulations and make students more interested in doing the experiments.

The purpose of this research is the effectiveness of Physical guided inquiry-based physics based learning to trained students' science process skills in MAN 3 Bojonegoro.

2. Experimental Method
This research uses quantitative and qualitative descriptive research. Descriptive research is intended to collect information about a matter based on existing facts [2], thus, it aims to describe a phenomenon. In this research, improvement of students' science process skill through inquiry model on the subject of material elasticity is measured. The research trial was conducted on 15 students in class XI SCIENCE1 and 15 students in class XI SCIENCE2 in MAN 3 Bojonegoro, odd semester of academic year 2017/2018. The design uses one group pre test-post test design test as it uses one group without any comparison group. Device test was performed to see the suitability of learning and student characteristics. This design is written as follows [3]:

![Figure 1. The design of one group pre test-post test design](image)

Description: $U_1$: Pre test; $U_2$: Post test; $L$: Learning using the Inquiry learning model.

In this research, data collection method is used to obtain relevant and accurate data, and can be used appropriately according to research objectives. Data collection methods used in this study is science process skills test, include: 1) Pre-test 2) Post-test

3. Result and discussion
Pre test and post test results of the science process skills are analyzed by qualitative descriptive analysis by calculating the average pre test and post test values, the mean value of pre test and post test are used to calculate the normalized N-gain score. Normalized N-gain scores were used to determine the category of students' science skill skills between before and after learning using inquiry learning models. The average
N-gain score obtained by the XI Science1 class is 0.61 – 0.87 in medium to high category [4]. The average score of N-gain class XI SCIENCE2 is 0.63 – 0.86 in medium to high category [4]. Both classes had moderate-to-high N-gain scores because at the time of the study both classes were very active and enthusiastic in learning. Based on the value of N-gain, there is an increase in the science process skills in class XI Science1 and XI Science 2. The result of science process skill test in class XI SCIENCE1 and XI SCIENCE2 can be seen in Table 3.1.

<table>
<thead>
<tr>
<th>Group</th>
<th>Students’ Guided Inquiry Model to Improve the Scientific Process Skills of High School Students</th>
<th>pre-test</th>
<th>post-test</th>
<th>N-gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>XI SCIENCE 1</td>
<td>Low</td>
<td>31.31</td>
<td>81.85</td>
<td>0.73</td>
</tr>
<tr>
<td>XI SCIENCE 2</td>
<td>Low</td>
<td>28.67</td>
<td>79.78</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Improvement of science process skills in both classes is due to the use of inquiry learning model as a vehicle to help students practice the science process skills. The improvement of these science process skills via inquiry learning model is also reported by [5]. It is concluded that the implementation of guided inquiry learning model can improve the junior high school students’ science process skills in Nigeria. At the stage of formulating problem, formulating hypotheses, identifying variables, designing experiments, conducting experiments, analyzing data, and making conclusions, teachers grouped students into learning groups. This grouping made students more active and courageous in expressing their opinions. This is in accordance with the social constructivism theory of Vignosky stating that students learn through interaction with more capable adults and peers. One of the stages that made students very enthusiastic in learning is doing experiment because the physics teachers never had experiments only monotonous learning. Monotonous learning is in contrast to the modern psychology saying "If teachers want to teach children to get fish, do not give the fish, simply give them the hook.” This metaphor actually has the meaning that the student must be self active and the teacher only gives a reference or tool [6]. Therefore, the task of educators is to guide, direct, motivate, and provide conditions in such a way that students can develop talent and potential. According to Piaget, children think when he does something. Without action means the child is not thinking [6]. This is in a line with [7] who states that “Inquiry process which makes knowledge explored by using different group of skills is very important. These skills are known as science process skills. These skills are not only important for scientist but also it is important to be applied in developing and designing learning in the classroom where the inquiry is focused on learning”. According to [8], science process skill involves cognitive or intellectual skills, psychometric skill as well as social skill. Cognitive skill is applied when students use their thinking, while psychometric skill is involved during students using instruments, doing measurement and setting up the instruments. Social skill is performed during students communicating and sharing their ideas to others in learning process. Moreover, the use of inquiry model can improve students’ science process skill in formulating problem and hypothesis, defining research variable, interpreting data, as well as making conclusion.

The result of normality test, homogeneity test, and paired t-test is shown in Table 3.2.

| Table 3.2. Result of normality test, homogeneity test, and paired t-test |
The results of normality test using Shapiro Wilk test is shown in Table 3.2. Based on testing hypothesis the results showed that $H_0$ and $H_1$, $\text{sig} > \alpha$ then $H_0$ is accepted, it means that the data came from normally distributed population. It means that the condition of the sample taken is similar to the actual population.

Based on hypothesis test of $H_0$ and $H_1$, $\text{sig} > \alpha$ then $H_0$ is accepted, it means the data comes from homogeneous population variance. It shows that all students have the same knowledge ability at the beginning of learning. The result of paired t test is shown in Table 3.2. Based on testing hypothesis $H_0$ and $H_1$, $\text{sig} < \alpha$ then $H_0$ is rejected or $t_{\text{table}} < t_{\text{count}}$, then $H_0$ is rejected, meaning that there is significant difference in pre test result and post test result [9]. It shows inquiry model affect the increasing significance of students’ science process life skill.

### 4. Conclusion

Based on the results of research that has been done, it can be concluded that guided inquiry learning model using PhET is to trill the skills for students in MAN3 Bojonegoro in finding challenge and its effectiveness to improve their skills. This was proven by the improvement of process skills with N-gain class XI SCIENCE1 with 0.73 in high category and also class XI SCIENCE2 with 0.72 in high category.

### 5. Acknowledgments

We deeply thank our supervisor for the time, thoughts, and guidance that everything can run well.

### 6. References

The Development of Physics Learning Material Based On Guide Inquiry to Improve Creative Thinking Skills

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Abstract. This research had aimed to develop a Natural Physics Learning Material based on using guided inquiry model that is feasible to facilitate students’ creative thinking skill. The learning instrument is developed by using 4-D model with a try out-design namely one group pre-test - post-test design. In order to measure applicability of the lesson plan, learning obstacles, the result of students’ learning in form of creative thinking students’ responses to the developed lesson plan. The lesson plan has been tried out to 15 students’ of class XI IPA 4 in SMAN 1 Balongpanggang in the even semester of 2017/2018 academic year. The research findings were as follows: (1) The validity of the learning instrument which comprises Lesson Plan, Student Book, Student Worksheet, and a valid Creative Thinking Test Instrument; (2) The practicality of the learning instrument that can be found from: (a) the implementation of the lesson plans that is categorized as ‘good’, and (b) the constraints occurred during the implementation of the learning process; (3) The effectiveness of the learning instrument that was reviewed through: the students’ creative thinking skills ability measured by n-gain reach moderate level of category. Based on the data analysis, it can be concluded that the Natural Science Learning Instrument by using guided inquiry model was feasible to facilitate students’ creative thinking skill.

1. Introduction
One effort to give birth to quality human beings is by improving the aspect of creativity of Indonesian citizens through education. This creativity is needed to respond to the challenges that exist in the era of globalization. It is expected to form a creative and innovative generation in Indonesian citizens. The importance of creative thinking ability is supported implicitly in the purpose of national education based on Law Number 20 Year 2003 which is to develop the potential of students to become human beings who believe and fear Allah Almighty, have noble character, healthy, knowledgeable, capable, creative, independent, and become a democratic and responsible citizen. The creative thinking ability of the future of the sons and daughters of Indonesia is still very low. This is demonstrated by the results of the 2015 PISA (Program for International Student Assessment) study which shows that Indonesia can only rank 69 out of 76 countries. From the results of the TIMSS (Trends in International Mathematics and Science Study) study, it shows that Indonesian students are ranked 36 out of 49 countries in terms of performing scientific procedures. Conclusion of reasoning ability and doing scientific procedures of students in Indonesia is weak if referring result of PISA and TIMSS. Scientific procedures in TIMSS observed student competence include knowledge, application and reasoning, thereby the reasoning ability of Indonesian students who follow TIMSS is low category because it only ranks 36 out of 49 countries. The low reasoning ability is thought to be caused by the lack of creative thinking ability of the students, this is in line with Krulick and Rudnick's opinion (Sukayasa, 2012: 46) that reasoning includes basic thinking, creative thinking and creative thinking. Based on these results, students in Indonesia in terms of creativity is one aspect that needs to be improved. The low ability of creative thinking is caused by
students in Indonesia are not prepared maximally to compete against the 21st century, because less trained in improving thinking skills. Students often rely on teachers and textbooks as the only one of many available learning resources, memorizing information, being forced to remember and storing information without being involved in knowing the process of understanding the information it recalls and then practicing it into everyday life (Sanjaya, 2012; Ifeoma & Oge, 2013: 208). Creative thinking skills are both cognitive and psychomotor skills when it comes to acquiring new ideas or ideas, new ideas developed on the basis of previously born ideas and the ability to solve problems from different points of view. Coughlan (2007) says that creative thinking involves a variety of approaches including using thought and finding solutions. A learning model that is developing and able to develop new ideas through scientific and discovery procedures is a guided inquiry model. Thus this model of learning is a solution for researchers to improve students' creative thinking skills in Indonesia. Guided inquiry is a model of learning through research activities on topics, problems, to materials carefully guided by teachers with the aim of improving motivation, developing understanding, and training students to learn independently by experimental design, analysis to derive conclusions from activities do. The guided inquiry model has been investigated to improve thinking skills, foster interest and motivation of students to learn so as to better understand the concept through problems that occur in everyday life (Wulandari, 2013: 25). Learning using guided inquiry model is expected to be an innovation in learning so that it can be applied in teaching the material of Optical Instruments to the students of class XI even semester. This material is studied in Basic Competence 3.11 that is Analyzing the workings of optical tools using the properties of reflection and refraction of light by mirrors and lenses, 4.11 Create works that apply the principle of reflection and / or refraction to mirrors and lenses. From the basic competence is why the material of optical tools is very suitable for use in improving students' creative thinking ability. Another reason for this learning tool is developed because the material of optical tools is difficult to understand, students need high-order thinking skills especially the ability to think creatively through the works that can be produced by students to understand the concepts of the workings of optical instruments. And also this material is not suitable if only based on lecture methods like that done in SMAN 1 Balongpanggang because of the basic competencies described above students are required to be able to create works and design their own work, meaning that the process must occur directly. The material described only by the lecture method based on the formula formula usually causes the students less interested, not interested and less like the material, so that students difficult to understand the material he learned. Therefore, the author tries to develop a learning tool to overcome the problem entitled "Development of Learning Devices with Guided Inquiry Model to Improve Creative Thinking Skills of SMA Negeri 1 Balongpanggang". Learning tools that are developed consist of syllabus, Learning Implementation Plan (RPP), Student Handbook (BAS), Student Activity Sheet (LKS) oriented guided inquiry model and Sheet Orientation oriented on student creative thinking

2. Method

2.1. Sample

The population of the this study has been all the male and female student aging from 17 to 18 years old studying in the senior highschool in Balongpanggang, Gresik the academic year of 2017-2018.

2.2. Procedure

The implementation of research conducted in two stages, namely the development of learning tools and the implementation of learning tools. At the development stage, the device is developed using a 4-D model. The 4-D model coined by Thiagarajan, et al. (1974), beginning with the defining, designing, developing, and ending phase with the examination stage.
2.3. Data Collection Instrument

Analysis Learning Device Validity is determined based on the assessment of two expert validators. The results of the assessment of two validators then followed up by the researchers in accordance with the suggestions and comments provided and analyzed using statistical analysis of percentage of agreement.

Analysis RPP Implementation is determined by comparing the average assessment given by both observers. The instrument is said to be suitable if it has a match rate between observers > 75% (Borich, 1994: 385).

Analysis of Creative Thinking Skill First Before analyzing the creative thinking skill, the test of pre-test and post-test difference was done using Paired Sample t Test using SPSS 25 for windows with significance level $\alpha = 0.05$ (2-tailed). However, before $t$ test it is necessary to analyze whether the data is normal or not, using the normality test. Normality test used is Shapiro Wilk test with the help of SPSS 23 for windows program. Assessment of creative thinking skills is done at the beginning and end of learning activities to measure the level of creative thinking skills of students before and after following the learning activities using guided inquiry model. The value of creative thinking skills gained is used to determine the level or level of creative thinking of each student. Creative thinking skills of students are divided into 4 categories: High creative, Creative, Low Creative, Not creative.

3. Result and Analysis
3.1 Learning Material Validity

Based on the device validation diagram the value range of assessment aspect between 3.5-4. Thus each validity aspect has a valid category, which means it is feasible to use in the trial.

3.2 Data Analysis for Learning

3.2.1 Analysis Implementation Learning
Data analysis result of observation of learning activity is known that the implementation of RPP meeting 1 is 96%, meeting 2 and meeting 3 are equal to 100% so that included in the category is done very well, while the learning implementation score by two observers get very good category (Riduan, 2012: 15).

3.2.2 Analysis Problem Learning
The constraints faced during the learning process use guided inquiry model are presented in Table 3.1

<table>
<thead>
<tr>
<th>Problem</th>
<th>Alternate Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>In general, the constraints experienced is the timing, learning is done in the laboratory, so it takes more time to prepare students to the laboratory and prepare the tool. Every meeting is made to use 3 hours of lesson</td>
</tr>
<tr>
<td>Skills</td>
<td>At the beginning of learning, the teacher gives direction and guides the students especially at the first meeting to design the model works well of students less skilled in designing a model for the work of optical devices to be made.</td>
</tr>
</tbody>
</table>

3.2.3 Analysis Creative Thinking Skills
The effectiveness of instructional tools is assessed from the results of students' creative thinking skills tests on the materials of optical instruments. Data analysis of students' creative thinking skills are detailed in Table 3.2

<table>
<thead>
<tr>
<th>No.</th>
<th>Pre</th>
<th>Gain Score</th>
<th>Post</th>
<th>N&lt;sub&gt;g&lt;/sub&gt;</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>53</td>
<td>Ck</td>
<td>97</td>
<td>0.94</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>Kk</td>
<td>44</td>
<td>0.23</td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>33</td>
<td>Kk</td>
<td>78</td>
<td>0.67</td>
<td>Medium</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>Kk</td>
<td>75</td>
<td>0.67</td>
<td>Medium</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>Kk</td>
<td>78</td>
<td>0.67</td>
<td>Medium</td>
</tr>
<tr>
<td>6</td>
<td>36</td>
<td>Kk</td>
<td>89</td>
<td>0.83</td>
<td>High</td>
</tr>
<tr>
<td>7</td>
<td>47</td>
<td>Ck</td>
<td>94</td>
<td>0.89</td>
<td>High</td>
</tr>
<tr>
<td>8</td>
<td>36</td>
<td>Kk</td>
<td>78</td>
<td>0.65</td>
<td>Medium</td>
</tr>
<tr>
<td>9</td>
<td>42</td>
<td>Ck</td>
<td>92</td>
<td>0.86</td>
<td>High</td>
</tr>
<tr>
<td>10</td>
<td>33</td>
<td>Kk</td>
<td>81</td>
<td>0.71</td>
<td>High</td>
</tr>
<tr>
<td>11</td>
<td>33</td>
<td>Kk</td>
<td>83</td>
<td>0.75</td>
<td>High</td>
</tr>
<tr>
<td>12</td>
<td>28</td>
<td>Kk</td>
<td>81</td>
<td>0.73</td>
<td>High</td>
</tr>
<tr>
<td>13</td>
<td>33</td>
<td>Kk</td>
<td>86</td>
<td>0.79</td>
<td>High</td>
</tr>
<tr>
<td>14</td>
<td>44</td>
<td>Ck</td>
<td>92</td>
<td>0.85</td>
<td>High</td>
</tr>
<tr>
<td>15</td>
<td>47</td>
<td>Ck</td>
<td>94</td>
<td>0.89</td>
<td>High</td>
</tr>
<tr>
<td>Min</td>
<td>25</td>
<td>75</td>
<td>0.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
From table 3.2 it is found that all students experience improvement of creative thinking skill. The increase can be seen from the large N-gain in the table by taking the average data of 15 students by 0.74 so that the average data of 15 students taken has high N-gain categorized. The N-gain shows a well-guided inquiry model to improve the creative thinking skills of high school students of optical equipment.

3.2.3 Analysis N-Gain Each Aspect Creativity

<table>
<thead>
<tr>
<th>No</th>
<th>Aspect of Creativity</th>
<th>Rate N-gain</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fluency</td>
<td>0.77</td>
<td>High</td>
</tr>
<tr>
<td>2</td>
<td>Flexibility</td>
<td>0.65</td>
<td>Medium</td>
</tr>
<tr>
<td>3</td>
<td>Originality</td>
<td>0.78</td>
<td>High</td>
</tr>
<tr>
<td>4</td>
<td>Elaboration</td>
<td>0.67</td>
<td>Medium</td>
</tr>
</tbody>
</table>

From the table above creative thinking Gain on each indicator shows increase with medium category for fluency, elaboration, flexibility, and originality with high category. To know the difference between students' ability before and after being treated, they tested different ability of creative thinking. The data were tested for normality in order to know whether the data were normal distribution or not before paired t-test and correlation test because the requirement of paired t-test and Pearson Product Moment Correlation is data must be normal distribution. Researchers use the help of SPSS 25 for windows program to test whether the data is normally distributed or not. Normality test results are presented in Table 4.11.

3.2.3 Analysis N-Gain Each Aspect Creativity

<table>
<thead>
<tr>
<th>Test of Normality Pretest-Postest</th>
<th>128</th>
</tr>
</thead>
</table>
From the table above shows the pretest-posttest data is normal with Sig <0.05 (2-tailed). After knowing the normal distributed data can mengguanakan paired t test and correlation test. The pre-test and post-test differences were tested using Paired Sample t Test with SPSS 25 for windows with a significance level of a = 0.05 (2-tailed) (Appendix 8) and presented briefly in Table 3.5.

<table>
<thead>
<tr>
<th>Tests of Normality</th>
<th>Kolmogorov-Smirnov</th>
<th>Shapiro-Wilk</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRETEST</td>
<td>Statistic: .211, Df: 15, Sig: .071</td>
<td>Statistic: .925, df: 15, Sig: .227</td>
</tr>
<tr>
<td>POSTEST</td>
<td>Statistic: .221, Df: 15, Sig: .047</td>
<td>Statistic: .800, df: 15, Sig: .004</td>
</tr>
</tbody>
</table>

a. lilliefors significance correction

The table above shows the pretest-posttest data is normal with Sig <0.05 (2-tailed). After knowing the normal distributed data can mengguanakan paired t test and correlation test. The pre-test and post-test differences were tested using Paired Sample t Test with SPSS 25 for windows with a significance level of a = 0.05 (2-tailed) (Appendix 8) and presented briefly in Table 3.5.

Table 3.5 Paired Sample t Test

<table>
<thead>
<tr>
<th>Paired Samples Test</th>
<th>Paired Differences</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
</table>

The table above shows the sig value. <0.05, this means that there is a significant difference in creative thinking ability between pre-test and post-test results. These results indicate that learning in guided inquiry model is very effective in improving the creative thinking ability of high school students in the materials of Optical Devices.

4. Conclusion
4.1 Conclusion

Based on the findings in the previous chapter obtained a general conclusion that the learning device inquiry model is guided in the material of optical devices developed is feasible to be used in learning to improve creative thinking skills.

4.2 Suggest

Some suggestions as one alternative solution of some obstacles encountered in this study are:

4.2.1 Given the constraints faced when designing and conducting experiments is usually a matter of time management, it takes better time control and preparation.

4.2.2 Intensification of learning on designing models for experiments and practicum is improved, so that students can design, conduct and use experimental tools well.
5. References


Exploring Student’s Creative Thinking Process Using Open-Ended Problem in Learning Fraction

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Abstract. This study is aimed to investigate student’s creative thinking process using open ended problem in learning fraction. The task is designed in open ended problem so that student can use many strategies or give many answers. The task in this research is about dividing some cakes to some people so that each person gets the same part. In this research, indicators that are used to know student’s creative thinking process in solving the problem are fluency, flexibility and novelty. It is a descriptive research with a qualitative research approach. The rational analysis is done descriptively from the written data which is made by evaluator (researcher, colleagues and teachers), from the result of written task experiment and interview based task to students at 5th grade. Its result is that the given task can support student’s creative thinking process in learning fractions. Students were able to solve the problem fluently and flexible using many strategies. The given task also gives the chance to students to show their answers in some representations in pictures and mathematics forms.

1. Introduction

To know the creative thinking process of students in mathematics it needs a task (tool / instrument) that can really identify that. The task must be in accordance with the goals or objectives will be measured, and satisfy validity and reliability as a tool of assessment.

The objective of this task is to assess student’s creative thinking process in learning fraction of 5\textsuperscript{th} graders. Thus the content aspect (material), level of ability, context and form of task must be tailored and fulfilled criterion or notion of "creative thinking" as intended.

Creative thinking is a process that is used when we bring in / bring up a new idea. It combines many ideas that have not been done yet. Creativity is a product of creative thinking of someone. Creative thinking can also be interpreted as a combination of logical thinking and divergent thinking based on intuition but still in consciousness (Pehkonen, 1997). When one applies creative thinking in problem solving, divergent thinking produces many ideas. It will useful in finding the solution.

Another view of creative thinking is proposed by Krulik and Rudnick (1999), which explains that creative thinking is a thought of authenticity and reflective that produce a complex product. That thinking involves synthesizing ideas, building new ideas and determining their effectiveness. It also involves the ability to make decisions and produce new products. Krutetskii (1976) cites the idea of Shaw and Simon giving an indication creative thinking, namely (1) the product of mental activity has novelty and is valued both subjectively and objectively; (2) the thinking process is also new, ie asking for a transformation of the initial ideas that is accepted or rejected; (3) the thinking process is characterized by a strong and stable motivation, and can be observed beyond the time taken into consideration or with high intensity.
Haylock (1997) says that creative thinking always seems to show flexibility. Even Krutetskii (1976) identified that the flexibility of mental processes as a component of mathematics creative ability in school. Haylock (1997) shows the criteria according to type of test Torrance in creativity, ie eloquence (the number of responses received), flexibility (number of different responses), and authenticity (the prohibition of responses in relation to a group of partners). In the context of mathematics, the eloquence criterion seems less useful than with flexibility. For example, if a student is asked to make a matter of a value of 5, students may start with 6-1, 7-2, 8-3, and so on. The value of the student high, but does not show creativity. Flexibility also emphasizes on the number of different ideas used. So in math to judge divergence products can use the criteria of flexibility and authenticity. Another criteria is appropriateness. The mathematical response may indicate authenticity which is high, but useless if it does not fit in general mathematical criteria.

Silver (1997) explains that to assess children's creative thinking and adults are often used "The Torance Tests of Creative Thinking (TTCT)". The three key components assessed in creativity using TTCT are fluency, flexibility and novelty. Fluency refers to the number of ideas created in response to a command. Flexibility looks on the approach changes when responding to commands. Novelty is the authenticity of the idea created in response to the command.

The ideas of these three aspects of creative thinking are adapted by some experts in mathematics. Fluency refers to the number of problems posed, flexibility refers to the many categories of categories different from the problems created and the authenticity of seeing how elasticity (different from habit) a response in a set of all response. Getzel & Jackson in Silver (1997) also developed a test for assessing the eloquence and authenticity of problem solving that have answers diverse or various ways / approaches. Thus the activity submissions and troubleshooting that review fluency, flexibility and novelty can be used as a means to assess creativity as a product creative thinking of the individual.

For further studies, creative thinking is defined as a process used someone in synthesizing (interweaving) ideas, building new ideas and apply them to produce new products fluently and flexible. Silver (1997) provides an indicator for assessing students' creative thinking (fluency, flexibility and novelty) using problem solving. The relationship can be illustrated in the following table.

<table>
<thead>
<tr>
<th>Problem Solving</th>
<th>Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students explore open ended problems, with many interpretations solution methods, or answers</td>
<td>Fluency</td>
</tr>
<tr>
<td>Students solve (or express or justify) in one way, then in other ways. Students discuss many solution methods</td>
<td>Flexibility</td>
</tr>
<tr>
<td>Students examine many solution methods or answers (expressions or justifications); then generate another that is different</td>
<td>Novelty</td>
</tr>
</tbody>
</table>

The three components to assess creative thinking process can be operationalized as follows.
- Fluency in problem solving refers to diversity of answer to the problem that is made correctly. Two answers are variety is not necessarily different. Some answers to the problem are said to vary but no different if the answers are not the same as the others, but appears to be based on a particular pattern or sequence.
- Flexibility in problem solving refers to the student's ability solving problems in different ways.
- Novelty in problem solving refers to the student's replying ability problem with several different answers but true or one unusual answer done by the individual (student) at the stage their development or level of knowledge.

Based on the above study, then the task of assessing creative thinking process must meet the following characteristics.

1. Problem-solving (Silver, 1997; Pehkonen, 1997; Nasoetion, 1991; Dunlop, 2001; Leung, 1997)
2. Be divergent in the answer and how to solve, so elicits criteria for flexibility, novelty and eloquence. (Silver, 1997; Pehkonen, 1997; Krutetskii, 1976; Haylock, 1997)
3. Associated with more than one knowledge / mathematical concepts of students before and in accordance with the level of ability. This is to generate divergent thinking as a characteristic of creative thinking process.
4. Information should be easily understood and clearly caught meaning or meaning, does not lead to multiple interpretations and sentence composition using standard rules of good and correct.

To find out if the tasks are designed in accordance and meet the above characteristics, then performed the validation to the expert and tested to find out reliability of the task. Thus the purpose of this study is to knowing that the tasks are designed to identify students' creative thinking process has fulfilled the requirements of validity and reliability as an appraisal tool.

2. Method

This research is included a descriptive-qualitative research. This research seeks to describe and interpret the nature of the task designed by researchers (Best, 1982). Data in the form of written statements (validator assessment) and oral (interview to students) were analyzed descriptively.

The criteria used to assess the designed task are validity and reliability of the task (Kemp, 1977; Kemp, 1994; Popham, 1995; Nurkancana & Sunartana, 1992). A measuring device/ assessor is said to be valid (meets validity), if the tool can measure what is thought to have been learned (owned) which relates to the content of the lesson or material tasks appropriately. In this study, the task is designed to be valid, if it meets its characteristics and purpose to know the creative thinking ability of students. Validity has several types such as validity of forecast, comparability validity, content validity, and construct validity.

Validity in this study includes the type validity of content and construct. Content validity reviewing the accuracy of the materials used 5th grade of elementary students and the task is possible for students to give many answers as well as the way of completion. Validity of construct reviews about accuracy in the arrangement / construction of tasks such as the obvious question point, can be understandable or easily to get the meaning, does not lead to multiple interpretations and actually measure the ability to think creatively (fluency, flexibility, and novelty). To assess the validity it is done by rational analysis by asking suggestions, opinions, comments, or assessments to two mathematics lecturers and two mathematics teachers.

Reliability refers to consistency by which the assessment procedure measures what must be measured (Popham, 1995). Type of reliability consists of three types, namely stability (consistency of results on different test occasions), alternate form (consistency of results between two or more formats of a different test), and internal consistency (consistency of means of the assessment instrument). In this research use internal consistency type, that is to see if the task can function equally (homogeneous) to identify indicators of creative thinking process of students. The degree of reliability is not measured / analyzed numerically, because the task form of a performance task is not rated or numerically scanned (using interval scale). The result of the task is to notice how students can show indicators of creative thinking process (fluency, flexibility and novelty) or not. In this study is not just to see the product of student’s creative thinking, but more important is to explore how is the process of student’s thinking to produce that product.
Reliability can actually be achieved if the task has been fulfill validity (Popham, 1995), so that if validity has been met, then automatically the reliability is achieved. In addition, Heuvel-Panhuizen (1996) summarizes some expert opinions that validity is more important than reliability for open ended tasks. Magone (Heuvel-Panhuizen, 1996) describes the procedure for validating cognitive complexity and the quality of the content of the task material for assessment, among others by the logical analysis of the contents and expected performance, internal reviews and external experts, and qualitative analysis of response of students collected from piloting test.

In this study the procedure is as follows.

1. Designing tasks and examples of alternative solutions to identify creative thinking process. The task is in the form of problem solving that allow students to show indicators fluency, flexibility and novelty. The task is about dividing some cake to some people so that each person get same part. The material is related to concepts of fraction that have been studied by students. Thus rationally has designed according to the characteristics or character of the task to identify student’s creative thinking process. The task is draft-1. The task is formulated as below.

   The first person has 5 cakes and the second person has 3 cakes (The whole cake has the same shape and size). Then a third person came who did not have a cake. If the whole cake will be shared for the three people with each person getting the same share, then:
   a. make a variety of possibilities that can be done to distribute the cake! how do you make those possibilities for sharing the cake?
   b. select one possible distribution of the cake as you did in part (a), then point it out in different ways to solve the possibility!

2. The task of draft 1 is validated in terms of content by two mathematics lecturers. Instrument or validation sheet designed by the researcher and the validator can also provide comments or suggestions on the task script directly. The validation results are used by researchers to revise the task. This validated task is called draft 2.

3. The draft 2 was validated to the teacher in SDN Kertajaya Surabaya and the teacher in SDN Pacar Keling V Surabaya. Then, experiment was conducted to some students in both school. The revised result of draft 2 is a prototype of the final task. Validity the task is known from the results of content validation and construct by the lecturers and the teacher. The reliability is known from the test results and interviews to the two students.

3. **Results And Discussion**

   The draft-1 tasks designed were validated to 2 lecturers and 2 teachers. The results are as following.

   1. Not all validators fill in the instrument or validation sheet provided. Validators that do not fill validation sheets provide comments, suggestions or questions directly on a task or alternative script completion of each of these tasks. Only one validator filled out and write down the written recommendation, the task is worthy of use with the repair.
   2. Most comments and suggestions pertain to revisions to terms, words, sentences, writing, punctuation, and symbols used.
   3. One of the results of discussion with lecturers is to make some possibilities of student’s answers.
   4. Based on the discussion and direct suggestions that are not written, the conclusion that the task is possible to explore student’s creative thinking process.
   5. The tasks made need to be revised and tested on the students to know the legibility.

   This result was followed up by revising the task and improving from the aspect both the construct and the language. Revision of draft-1 tasks generates draft-2 that was validated by two lecturers and two teachers. The result are as following.
1. The suggestion from one of lecture is that the question b don’t need to be printed in the task, but it is given along the interview if the students don’t give answer that show flexibility.
2. The suggestion from another lecturer is that is the question b is need to be printed in the task to see all aspect of creativity.
3. According to the suggestions, the task is still written in the draf 1, but the question of b is asked to student when the answer of student haven’t appear flexibility.
4. The general conclusion is that the task can be used to identify student’s creative thinking process and from the aspect of the content and the construct it is valid. Because of revision that is recommended only on words / terms used not on the characteristics and the purpose of the task.

Next, the draft of this task was tested to students in one of class of SDN Kertajaya Surabaya and SDN Pacar Keling V Surabaya. Below is one of the student’s answer of the task (subject RF).

Figure 1. Student’s answer by dividing all cakes into 3 parts

Student’s answer the task by using picture that represents the cakes. The strategy is by dividing all cakes into three parts. Then each part is for each person. The student also show in mathematics form that each person gets $\frac{1}{3} \times 8 = \frac{2}{3} = 2\frac{2}{3}$. Student’s also can show the result in other form as below.

Figure 2. Student’s answer in mathematics form

Then, the student was interviewed. Subject RF was asked to use another way to solve the problem. Below is the other answer using different strategy that show her flexibility.
Figure 3. Student’s answer by dividing two remaining cakes into 3 parts

When subject RF was asked to show other possible answers, she gave many ways that show her fluency and flexibility. Some of her answers are as following.

Figure 4. Some student answers of subject RF

The overall conclusion of the design process of this task is generated a task prototype (revised 2nd draft assignment) to identify creative thinking process of students that are valid and reliable.

The revised 2nd draft assignment is the final task in this research that is used as an instrument to explore student’s creative thinking process in grade 5th SD Muhammadiyah 4 Surabaya. The task was given to some students that have been chosen according to the level of mathematics ability.

The following pictures are some student’s answers of Subject MA.
FIGURE 5. Some student’s answers of subject MA
From Figure 5 and Figure 6, it shows that the student can give many answers rightly and fluently. The student also flexible to use his own strategy to give some answers in some different ways. It can be conclude that the given task can support student’s creative thinking process in learning fractions. The given task also give the chance to the student to use his understanding about some concepts in mathematics.

4. Conclusions

In this research, the given task using open ended problem can explore student’s creative thinking process in learning fractions. This research has produced a prototype task to explore student’s creative thinking process of elementary students in learning fraction that are valid and reliable. In designing the task, it is important to give attention to the aspects of the content (material), context, construction and language. The content or material must have been studied or known by students, and it is related to more than one student’s mathematical concepts or knowledge. The context of the problem should be known by the student and it should be appropriate to the class level or cognitive development of students. Construction or task form can be a problem solving that is designed in open ended problem so that the composition of the question leads to the divergence of answers and solutions. For the language of the task, it is not all students can understand the task directly. Therefore it needs to be as optimal as possible to design the sentence structure according to the rules of language and to consider the sentence structure that is easier to be understood by students. However, it is necessary to realize that the more important is the aspect content or task material. If students could not understand the composition of the task sentence, then researchers need to read out or indicate the purpose of the task order so that the goal assessment or purpose of the assignment is achieved.
References


The Effectiveness of Student Activity Sheet (LKS) Science based on Problem Based Learning (PBL) for Improving Ability to Solve Problems of Elementary School Students

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ABSTRACT

Ability to solve the problem is an ability that must be owned by an individual, especially elementary school students because the reality can not only be applied in solving real life problems but also in solving learning problems, especially on science subjects. The method used to improve the problem solving skills in elementary school students is required by LKS based on PBL as a student companion in learning. The purpose of this research is to describe the effectiveness of LKS IPA based on PBL to improve the ability to solve the problem of elementary school students. This research is a development research conducted at SDN Kebraon 1 Surabaya using Thiagarajan development model with one group pretest posttest research design. The study was conducted using data from 15 students on a limited trial. The data used are data from student response questionnaire and test of cognitive learning result and problem solving test. The results showed that students' responses showed positive results and improved cognitive tests in the high category and problem-solving tests in moderate categories.

1. Introduction

Entering the era of globalization, every individual will be more required to have the skills to decide every action that will be done in the face of all problems[1]. These skills can include the ability to operate the technology, the ability to collect and process information, the ability to cooperate, the ability to innovate and ability in a career. Such capability is indispensable especially for the survival of the 21st century.

Efforts to realize these skills, learning in schools should refer 4C, namely: (1) Communication, learning adheres to the theory of constructivism; (2) Collaboration, student learning process is done in groups to create social improvement by giving and receiving advice from others; (3) Critical Thinking and Problem Solving, learning must be based on problems so students can think of an original solution to the problem. (4) Creativity and Innovation, learning must condition students to create innovation and develop their creativity[6].

One of the abilities students must have is the ability to solve problems. Tivani says that problem-solving ability is important because the reality can not only be applied in solving real-life problems but also in solving learning problems[12]. Behrman et al argues that not only mathematical calculations require problem solving, but many other subjects include social and science subjects[3].

The results of observations by researchers, in primary schools are still using LKS that have not been able to help students understand about the problems that are happening in real life as well as in classroom learning. This is supported by Taeyeb and Ayu's research that during this time LKS is mostly used to evaluate student learning outcomes that are given at the end of learning or as homework materials[11].
LKS is not just a teacher's tool in learning or just a complementary explanation of a concept but LKS should be the trigger of the discovery of the concept itself.

One of the most difficult-to-understand science materials is the matter of the water cycle. Water cycle is actually visible to students every day. The problem of the water cycle is also often seen and experienced by the students but the students have not understood the actual concept of the water cycle. The use of LKS in the presence of practical guides and activities to solve real-life water cycle problems can help students to understand the concept of water cycle because students are directly involved in learning. It is in accordance with the opinion of Ibrahim that learning is useful and real or not abstract if the students involved in completing a project in the learning activities[7].

Suitable learning is used to improve problem solving skills by using Problem Based Learning (PBL). According to Ibrahim PBL is a learning that uses authentic problems as a starting point in a learning process[7]. Teachers can choose the problem, where the problem is related to the problem in the day-to-day life of the learners[10]. This is supported by research by Anindyta and Suja row after applying science lesson using PBL strategy to improve students' critical thinking especially in solving problems given by teachers[2]. PBL can also be used as a way to provide students with a conceptual understanding by directly training students to solve real-life problems as well as problem solving evaluation conducted at the end of the learning in accordance with the previously mentioned research.

Based on the problems that have been described, the researcher made a research about the practicality of LKS based Problem Based Learning (PBL) to improve the ability to solve the problems of elementary school students.

2. Method

The effectiveness of the use of LKS can be seen from the percentage of student responses and improvement of learning outcomes and problem-solving skills

1) Analysis of Student Response

Student response data is analyzed descriptively quantitatively in percentage form. The questionnaire response data were analyzed using Guttman scale with score 1 for "yes" answer and score 0 for "no" answer[9]. The results of the questionnaire were assessed using the equation below with the percentage category of student responses in Table 3.1.

\[
P(\%) = \frac{\text{number of students answered "yes"}}{\text{number of students overall}} \times 100\%\]

<table>
<thead>
<tr>
<th>Percentage of Scores</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>76% - 100%</td>
<td>Positive</td>
</tr>
<tr>
<td>51% - 75%</td>
<td>Quite Positive</td>
</tr>
<tr>
<td>26% - 50%</td>
<td>Less Positive</td>
</tr>
<tr>
<td>0% - 25%</td>
<td>Not Positive</td>
</tr>
</tbody>
</table>

The results of the student response questionnaire were used to measure the effectiveness of the developed LKS. LKS and supporting tools are said to be effective if the percentage of student responses during the learning activity lasts at least 51%.

2) Test Analysis of Cognitive Learning Outcomes and Problem Solving Test

Analysis of learning outcomes using inferential statistics to compare students' pretest and posttest scores. The test of cognitive learning outcomes and problem-solving skills tests are descriptions. Data
from pretest and posttest are also translated into normalized gain to find out the categories of problem-solving abilities in students before and after the implementation of PBL-based LKS. Analysis of learning result data and ability to solve student problem is done by using statistical test to normalized gain. The N-gain formula according is as follows[4]:

\[(N-g) = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \times 100\]

Description:
(N-g) : N-gain test
Spost : The final test score
Spre : Initial test score
Smax : The maximum score (ideal) of the initial and final tests

The normalized low gain (N-gain) can be classified as follows: (1) if g ≥ 0.7, then the resulting N-gain belongs to the high category; (2) if 0.7 > g ≥ 0.3, then the resulting N-gain is categorized as moderate, and (3) if g <0.3 then the resulting N-gain belongs to the low category.

**Results**

The effectiveness of LKS based on PBL can be seen from the questionnaire of student response about LKS that have been developed and the result of student learning in the form of test of cognitive learning result and problem solving test.

1) **Student Response**

Student responses can be seen from the questionnaire of student responses given to students after a limited trial. The student's response to learning using LKS based on PBL to improve problem solving ability is presented in Table 4.1 below.

<table>
<thead>
<tr>
<th>No.</th>
<th>Rated Aspect</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>P (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>K</td>
</tr>
<tr>
<td>1.</td>
<td>a. Content / Material Components</td>
<td>86.7</td>
</tr>
<tr>
<td>2.</td>
<td>Is the material presented in the worksheet easy to understand?</td>
<td>Positive</td>
</tr>
<tr>
<td>3.</td>
<td>b. Components of Presentation</td>
<td>93.3</td>
</tr>
<tr>
<td>4.</td>
<td>Is the material presented in the worksheet related to real life?</td>
<td>Positive</td>
</tr>
<tr>
<td>5.</td>
<td>Does the material in LKS increase my knowledge?</td>
<td>100</td>
</tr>
<tr>
<td>6.</td>
<td>Does the material presented in the worksheet coherent from easy to difficult?</td>
<td>Positive</td>
</tr>
<tr>
<td>7.</td>
<td>Is the LKS display interesting and fun?</td>
<td>100</td>
</tr>
<tr>
<td>8.</td>
<td>Am I motivated to learn with this LKS?</td>
<td>86.7</td>
</tr>
<tr>
<td>9.</td>
<td>Do the activities in the LKS make me understand the material?</td>
<td>93.3 Positive</td>
</tr>
<tr>
<td>10.</td>
<td>Does the material presented include activities to identify problems?</td>
<td>86.7 Positive</td>
</tr>
<tr>
<td>11.</td>
<td>Does the material presented include activities to formulate the problem?</td>
<td>80 Positive</td>
</tr>
<tr>
<td>12.</td>
<td>Does the material presented include activities to form hypotheses?</td>
<td>86.7 Positive</td>
</tr>
<tr>
<td>13.</td>
<td>Does the material presented include activities to collect and analyze data?</td>
<td>93.3 Positive</td>
</tr>
</tbody>
</table>

**Table 4.1**

Student Response to LKS Developed
conclusions?

C. Language Components

13. Is the language used easy to understand? 100 Positive
14. Are the material presented using clear sentences? 100 Positive
15. Are the terms used in LKS easy to understand? 93.3 Positive
16. Does LKS use communicative and interactive language? 93.3 Positive

D. Component of Integrity

17. Is the cover color or cover of LKS attractive? 100 Positive
18. Are the fonts used in LKS clear? 100 Positive
19. Does the illustration or picture make it easier for me to understand the material? 100 Positive

Description:
P = Percentage
K = Description

Based on Table 4.18 the response of students to learning using LKS based on PBL to improve problem solving ability in every aspect got result that ≥ 75% student give positive response to LKS developed. The average response of students get a score of ≥ 86.7% which is in the positive category so that the LKS developed effectively used in learning.

2) Test Results Student Learning and Problem Solving Tests

Before learning using LKS based on PBL, students are given pretest in the form of cognitive learning result test and ability to solve student problem to know the student's early ability. Furthermore, students are awarded posttest with the same test after learning using PBL based LKS. The material taught is water cycle material. The results of the pretest and posttest analysis of the test results on a limited trial are as follows.

Table 4.2
Proportion of Achievement of Indicators on Student Study Results Test

<table>
<thead>
<tr>
<th>Student's Name</th>
<th>Pretest</th>
<th>Posttest</th>
<th>N-Gain</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proporsi (%)</td>
<td>Category</td>
<td>Proporsi (%)</td>
<td>Category</td>
</tr>
<tr>
<td>A01</td>
<td>33</td>
<td>incomplete</td>
<td>78</td>
<td>Complete</td>
</tr>
<tr>
<td>A02</td>
<td>53</td>
<td>incomplete</td>
<td>89</td>
<td>Complete</td>
</tr>
<tr>
<td>A03</td>
<td>44</td>
<td>incomplete</td>
<td>78</td>
<td>Complete</td>
</tr>
<tr>
<td>A04</td>
<td>55</td>
<td>incomplete</td>
<td>89</td>
<td>Complete</td>
</tr>
<tr>
<td>A05</td>
<td>67</td>
<td>incomplete</td>
<td>100</td>
<td>Complete</td>
</tr>
<tr>
<td>A06</td>
<td>33</td>
<td>incomplete</td>
<td>78</td>
<td>Complete</td>
</tr>
<tr>
<td>A07</td>
<td>33</td>
<td>incomplete</td>
<td>78</td>
<td>Complete</td>
</tr>
<tr>
<td>A08</td>
<td>67</td>
<td>incomplete</td>
<td>100</td>
<td>Complete</td>
</tr>
<tr>
<td>A09</td>
<td>55</td>
<td>incomplete</td>
<td>89</td>
<td>Complete</td>
</tr>
<tr>
<td>A10</td>
<td>44</td>
<td>incomplete</td>
<td>89</td>
<td>Complete</td>
</tr>
<tr>
<td>A11</td>
<td>33</td>
<td>incomplete</td>
<td>78</td>
<td>Complete</td>
</tr>
<tr>
<td>A12</td>
<td>44</td>
<td>incomplete</td>
<td>89</td>
<td>Complete</td>
</tr>
<tr>
<td>A13</td>
<td>55</td>
<td>incomplete</td>
<td>89</td>
<td>Complete</td>
</tr>
<tr>
<td>A14</td>
<td>67</td>
<td>incomplete</td>
<td>100</td>
<td>Complete</td>
</tr>
<tr>
<td>A15</td>
<td>22</td>
<td>incomplete</td>
<td>78</td>
<td>Complete</td>
</tr>
<tr>
<td>Total</td>
<td>705</td>
<td></td>
<td>1302</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>47</td>
<td>incomplete</td>
<td>86.8</td>
<td>Complete</td>
</tr>
</tbody>
</table>
Based on Table 4.2 shows the students' learning outcomes get the average proportion of 47% achievement indicators in the far pretest of established minimum completeness criteria, which is 75%, whereas in posttest, all students can reach minimum completeness criteria which is determined by obtaining average proportion of achievement of all student indicator amounted to 86.8%. It shows that the use of PBL based LKS in learning can improve student learning outcomes on the knowledge aspect by obtaining $N_{gain}$ score 0.77 which is in high category. Furthermore, to improve the learning outcomes of problem solving ability can be seen in Table 4.3.

<table>
<thead>
<tr>
<th>Student's Name</th>
<th>Pretest</th>
<th>Posttest</th>
<th>N-Gain</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proporsi (%)</td>
<td>Complete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A01</td>
<td>20</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A02</td>
<td>40</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A03</td>
<td>40</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A04</td>
<td>60</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A05</td>
<td>60</td>
<td>incomplete</td>
<td>100</td>
<td>Complete</td>
</tr>
<tr>
<td>A06</td>
<td>20</td>
<td>incomplete</td>
<td>60</td>
<td>incomplete</td>
</tr>
<tr>
<td>A07</td>
<td>40</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A08</td>
<td>60</td>
<td>incomplete</td>
<td>100</td>
<td>Complete</td>
</tr>
<tr>
<td>A09</td>
<td>60</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A10</td>
<td>40</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A11</td>
<td>20</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A12</td>
<td>20</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A13</td>
<td>40</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A14</td>
<td>40</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>A15</td>
<td>20</td>
<td>incomplete</td>
<td>60</td>
<td>incomplete</td>
</tr>
<tr>
<td>Total</td>
<td>580</td>
<td>1200</td>
<td></td>
<td>10.27</td>
</tr>
<tr>
<td>Average</td>
<td>38.7</td>
<td>incomplete</td>
<td>80</td>
<td>Complete</td>
</tr>
</tbody>
</table>

Based on Table 4.3 shows that the results of problem-solving tests on the water cycle material averaged 38.7% on pretest away from the established minimum completeness criteria, ie 75%. While in posttest, all students can reach minimum completeness criteria which is determined by obtaining the average proportion of 80% achievement of all student indicator by obtaining $N_{gain}$ score 0.68 which is in medium category.

3. Discussion

The result of the student's response about the components of the developed LKS kegrafikan shows the result with 100% percentage on all questions asked. The results indicate that the cover color or cover of LKS is very interesting for students to read. Cover or cover is an important component in LKS development. This matter has been arranged in Permendikbud Number 8 Year 2016 about the book used by educational unit should pay attention to layout of book design components at front of book leaf following pattern of book content layout [8]. The next aspect of kegrafikan that gets 100% student response is the use of images or illustrations that make it easier for students to understand the material presented. the results indicate that with the presence of gamabar or ilustrasi in the LKS can help students to understand the material being taught.

Furthermore, the effectiveness of LKS can also be seen from the test of cognitive learning outcomes and the ability to solve student problems. The test of learning outcomes and problem solving abilities are based on learning indicators that refer to the basic competencies of the water cycle material. The test of
cognitive learning result consists of problem description as much as 15 problem and problem solve ability test consist of 5 problem description which is adjusted with indicator of problem solving ability. The result of pretest and posttest value is calculated to know the completeness of the learning result and the ability to solve the problem and gain the score to know the improvement of problem solving ability for the students on before and after the implementation of LKS based on PBL to improve problem solving ability. The result of the calculation shows the result of student learning get score N-Gain 0.77 which is in high category. These results indicate that the use of PBL based LKS in learning can improve student learning outcomes cognitively. This is in accordance with the opinion of Yew and Karen which revealed that the learning phases using PBL can improve student learning outcomes[13].

The results of the completeness calculation on the problem-solving test showed a N-Gain score of 0.68 in the medium category. These results indicate that there are LKS influences that are developed on the ability to solve the problem of students in the medium category. LKS is said to be effective if there is an increase from before the learning and the result after the learning is minimal in the medium category so that LKS based on PBL can improve the ability to solve the problem of elementary school students. This is in line with the opinions of Achilles and Hoover (in De Gyu Kim and JaeMu Lee) suggest that primary and secondary education standards may increase as a result of the adoption of PBL in primary and secondary schools when students can solve problems within a learning group[5].

4. Conclusion
Based on the results of this study, it can be concluded that LKS Problem Based Learning (PBL) is effective to improve problem solving ability. The average response of students get a score of ≥ 86.7% which is in the positive category so that the LKS developed effectively used in learning. LKS Problem Based Learning can improve student learning outcomes in the aspect of knowledge by obtaining an N-Gain score of 0.77 which is included in the high category and on problem solving abilities obtain a N-Gain score of 0.68 which is included in the medium category.

5. Acknowledgments
This research can not be separated from the support of lecturers and residents of SDN Kebraon 1 Surabaya who has assisted the completion of this research.

References
Learning Resources Development with Project Based Learning Model to Improve the Critical Thinking Ability of Primary School Students in Science Subject

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(E-mail: suryanti@unesa.ac.id)

Abstract. This study aims to develop a decent learning tools (valid, practical, and effective). This research is based on the low ability of critical thinking of students. This research uses Dick & Carey model which is tested on grade V SDN Kebrak 1. The result of research shows that learning resources developed reaches average score above 3.6 which means valid. The test results of practicality of instructional materials show the average percentage obtained exceeds 75% which means performed very well. While the results of the effectiveness test is known that the percentage obtained exceeds 75% which means the response of students is very positive, and equal to 58.3% increased N-Gain calculation after the critical thinking evaluation test. The final results indicate that learning tools developed are appropriate for use in the learning process.

1. Introduction

The 21st century life is a life without boundaries, globalization, internationalization, and the exploration of information and communication technology is very easy. According to NCREL and Metiri Group (Turiman, 2011), the digital economy era of the 21st century requires a knowledgeable and skilled workforce to generate innovation and increase the productivity of a country. In order to compete in the 21st century, students must be prepared early in school. The era of 21st century competition requires people to be able to compete, so it must be equipped with various skills. Therefore, students must be able to solve problems with superior thinking ability to be ready to plunge into global society.

To overcome challenges in the 21st century, students need to be equipped with 21st century skills to strengthen the competitive soul of this era. In Turiman (2011), four major components of 21st century skills are digital literacy era, creative thinking, effective communication skills, and high productivity. Based on the four main components that have been described, one of the most important components today is the ability to think creatively that includes critical thinking skills. This is revealed by Zubaidah (2016), that the ability to think critically is one of the important aspects and become the skills that students need to have to face the challenges of the 21st century because of the influence of globalization, the problems that arise in life more diverse.

To find out the critical thinking skills of the students, a limited test was conducted on several students in the form of a description that the indicators were based on the opinion of R. Ennis (in Costa, 1985), namely: (1) to explain simply; (2) building basic skills; (3) make a conclusion; (4) explains further; and (5) develop strategies and techniques. The test results showed 0% of students with very critical category, 10% of students with critical category, 90% of students with less critical category, and 0% of students with uncritical category. So the greatest result is students in the category of less on critical thinking skills.

The emergence of project based learning model comes from constructivism theory which refers to contextual learning (Khamdi, 2007). Learning using this model is linked to the lives around students and
students directed to building knowledge independently. The project-based learning model can be defined as a learning model that involves the centralization of meaningful questions and problems, problem solving, decision-making, the search process of multiple sources, the provision of opportunities for members to work in collaboration, and closing with presentations. (Thomas, in Jagantara, 2014). The learning that will be applied is learning in the form of groups. Students will be given group projects, and they will design solutions to solutions. Group project results will be presented and discussed together. While the teacher accompanies and conducts assessment through observation during ongoing learning and tests.

Based on the study of some learning tools in elementary school, there is no learning tool available to train critical thinking skills. Therefore it is necessary to develop a learning device based on Project Based Learning model.

2. Literature Review
The importance of critical thinking ability is also expressed by Trilling and Fadel (2009: 76), which calls critical thinking a basic skill in the 21st century. Trilling and Fadel's opinion is supported also by Anderson, Krathwohl, &Airasian (2001: 56) critical early on in accordance with Bloom's Taxonomy includes remembering, understanding, applying, analyzing, evaluating, and creativity that are incorporated in a creative learning design in school.

In addition, based on Attachment Permendikbud no. 22 years 2016 on standard processes for elementary and secondary education units, learning in schools should use scientific inquiry learning so that students have the ability to think scientific, act and behave scientifically, and able to reveal the results of his work as one of the important ability in communicating. This is supported by UNESCO which views education as a building that is supported by four pillars of learning to know, learning to do, learning to be, and learning to live together. In addition, the success of science learning is influenced by several factors, namely: curriculum, four pillars of education, resources, learning environment, teaching effectiveness, and evaluation of learning (Wiyanto, 2009: 63).

The project-based learning model can be defined as a learning model involving the centralization of meaningful questions and problems, problem solving, decision-making, the search process of multiple sources, the provision of opportunities for members to work in collaboration, and closing with real-world product presentations (Thomas, in Ni Luh, 2012). Projects in this lesson are carried out within a certain time in a collaborative manner, producing a product, whose results will then be presented and presented. Project implementation is done in an innovative, unique, focusing on solving problems related to student life. Project-based learning is part of a learner-centered instructional method.

The use of project based learning model in this research is based on constructivism learning theory that emphasizes one's activeness in developing and composing comprehension and knowledge (Santrock, 2004). In addition, this model can also trace the critical ability of the child according to its development in Piaget theory that is sensory-motor stage, pre-operational, concrete operational, and formal operational (Dahar, 2011). This model has a learning syntax that can be tailored to the learning steps to train students' critical thinking skills.

One of the previous studies was also performed by RemziyeErgul and ElifKeskinKargin (2014) under the title The Effect Of Project Based Learning On Student's Science Success. The results of this study indicate that project-based learning affects the quality of learning in schools.

3. Material and Methodology
3.1 Data
Data collection is done through: (1) validation of learning devices by two experts; (2) observations related to the implementation of learning and student activities by two observers; (3) questionnaire distribution to
find out student response during learning; and (4) giving critical thinking test. Data analysis technique using quantitative descriptive analysis technique. The test of learning devices using one group pre-test post-test design is illustrated with the following pattern (Fraenkel, Wallen, & Hyun, 2012):

<table>
<thead>
<tr>
<th>Early Test</th>
<th>Treatment</th>
<th>Finish Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₁</td>
<td>X</td>
<td>O₂</td>
</tr>
</tbody>
</table>

Then after try out, to determine the degree of improvement of critical thinking skills using inferential statistics through N-Gain score analysis by the formula (Hake, 1999):

\[
g = \frac{(S_{post}) - (S_{pre})}{skor \ max - (S_{pre})}
\]  \hspace{1cm} (1)

After testing the device, the students' critical thinking test results will be analyzed using N-Gain and converted according to the criteria in Table 1 below.

**Table 1. N-Gain Score Criteria (Sundayana, 2014)**

<table>
<thead>
<tr>
<th>g</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>g &gt; 0.7</td>
<td>High</td>
</tr>
<tr>
<td>0.3 ≤ g ≥ 0.7</td>
<td>Medium</td>
</tr>
<tr>
<td>g &lt; 0.3</td>
<td>Low</td>
</tr>
</tbody>
</table>

The degree of reliability of the device validation results and the acquisition of observed scores of instructional learning will be analyzed by the Percentage of Agreement formula, as follows (Borich, 1994):

\[
Percentage\ of\ Agreement = (1 - \left(\frac{A - B}{A + B}\right) \times 100\% \hspace{1cm} (2)
\]

An assessment instrument is said to have a match between validator or observer if the value of Percentage of Agreement is ≥ 0.75 or ≥ 75%. The average total score of device validation results will be converted according to Table 2 below.

**Table 2. Criteria Categorization Learning Device Validity (Ratumanan & Laurens, 2011)**

<table>
<thead>
<tr>
<th>Validate Score Interval</th>
<th>Assessment Category</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6 ≥ SV &gt; 4</td>
<td>Valid</td>
<td>Can be used without revision</td>
</tr>
<tr>
<td>2.6 ≥ SV &gt; 3.5</td>
<td>Enough</td>
<td>Can be used with a few revisions</td>
</tr>
<tr>
<td>1.6 ≥ SV &gt; 2.5</td>
<td>Less</td>
<td>Can be used with many revisions</td>
</tr>
<tr>
<td>1.0 ≥ SV &gt; 1.5</td>
<td>Invalid</td>
<td>Not yet in use, still need consultation.</td>
</tr>
</tbody>
</table>

After the learning was done, the observation result of the learning activity, the student activity, and the student's response were analyzed descriptively quantitatively by calculating the observation result with the following formula (Arifin, 2009):

\[
P = \frac{\sum K}{\sum N} \times 100\% \hspace{1cm} (3)
\]

Then, the percentage of learning activities will be converted using the criteria listed in Table 3 below.

**Table 3. Criteria for the Implementation of Learning (Riduwan, 2012:15)**

<table>
<thead>
<tr>
<th>Interval</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% ≤ P &lt; 25%</td>
<td>Not done</td>
</tr>
<tr>
<td>25% ≤ P &lt; 50%</td>
<td>Less done</td>
</tr>
<tr>
<td>50% ≤ P &lt; 75%</td>
<td>Well done</td>
</tr>
<tr>
<td>75% ≤ P &lt; 100</td>
<td>It worked very well</td>
</tr>
</tbody>
</table>
While the percentage of student activity observation will be converted using the criteria contained in Table 4 below.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% - 24%</td>
<td>Not done</td>
</tr>
<tr>
<td>25% - 49%</td>
<td>Less done</td>
</tr>
<tr>
<td>50% - 74%</td>
<td>Well done</td>
</tr>
<tr>
<td>75% - 100%</td>
<td>It worked very well</td>
</tr>
</tbody>
</table>

Finally, the student's response questionnaire will be converted according to Table 5 below.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0% ≤ P &lt; 25%</td>
<td>Very weak</td>
</tr>
<tr>
<td>25% ≤ P &lt; 50%</td>
<td>Weak</td>
</tr>
<tr>
<td>50% ≤ P &lt; 75%</td>
<td>Enough</td>
</tr>
<tr>
<td>75% ≤ P &lt; 100%</td>
<td>Very strong</td>
</tr>
</tbody>
</table>

3.2 Method

This research is a study of learning device development of Learning Implementation Plan (RPP), Student Textbook (BAS), Student Activity Sheet (LKPD), and critical thinking test. Device development conducted in this study refers to the model of Dick & Carey. This research begins by analyzing basic competencies, analyzing students, analyzing learning, and formulating indicators and learning objectives. Furthermore, the preparation of benchmark reference tests, choosing learning strategies, selecting media and teaching materials, and developing learning tools. Learning tools that have been developed are then validated and tested.

4. Result

Based on the results of validity test, practicality test, and effectiveness test can be seen that the learning device developed feasible for use in learning, described as follows.

Validation Test Result

The result of the learning device validation test shows that the learning tools developed are very valid with the average score obtained above 3.6 and the percentage of matching assessment given by two validators more than 75%.

The result of the average score of learning device validation can be seen in Figure 1 below.
Practically Test Result
The practicality of instructional tools seen from the implementation of learning and student activities. The results of observation of the implementation of learning shows that in general the implementation of learning tools developed included in very good category with the percentage of average score obtained above 75%.

While the results of observations on student activity indicate that in general the student activity during learning performed very well with the average percentage obtained exceeds 75%.

The test results of practicality of instructional devices can be seen in Figure 2 below.

Effectiveness Test Results
The effectiveness of instructional tools viewed from the results of the questionnaire of student responses and the results of critical thinking tests. In general, students' responses to learning with learning tools developed in the mentioned aspects show an average percentage above 75% which means that most students respond positively. While the critical thinking test results showed N-Gain score that was 58.3% of students showed a high category increase.

5. Discussion
The validation test results show the average scores obtained from both validators exceed 3.6 and the percentage of agreement level of the two validators exceeds 75% which means the learning devices are in very valid category and are suitable for use in learning.

Learning steps designed to train students to play an active role in learning, while the teacher as a facilitator because in the digital literacy era students as a subject of learning play an important role in the
retrieval of information, while teachers become facilitators for students who will help students to confirm on any information obtained (Dewi, 2015).

The practicality of learning tools that have been developed can be seen from the implementation of learning and student activities. The result of observation of the implementation of learning shows that the learning is done with very good category with the percentage of average score obtained above 75%. While the results of observations on student activity indicate that in general the student activity during learning performed very well with the average percentage obtained exceeds 75%.

An important factor affecting students to learn is the extent to which the planned lesson plans are accomplished and how much actual time students need in learning (Muijs & David, 2008).

Learning takes place in accordance with the steps contained in the RPP. While BAS, and LKPD used as much as possible to be a means for students to explore with friends and find their own concepts. The teacher acts as a facilitator, and the student is the center of learning (student centered). This is in accordance with the opinion of Panasan (2010), that in carrying out his duties as an educator, a teacher must master the material to be taught and the methods he uses when learning.

In the observation of student activities tailored to the indicator of critical thinking, as Paul & Elder (2008) discloses, one is said to be critical if: (1) raises important questions about a problem; (2) collecting and assessing information in a relevant manner; (3) make conclusions and solutions through appropriate reasoning; (4) open mindedness; (5) communicates effectively in conveying solutions to problems.

Implementation of learning becomes important in accordance with the theory of costructivism that students prepare their own knowledge independently and actively. Bruner also revealed with discovery learning then the students will get maximum learning outcomes. While the effectiveness of learning tools that have been developed can be seen from the results of questionnaire responses of students and the results of critical thinking evaluation.

The result of questionnaire of student response to the learning is very good with an average score of 97.74% which means that students respond positively to learning activities using learning tools developed. This categorization adopted the opinion of Riduwan (2003), who categorized the 81% -100% response as a very strong category (very positive). The high percentage of students who respond positively indicates that students support, feel happy, interested, and enthusiastic about the learning that has been implemented.

At the pilot stage, the critical thinking test results showed an increase in pre-test and post-test scores indicating an increase in students' critical thinking skills. From the calculation of N-Gain, as much as 58.3% of students showed a high category increase and the rest experienced an increase in the medium category.

6. Conclusion

This study concludes that learning tools with project based learning model to improve students' critical thinking ability is suitable for learning based on the prevalence of learning tools, the implementation of learning well, the increasing of students' critical thinking ability, and good response from the students.

References


Effectiveness of Student Activity Sheet Science Based Quantum Teaching to Improve the Critical Thinking Skills of Primary School Students

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Abstract. The learning model of quantum teaching is one of the learning models known as TANDUR syntax, namely: Grow, Natural, Name, Demonstrate, Repeat, and Celebrate. Where the model quantum teaching provides an opportunity for students to be actively involved and creative in the learning process, interacting well with the material, friends, and teachers. Therefore, the development model of this student activity sheet follows the TANDUR syntax, that makes the learning atmosphere more enjoyable. This study aims to produce Student Activity Sheets and related resources learning such as, Lesson Plan (RPP), and Critical Thinking Skills Tests based on quantum teaching to improve the critical thinking skills of fourth grade students of primary school on the material of light properties. The research method used is the developmental method. This development study refers to the development model 4-D by Thiagarajan, but only up to three stages consisting of: stage (1) definition, (2) design, (3) development. Trial design using One Group Pre-Test Post-Test Design. The instruments used in this research are test and questionnaires. The results showed that worksheet based on quantum teaching is feasible to be used in learning, by fulfilling the effective criterion, based on critical thinking skill test and student response result.

1. Introduction
According to Permendikbud No. 64 of 2013 concerning the standard content of primary and secondary education, the goal of natural science learning in elementary schools is so that students have the following abilities: a) show a scientific attitude of curiosity, honesty, logical, critical, and discipline through science; b) ask questions about what, why, and how about nature; c) observing IPA objects using five senses and simple tools; d) record and present data from observations of the surrounding nature in a simple manner; e) report the observations of the surrounding nature verbally and in simple writing and f) describe the concept of science based on observations. [4].

Entering the 21st century, emphasized the needs of students to be communicative, collaborative, creative, innovative, critical thinking, and analytical and able to solve real problems effectively [7]. This is in line with the opinion by [6] which explains that in the world of education, critical thinking skills are increasingly emphasized in which the era of globalization requires workers to be more productive. The ability to think critically becomes an indispensable thing for students to be able to face challenges and to find out the truth and information around them. Critical thinking skills are not only useful in education, but in various disciplines are also needed. The field of science includes research results from [7] in engineering undergraduate learning environments, it is said that to enter the world of global markets, it is required that they be able to transfer the skills of critical thinking skills to the world of work. With these skills, they will be ready to work together successfully, think critically, analytically, communicate
effectively, solve problems efficiently, be able to participate in team activities at work and believe in the ability to contribute to the science and engineering of the community.

One way to improve students' critical thinking skills is by using worksheet as one of the teaching materials that support students in learning. Worksheet is a student guide that contains a summary of the material and the guidance of the implementation of learning tasks that must be done by the students, which refers to the basic competencies to be achieved [5]. From interviews conducted by researchers on September 03, 2017, with science subjects teachers, stated that most of the worksheet used by teachers and students obtained by buying at the publisher. This is also supported by field observations. The statement indicates that there are still many teachers who have not innovated to create their own worksheet for various reasons, one of which is practicality. Agreeing with it [2], it is revealed that teachers use worksheet not from their own development results but are obtained from publishers who have provided them, and according to [3] worksheet currently used are worksheet distributed by private publishers. The worksheet only contains material, sample questions, and practice questions in the form of multiple choice test, field, and description only.

Thus, it is important for teachers to produce worksheet independently to fit the expected learning objectives, which can improve students' critical thinking skills, worksheet in which invites students to be active and able to train students to think scientifically in learning. The learning model of quantum six steps of learning known as learning framework TANDUR, namely cultivate student interest, naturally that is creating a real experience that can help students learn, name namely a keyword so that students are able to give a name to the concepts studied, demonstrated that give opportunity for students to show that they know or understand the material being learned, repeat that is telling students ways of repeating the material, celebrate that is to give acknowledgment for completion, participation, and achievement [1].

The purpose of this study is to produce a sheet of student activity based on quantum teaching IPA effectively used to improve the critical thinking skills of elementary school students. The results of this study are expected to be used as a reference for other researchers relevant to the material or at different grade levels.

2. Method
This research is a type of development research using 4-D model, which is developing student activity sheet based on quantum teaching for class IV SD on light properties. In the field of education, research development is a study that produces a particular product, and test the effectiveness of the product. The subject of this research is student activity sheet based on quantum teaching to improve students' critical thinking skill on light properties, which will be tested on 10 students of grade IV of elementary school year 2018/2019 even semester.

The design of this study begins by doing pre test as a test to determine the initial ability of students, then subject to treatment within a certain period and then performed post test as a final test to determine the understanding of the concept of light properties by students. At the end of the learning activities, students are asked to fill out a questionnaire of student responses to student activity sheet based on quantum teaching.

3. Results
Student responses given to fourth graders of SDK Kristen Tunas Gloria Kupang and the students' response to learning using Student Activity Sheet based on quantum teaching to improve critical thinking skill in every aspect showed that ≥70% of students responded with positive category. The conclusion of this result that the Student Activity Sheet developed effectively applied to the learning activities. Results of student responses can be seen in the table below:
Table 1. Results of Student Response

<table>
<thead>
<tr>
<th>No.</th>
<th>Aspect</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Do you feel happy with the appearance of worksheet based on quantum teaching that is used now?</td>
<td>100, Very Good</td>
</tr>
<tr>
<td>2.</td>
<td>Do you think that the current worksheet based on quantum teaching is interesting?</td>
<td>100, Very Good</td>
</tr>
<tr>
<td>3.</td>
<td>Do you think that the image display on worksheet based on quantum teaching used is now interesting?</td>
<td>100, Very Good</td>
</tr>
<tr>
<td>4.</td>
<td>Do you think that the language used in quantum teaching worksheets is easy to understand?</td>
<td>80, Good</td>
</tr>
<tr>
<td>5.</td>
<td>Do you think the selection of LKS colors used is now interesting?</td>
<td>90, Very Good</td>
</tr>
<tr>
<td>6.</td>
<td>Do you think that the shape and size of the letters are clearly read?</td>
<td>100, Very Good</td>
</tr>
<tr>
<td>7.</td>
<td>Do you think that the presentation of material and the instructions for activities in worksheets based on quantum teaching are easy to understand?</td>
<td>90, Very Good</td>
</tr>
<tr>
<td>8.</td>
<td>After participating in learning with quantum teaching worksheets makes your learning interest increase?</td>
<td>80, Good</td>
</tr>
<tr>
<td>9.</td>
<td>Do you find it easy to do evaluation questions after taking lessons with worksheets based on quantum teaching?</td>
<td>70, Good</td>
</tr>
<tr>
<td>10.</td>
<td>Are you interested in following the next learning activities using quantum teaching worksheets?</td>
<td>90, Very Good</td>
</tr>
</tbody>
</table>

Outcomes Achievement of critical thinking skills indicators from data pre-test and post-test of student activity sheet development based on quantum teaching can be seen in Table 2 and Table 3.

Table 2. Results Data Pre-Test Critical Thinking Skills Student

<table>
<thead>
<tr>
<th>Category</th>
<th>Pre Test</th>
<th>Indicator</th>
<th>Number</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 (Give a simple explanation) 2 (Building basic skills) 3 (Conclude) 4 (Provide further explanation) 5 (Set Strategy and tactics)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>2 2 1 0</td>
<td>6</td>
<td>54.54</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>2 2 1 0</td>
<td>6</td>
<td>54.54</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>1 1 0 0</td>
<td>4</td>
<td>36.36</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>1 1 0 0</td>
<td>4</td>
<td>36.36</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>2 1 1 0</td>
<td>5</td>
<td>45.45</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>2 2 2 0</td>
<td>4</td>
<td>36.36</td>
</tr>
<tr>
<td>G</td>
<td>2</td>
<td>1 0 1 0</td>
<td>4</td>
<td>36.36</td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>2 2 1 0</td>
<td>6</td>
<td>54.54</td>
</tr>
<tr>
<td>I</td>
<td>0</td>
<td>1 2 1 0</td>
<td>4</td>
<td>36.36</td>
</tr>
<tr>
<td>J</td>
<td>0</td>
<td>2 1 0 0</td>
<td>4</td>
<td>36.36</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>15 14 9 0</td>
<td>47</td>
<td>48.177</td>
</tr>
</tbody>
</table>

From the data of pre-test student, got percentage of achievement result of critical thinking skill indicator reach 48.177%. Then, for the data post-test are student’s presented in Table 3 below.
Table 3. Results Post-Test Critical Thinking Skills Students

<table>
<thead>
<tr>
<th>Category Pre Test</th>
<th>Indicator</th>
<th>Number</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 (Give a simple explanation)</td>
<td>2 (Building basic skills)</td>
<td>3 (Conclude)</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>E</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>G</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>H</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>J</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>25</td>
<td>30</td>
</tr>
</tbody>
</table>

From the data post-test student's above, we get the percentage of achievement indicator of thinking skill critical students reached 83.628%. Based on the data of pre-test and post-test of the students, the percentage of achievement of students' critical thinking skill indicator that the student's post-test result is higher than the result pre-test student, it means that there is a significant increase.

The large increase in student learning outcomes was analyzed using the formula N-Gain. The calculation results N-Gain can be seen in Table 4.

Table 4. Score Calculation of N-Gain Limited Trial Class

<table>
<thead>
<tr>
<th>No</th>
<th>Name of Student</th>
<th>KKM</th>
<th>Value</th>
<th>Completeness</th>
<th>N-Gain</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A</td>
<td>75</td>
<td>48</td>
<td>T</td>
<td>.75</td>
<td>High</td>
</tr>
<tr>
<td>2.</td>
<td>B</td>
<td>75</td>
<td>30</td>
<td>T</td>
<td>.82</td>
<td>High</td>
</tr>
<tr>
<td>3.</td>
<td>C</td>
<td>75</td>
<td>30</td>
<td>T</td>
<td>.68</td>
<td>Medium</td>
</tr>
<tr>
<td>4.</td>
<td>D</td>
<td>75</td>
<td>45</td>
<td>T</td>
<td>.80</td>
<td>High</td>
</tr>
<tr>
<td>5.</td>
<td>E</td>
<td>75</td>
<td>32</td>
<td>T</td>
<td>.70</td>
<td>Medium</td>
</tr>
<tr>
<td>6.</td>
<td>F</td>
<td>75</td>
<td>36</td>
<td>T</td>
<td>.71</td>
<td>High</td>
</tr>
<tr>
<td>7.</td>
<td>G</td>
<td>75</td>
<td>33</td>
<td>T</td>
<td>.65</td>
<td>Medium</td>
</tr>
<tr>
<td>8.</td>
<td>H</td>
<td>75</td>
<td>38</td>
<td>T</td>
<td>.72</td>
<td>High</td>
</tr>
<tr>
<td>9.</td>
<td>I</td>
<td>75</td>
<td>40</td>
<td>T</td>
<td>.63</td>
<td>Medium</td>
</tr>
<tr>
<td>10.</td>
<td>J</td>
<td>75</td>
<td>32</td>
<td>T</td>
<td>.70</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Average at 6.4 2.2 T .72 High

Based on Table 4 it can be seen that the score of improvement on student learning outcomes is categorized as high gain with average N-Gain of 0.72. Number of students with high criteria N-Gain were 5 students (50%) and number of students with criteria N-Gain were 5 students (50%). This result indicates that there is influence of Student Activity Sheet that has been developed on students' critical thinking skills. The results can be concluded that the Student Activity Sheet developed effectively applied to the learning.
4. Discussion
The divergent subject the responses of ten students in the ten questions above can be concluded that ≥70% of students respond with very good category. This is not separated from teachers who can present teaching and learning activities into an interesting and fun atmosphere, so that understanding of learning is captured by students will be strong. The understanding it will be known how the response of students in following the learning. The response itself is any behavior that reaps responses or replies to stimuli or stimuli in the form of reactions or answers. Where very good responses can be seen from the teaching and learning process, visible the activeness of students in following the process of teaching and learning activities, the attitude of students who are happy and eager to follow the learning. Conclusion from the result of this analysis that LKS based on quantum teaching developed by the researcher is effectively applied to the learning activity.

The results of critical thinking skills tests and student responses based on the above discussion can be concluded that LKS based on quantum teaching effectively used in learning activities. Thus, the research question has been answered that the student activity sheet based on quantum teaching developed effectively to be applied.

5. Conclusion
Based on the results of research and discussion of research that has been done, it can be concluded that Student Activity Sheet (LKS) IPA based on quantum teaching to improve students' critical thinking skills that have been developed is valid, practical, and effective in learning activities.

6. Acknowledgments
This research itself can not be separated from the help and support from the Christian SDK Tunas Gloria Kupang so that the authors are grateful to the headmaster and the fourth grade teacher who has helped launch the research activities.

7. References
Students creativity in solving realistic-mathematical problems

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Abstract. Primary school students need to be equipped with creativity, because creativity is important in everyday life. So students need to be trained to deal with realistic mathematical questions so that students can think creatively. The purpose of this study is to describe the creativity of primary school students in solving realistic mathematical problems. This descriptive research was conducted on primary school students of third grade as many as 20 students in SDN Kemuning-Sidoarjo. The research method is done by giving test in the form of three problem solving realistic problem, observation, and interview. Then the data is judged based on the indicators of creativity that is fluency, flexibility, and novelty. Qualitative analysis in this research consists of data reduction, display, and verification. The results show that from 20 third grade students at SDN Kemuning showed that 4 students are at third Level of Mathematical Creative Thinking (creative), 4 students are at second level (creative-enough), 8 students are at first level (less-creative), and 4 students are at zero level (not-creative). This shows that student creativity still needs to be improved. As a suggestion needs to be done research with realistic mathematics education to improve the creativity of primary school students.

1. Introduction
Mathematics is one of the subjects given at every level of education starting from primary school. The aim of the mathematics course is to equip students with logical, analytical, systematic, critical, and creative thinking skills and the ability to work together (Depdiknas, 2006). This ability is required for students to obtain, manage, and use information as the provision of living in a very competitive era.

In learning mathematics, students are required to think creatively. This is because by thinking creative students can solve a math problem. Thus if students think creatively in the learning of mathematics then allows students to have creativity in solving math problems. Creativity is important in learning, because creativity has a role in helping students to find solutions to the problems they face. So in solving mathematical problems, students need to think and have creative ideas in formulating, solving mathematical models and interpreting the solution of a mathematical problem. If students' creativity is low then students will have difficulty in learning mathematics material and solving problems faced in learning mathematics. So that creativity required students to be proficient in solving problems encountered in life as well as a provision to survive in conditions that are always changing both in the present and future.

Creativity as an ability to create new and powerful ideas or products is felt to help a person survive or improve the quality of life (Munandar, 2012). Due to technological developments and increasingly rapid economic competition, creativity becomes one of the most needed abilities. So that the creativity of children should be developed as much as possible when taking education. This is in accordance with the statement of Torrance (1972), that "in addition to the family environment, the educational environment in which a child undertakes formal learning activities can be one of the supporting factors for the emergence and development of the child's creative ability".
According to Siswono (2008) "creativity is a product of thinking ability (in this case creative thinking) to produce a new way or something in looking at a problem or situation". Furthermore, according to Ali and Asrori (2009, p.42-43), "creativity is a person's ability to create something entirely new or a combination of pre-existing works into a new work done through interaction with his environment to deal with problems and seek alternative solutions through divergent ways of thinking".

Silver (1997) explains that three key components judged in creativity are fluency, flexibility, and novelty. Fluency refers to the number of ideas created in response to a command. Flexibility appears in the approach changes when responding to commands. Novelty is the originality of an idea created in response to a command.

In this research creativity is defined as the ability of individuals to generate ideas or ideas that refer to the three components of fluency, flexibility, and novelty. Student's creativity in this research is measured based on three indicators:

1. Fluency refers to the student's ability to provide a variety of answers and true value.
2. Flexibility refers to the student's ability to solve problems in different ways or strategies.
3. Novelty refers to the ability of students to answer the problem with the first new answer used, in contrast to the previous idea either way or the answer.

Siswono (2007) also develops Levels of creative thinking consisting of five levels of creative thinking level 4 (very creative), creative thinking level 3 (creative), level of creative thinking 2 (creative enough), level of creative thinking 1 (less creative), and the level of creative thinking 0 (not creative).

Table 1. Level of Mathematical Creative Thinking (LMCT)

<table>
<thead>
<tr>
<th>Level of Mathematical Creative Thinking (LMCT)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 4 (very creative)</td>
<td>Students are able to solve a problem with more than one alternative answer or how to solve or create different problems fluently (fluently) and flexible.</td>
</tr>
<tr>
<td>Level 3 (creative)</td>
<td>Students are able to show a new answer by means of a different solution (flexible) although not fluent or make new answers even though not in different ways (inflexible). In addition students can create different problems fluently (fluently) even though the answer to a single problem or create a new problem with divergent answers.</td>
</tr>
<tr>
<td>Level 2 (creative enough)</td>
<td>Students are able to make one answer or problem different from common practice though not flexibly or fluently, or be able to show different ways of completion that are fluency even if the answer is not new.</td>
</tr>
<tr>
<td>Level 1 (less creative)</td>
<td>Students are not able to make answers or create different (new) problems, even if one of the following conditions is met, ie different ways of completion (flexible) or elaborate answer / problem (fluency).</td>
</tr>
<tr>
<td>Level 0 (not creative)</td>
<td>Students are not able to make alternative answers or solutions or make different problems fluent (fluent) and flexible.</td>
</tr>
</tbody>
</table>

The ability to collect possibilities for solving a problem is an important part of enhancing creativity. Therefore, focusing on the ability to bring together the various possible solutions to problems becomes important in learning. By applying learning that emphasizes creativity, students can develop their own
ideas and skills. One of the learning that allows to improve student's creativity is Realistic Mathematics Education (RME). It is based on the principles and characteristics of Realistic Mathematical Education (RME).

Principles of Realistic Mathematics Education is the rediscovery of mathematical concepts, didactic phenomenology, and self-building models. On these principles students will be required to rediscover mathematical concepts and will learn by experiencing themselves. So that meaningfulness will be felt by students and students' ideas will develop in determining the model according to problem solving.

As for the characteristics of Realistic Mathematics Education one of them is the use of models in solving mathematical problems. The model relates to situational models and mathematical models developed by students as a bridge to create models of real situations to the abstract from informal mathematics to formal mathematics. So these characteristics allow students to need creativity in modeling to solve math problems.

According to Freudenthal (in Hadi, 2005, p.9), "students should be given the opportunity to reinvent mathematics under the guidance of adults". The rediscovery of mathematical ideas and concepts must be created by the teacher through contextual problems so that students are accustomed to finding solutions or solving problems in their own way. It can also help students in understanding the mathematical concepts themselves.

In the viewpoint of Freudenthal (1971, 1973), the emphasis on mathematical concepts as human activities is problem-solving activity, problem-solving, but also the activity of organizing concepts of subject matter. This may be a real-life problem that is arranged according to mathematical patterns if the problem stems from the reality to be solved (Gravemeijer 1994, p 21). With learning that provides realistic problems to solve, then students' creativity will develop in determining the solution of the problem. Realistic problems given to students can be open-ended. Mahmudi (2008) says that "the open question is a matter that has many solutions or completion strategy".

The purpose of the open questions in mathematics learning is to enhance students' creativity. It is characterized by giving students the opportunity to think freely according to their interests and abilities in solving the open question. With a variety of ways of completion or answers to give flexibility of students to increase creativity in solving problems.

Based on the results of observations in SDN Kemuning obtained data that mathematics learning is done by providing formal mathematics to understand a concept, without beginning with realistic problems. So that students less gain meaningfulness in learning and tend to memorize concepts that have been taught. In addition, the problems given to students are closed are the questions that have one correct answer. So that the creativity of students is less developed because it is not familiarized with open questions that have solutions and various ways of completion.

In addition, researchers also conducted interviews to teachers at SDN Kemuning. Based on the results of interviews, the data obtained that teachers are less understanding how student creativity. This is because during this creativity is not a goal to be achieved in learning mathematics in primary school. Therefore, researchers interested in conducting research in order to reveal the creativity of primary school students in solving realistic mathematical problems in SDN Kemuning, especially third grade.

2. Method
The method used in this research is qualitative method. Qualitative method aims to explain the phenomenon that occurs thoroughly through the collection of data obtained. Subjects in this study were students of SDN Kemuning third grade as many as 20 students. This research uses three methods of data collection that is giving test in the form of three problem solving realistic problem, interview and observation. In this research, data analysis technique used adopted from Milles and Huberman is data reduction, display (present data), and verification (drawing conclusion). After the data was analyzed until
the answer of the research question was found, then checking the validity or validity of the findings data. Checking the validity of this data is done by using triangulation technique.

3. Results
Based on the results of creativity analysis students include the results of creativity tests with realistic mathematics education, observation, and interview results. The results of tests, observations, and interviews will be used as a reference for grouping students into the level of creative thinking ability mathematically. The results showed that from 20 students who were subjected to 4 subjects (creative), 4 students were at the level of creative thinking level 2 (creative enough), 8 students were at the level of mathematical creative thinking level 1 (less creative), and 4 students are at the level of creative thinking level 0 (not creative) mathematical. The following is the analysis of the level of students' mathematical creative thinking based on their level of ability

Results of student creativity analysis based on the level of mathematical creative thinking is at level 3 (creative) as many as 4 students. These students include students who have high levels of proficiency in the classroom. After being given realistic mathematics test in the form of open question, student's answer is analyzed based on student's creativity indicator that is fluency, flexibility, and novelty.

Generally fluency indicators have been met by 4 students. Where the student has been able to work on the problem very smoothly. Students have been able to work out problems fluently. Students are fluent in mentioning the information provided on the question. So students do not find it difficult to work on the problem and are confident that the answer is correct. This is because students already have enough knowledge about the matter of plane (geometry). The answer given cultivated more than one answer. Students work on the problem with the correct process and provide a fairly complete explanation.

The achievement of the flexibility indicator is in a sufficiently flexible category. Students have tried to provide answers in more ways, but there are still errors in the calculation process. Some students have pointed out considerations in solving the problems and concepts raised in solving the given problem. However, there are still students who do not understand the purpose of the problem on the problem so that only able to provide one way to solve the problem.

On novelty indicators students are only able to be at a good level. On the question with the novelty indicator, the students only partially show new answers. because students are only accustomed to the way they learn. So it is less able to give new ideas to solve problems in their own way. Students mentioned that they had never done the job as given. Students work on the problem with the correct process and provide a fairly complete explanation.

Results of student creativity analysis based on the level of mathematical creative thinking is at level 2 (creative enough) as many as 4 students. The students are students who have a level of ability in the class. After being given realistic mathematics test in the form of open question, student's answer is analyzed based on student's creativity indicator that is fluency, flexibility, and novelty.

Generally fluency indicators have been met. Five students have been able to work out the problem smoothly. Students have been able to solve problems fluently. Students are fluent in mentioning the information provided in the question. So students do not find it difficult to do the problem and believe the answer is correct. This is because students already have enough knowledge about plane (geometry). The answers given by the students are more than one answer. Students work with the correct process and provide a fairly complete explanation.

On the flexibility indicator (flexibility) student in the category is flexible enough. A small number of students have tried to provide answers in more ways, but many still make mistakes in the process of calculating them. Some students have pointed out things to consider to solve the problems and concepts
raised in solving the given problem. However, some students do not understand the purpose of the problem so that only able to find one way to solve the problem.

On the novelty indicator the student is in a fairly new category. On the question with the novelty indicator, the students only partially show one new answer. this is because students are accustomed to the way teachers have taught. So less able to solve the problem in their own way. Students feel difficult if the given problem is different from the problems that have been taught by the teacher or the problems that is in the book.

The result of creativity analysis of students based on the level of mathematical creative thinking is at level 1 (less creative) as many as 8 students. These students are a mix of students with moderate and lesser levels of ability in the classroom. After being given realistic mathematics test in the form of open question, student's answer is analyzed based on student's creativity indicator that is fluency, flexibility, and novelty.

In general, fluency indicators are in sufficient category. Some students have been able to work out the problems quite fluently and smoothly. Students are quite fluent in mentioning the information contained in the problem. So some students do not find it difficult to do the problem. However, some students are incomplete in providing explanations in solving the problem.

Achievement of flexibility indicators of students are in the less flexible category. Most students give wrong answers. Students also make mistakes in the calculation process. Students show less things to consider in solving the problem. So that it can be said that the students do not understand the purpose of the problem and only find one way.

On the novelty indicator students are in the less category. On the question with the novelty indicator, most students do not give new answers in answering questions. Students get used to the way the teacher has taught them. So less able to solve the problem in their own way. Students feel difficult if the given problem is different from the problems that have been taught by the teacher or the problems that is in the book. So new ideas in solving problems are not raised by students.

Results of student creativity analysis based on the level of mathematical creative thinking is at level 0 (not creative) as many as 4 students. These students are students who have less ability level in the classroom. After being given realistic mathematics test in the form of open question, student's answer is analyzed based on student's creativity indicator that is fluency, flexibility, and novelty.

Generally fluency indicators are in the less category. In working on the problem, students are not fluent. Students are not fluent in mentioning the information contained in the problem. So some students find it difficult to work on the problem and students are not complete in providing explanations in solving the problem.

Achievement of flexibility indicators of students are in the less flexible category. Most students do not answer and give wrong answers. Students also make mistakes in the calculation process. Students show less things to consider in solving the problem. So it can be said that students do not understand the purpose of the problem.

On the novelty indicator students are in the less category. On the question with the novelty indicator, all the students do not give a new answer in answering the question. Students get used to the way the teacher has taught them. So they can not solve the problem in their own way. Students feel difficult if the given problem is different from the problems that have been taught by the teacher or the question that is in the book. So new ideas in solving problems are not raised by students.

4. Conclusion
Based on the result of the research, it can be concluded that from 20 third grade students at SDN Kemuning showed that 4 students are at the third Level of Mathematical Creative Thinking (creative), 4 students are at the second Level of Mathematical Creative Thinking (creative enough), 8 students are at
the first Level of Mathematical Creative Thinking (less creative), and 4 students are at zero Level of Mathematical Creative Thinking (not creative). At the third level, 4 students have met the indicators of fluency, are flexible and new. So that can be said good student creativity. At the second level, 4 students have met the fluency indicator, quite flexible and fairly new. So it can be said student creativity has not developed. At the first level, 8 students have met the indicators quite fluently, less flexible and less new. So can be said creativity of student still less. And at zero level, 4 students have met the indicators are less eloquent, less flexible and less new. So it can be said that creativity has not been owned by students so it needs to be developed in mathematics learning.

5. Acknowledgements
This research itself can not be separated from the help and support from SDN Kemuning so the authors are grateful to the principal, third grade teacher, and third graders student of SDN Kemuning who has helped launch the research activities undertaken.

6. References


Contextual Video and Their Effectiveness on Science Learning

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Abstract. The aim of this study was to determine the effectiveness of contextual video on science learning. The subjects of the study were students at elementary school Poter 2 in Indonesia. The students studied were the fifth grade students of nine students. This study uses the pretest-posttest one-group design to analyze how the contextual videos contributed to student learning. The study was conducted using three stages of the Thiagarajan 4-D model consists of define, design and develop. The subjects were asked to do a test which aimed to view the effectiveness of contextual video. The results of the test were evaluated quantitatively. Based on the analysis of contextual learning video data has been qualified as an effective learning video to improve learning motivation. Posttest result of learning motivation of student become very high category after implemented learning using video of contextual learning.

1. Introduction

Motivation is one of the things that affect the success of learning activities of students [3]. Students will also learn well if there is a good learning motivation in him so that students are more eager students learn. In the process of learning in primary school (SD), teachers should be able to convey concrete learning information. Such concrete information will make it easier for students to understand the information submitted by the teacher. This is in accordance with the level of development of elementary students who are still in concrete operational level. To change the learning information abstract become concrete, the teacher need the instructional media.

One medium that can be used in the media is the use of video pedaling. Video is one of the learning media that can be used in SD. The video provides two sensory experiences of the student, the sense of hearing and the sense of sight. The more students' senses used in learning, the more likely the experience can be understood. This is because elementary students are still in the stage of concrete operational development.

Based on observations at public elementary schools (SDN) Poter 2, the School also has a variety of learning media, such as full mathematics learning videos, earth surface shapes, smart English board, sports practice tools and other media. However, the school does not have any natural science learning media, especially on the cycle of water cycle.

In the learning material of the cycle process there are some processes that are difficult or cannot be seen directly by the students and the place of the water cycle process is also difficult to be visited by the students during the learning process takes place. This causes the lack of enthusiasm for students to learn, low student motivation and low student learning outcomes. Explanation learning requires learning media that can concreting process water cycle.

Because of this the researcher begins to develop her learning to help students improve motivation and absorb information about the cycle of water cycle. Learning media that will be developed is contextual based learning video. The development of contextual-based learning videos is inspired by the Contextual the learning and learning approach, better known as CTL. CTL is a philosophy-based system that students can learn to understand the meaning of learning materials and activities when learning is related to the knowledge and experience that students have before [4]. The video in this study will be made to support the learning of co-contextual so that the learning can be better. One component of CTL is building
relationships to find meaning [4]. With the availability of this learning video, students are expected to build relationships to discover the meaning of learning.

Contextual learning videos are chosen so that students improve their learning motivation because the learning videos presented are related to the students' daily activities. Thus learning will be more meaningful because learning can be applied in real life. The development of the learning video is expected to improve the students' motivation and learning outcomes so students can gain better knowledge, attitude and skill, and more spirit in following the learning. With the development of contextual learning video is expected to improve student learning outcomes, especially in the discussion water cycle. Based on the background of the problem, the problem formulation in this research is how is the effectiveness of contextual based video learning media for elementary students to improve learning motivation?

2. Method

Research and Development (Research and Development) method is a research method used to produce a specific product and test the effectiveness of the product [6]. The research design used in this research is the research design of 4-D model development (Four D Models) according to Thiagarajan. This includes the four stages of defining (define), design, development and dissemination. This research uses the experimental design to know the result of development of contextual learning video. The product developed then tested its feasibility with the validity and product test to find out how far the improvement of learning motivation and learning outcomes of learners after learning using learning video media on the material of the cycle of water cycle. Based on the results of the validation, the learning video product that has been developed is in a valid category with an average score of more than three.

The research design uses one group pretest-posttest design. The design of this study used one group or group to be observed at pretest stage (O1) which then continued with treatment of certain treatment (X) and posttest (O2) [2]. The effectiveness of learning video products can be known by comparing the results of students' motivation questionnaires before watching video learning with the results of student motivation questionnaire after learning.

3. Results

Learning media effectiveness can be seen from student learning outcomes conducted before and after the learning activities. Learning media effectiveness can be seen from student learning outcomes conducted before and after the learning activities. Here is a picture of the results of the students' motivational measurements before and after using the learning video. This is figure one, explain about motivation learning before use video contextual and after use video contextual.
Based on the drawings, obtained from the four aspects, namely the attention aspect (attention) has a percentage of 71.3% categorized strong motivation, relevance (relevance) has a percentage of 61.8% categorized strong motivation, confidence aspect has 66.7% categorized strong motivation, and satisfaction aspect (satisfaction) has a percentage of 70.1% with strong motivation category. Based on these data, the lessons that students normally use before using contextual learning videos have strong category motivation.

After conducted pretest learning carried out by the treatment of treatment in the form of the use of contextual video learning. After that implemented posttest. Posttest results can be seen in the table below. Based on the figure I, obtained from the four aspects, namely the attention (percentage) has a percentage of 87% categorized strong motivation, the relevance (relevance) has a percentage of 85.4% categorized strong motivation, confidence aspect has 91.3% motivation, and satisfaction aspects have 85.1 percent percentage with strong motivation category. Based on the data, after using contextual learning video has motivation with very strong category. Means that student motivation increases from strong motivation becomes very strong with learning using contextual learning video.

The difference between the pretest and posttest values can be used to determine the improvement of learning outcomes so that it can serve as a reference for the effectiveness of contextual learning videos. Here are the results of student learning in the first trial.

Based on the data, after using contextual learning video has motivation with very strong category. Means that student motivation increases from strong motivation becomes very strong with learning using contextual learning video.

4. Discussion
Use of learning videos in learning activities have advantages can encourage and improve motivation to learn [1]. The use of contextual learning videos will greatly help students to improve students' learning motivation with the many interesting objects and senses that students use to gain a learning experience.
In addition to this increase in student learning motivation on learning using contextual learning videos because it is supported by material, images and explanations related to the daily life of students. Presentation of contextual learning videos is accompanied by clarity of exposure to learning objectives that get valid values by validator. Meaningful interconnection with student life is a component of contextual learning[4]. The content of instructional videos related to the daily life of the students can increase the students' motivation because students can be more interested and know the learning benefits for their life. This is in accordance with the opinion of which explains that generating interest to increase student motivation can be done explain the benefits of learning in the daily activities of students[5].

Learning motivation in aspects of attention has increased. Increased aspects of attention can be seen in the results of student motivation questionnaires that explain that students are happy and more eager to learn to implement learning by using contextual learning videos, student questionnaires on aspects of attention increase after using contextual learning videos. This is in accordance with the opinion of Wang & Antonenko (2017) which explains that the use of video learning will increase students' attention in learning [10]. It is also found in this study that after learning using contextual learning videos, students' attention to learning increases from the strong motivation category to the very strong motivation category. Increased attention is part of improving student learning motivation because according to ARCS motivation measurement theory, motivation can be measured from the aspect of life, relevance, trust and satisfaction [5].

Learning motivation in the relevance aspect has increased. This increase in motivation occurs after using contextual learning videos. In figure 1 we can see an increase in learning motivation in this aspect of relevance. The results of the students' answers to the motivation questionnaire indicate that students feel learning to use contextual video has a lot to do with student life. Increased motivation to learn the relevance aspect after using contextual learning videos is in accordance with the opinion of Slavin (2011) which states that motivation can be enhanced by helping students determine their own goals which can be attempted by connecting learning with students' lives [7]. Slavin (2011) adds that arousing interest in increasing student motivation can be done explaining the benefits of learning in students' daily activities [7]. In addition to being supported by presentations that can motivate students to learn by displaying interesting images and sounds, this contextual learning video is also presented with material content that relates to student activities everyday, close to students' lives (contextual). The contextual presentation also supports improving student learning motivation so that students are more confident in expressing their opinions, more concentrated in learning, and feel able to continue their next learning. Rodgers & Withrow-Thorton, (2014) explained that the learning presented with technology, such as video learning will further increase students' motivation to learn even though the learning material is the same [6].

5. Conclusion
Based on the discussion of the discussion can be concluded that the use of learning videos in learning activities can improve student learning motivation. Effective learning videos are developed to improve learning motivation

6. Acknowledgements
This research itself is not separated from the help and support of SDN POTER 2 so the authors are grateful to the head master of school and teacher who has helped launch the research activities.

7. Reference


An Analysis of Scientific Thinking Skills as a Basis for Selecting the Learning Model: On the Application of Creative Problem Solving Model with Scaffolding

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Abstract. The scientific thinking skill is the basic ability that students have to possess in solving problems. The aim of this paper is to analyze the influence of scientific thinking skill on learning outcomes as the basis for selecting the Creative Problem Solving (CPS) model with Scaffolding. CPS model with scaffolding is a learning model that accommodates scaffolding aspect into CPS step. This is a quantitative research with experimental methods. The subjects of this research are students of XI Grade in 3 Senior High Schools. The research involved 79 students. The data is taken by doing the test of scientific thinking skill with the instrument which is based on 4 aspects of scientific thinking skill. Data was analyzed by using SPSS 21 with regression test. The result of analysis, the value of R 0,371 with anova significance level is 0,001. Based on the anova significance level there is an influence of scientific thinking skill to the learning outcomes.

1. Introduction

The 21\textsuperscript{st} century is marked by the development of science and technology presented a new challenge in education. In the 21\textsuperscript{st} century students are required to have four important skills that are way of thinking, way of working, tool of working and living in the word. To achieve these skill’s demands, it is required a high level of thinking ability [6]. In line with the opinion of McFarlane which stated that to realize the 21\textsuperscript{st} century global life for the students required the learning process and the ability of high-level thinking that is able to understand science at the basic level as well as conducting investigations by utilizing the natural surroundings [14]. The ability of high-level thinking that is able to train students to perform the process of investigation or self-discovery one of them is the ability of scientific thinking.

The ability of scientific thinking is the ability needed to understand and evaluate information science [4]. The ability of scientific thinking is an ability that is closely related to the problem-solving ability that is as a basis someone has problem-solving ability. The ability of scientific thinking has characteristics associated with various abilities [13].

The ability of scientific thinking has four aspects, among others 1) inquiry or discovery process that starts from extracting ideas from emerging problems, formulating problems, formulating hypotheses and testing ideas through experiment until obtained data; 2) analysis or process of associating data with existing theory to obtain the truth; 3) inference or process checks the consistency between the theory used to determine the idea with the data obtained so as to obtain appropriate conclusions for the problems encountered; 4) the student's argument or process has implications for the conclusions that have been made and to know the extent of the consequences of the conclusions that have been revealed [12].

CPS is a learning model that focuses learning activities on the learning process and strengthens problem solving skills [15]. CPS model is one of the variations of systematic problem solving that is oriented towards students' creativity to solve problems. So in the problem solving process students can do problem solving skills to choose and apply alternative solutions.
During the problem solving process many students experience difficulties, so there needs to be help. Scaffolding is referred to as a reflection of the assistance given by the teacher to students in accordance with the way students study until students are able to learn independently. After students are able to learn independently, the assistance provided gradually must be eliminated [7]. Weaknesses in the CPS learning model can be helped by using scaffolding so that by combining the two stages it is expected to be able to become a learning model that can improve students' scientific thinking skills. The purpose of this study was to analyze students' scientific thinking abilities which would later be used as a basis for selecting learning models, in this case the CPS learning model with scaffolding.

2. Methods

This research is a quantitative research which used experimental method. The subjects of this study were the students of XI IPA grade in 3 Senior High Schools. The study involved 79 students. Research data obtained from the students' scientific thinking ability test. The test is in the form of a comprehensive multiple choice questions, so as to illustrate the domain of each student's scientific thinking ability. The problems are based on aspects of scientific thinking ability inquiry, analysis, inference, and argumentation [12]. In detail aspects and indicators of scientific thinking ability can be seen in Table 1.

Table 1. Aspects of Scientific Thinking Ability

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Indicator</th>
</tr>
</thead>
</table>
| 1. Inquiry | a. Formulate Goals  
               b. Identify the results of observation issues / phenomena  
               c. Explain the definition of problem formulation  
               d. Formulate issues based on issues / phenomena  
               e. Make a hypothesis  
               f. Explain the definition of hypothesis |
| 2. Analysis | a. Reasoning the results of the review literature  
                    b. Designing experimental design  
                    c. Presents experiment data  
                    d. Reveals the concept or theory of the observations |
| 3. Inference | a. Make a conclusion  
                        b. Matching conclusions with hypotheses |
| 4. Argument | a. Solve the problem using experimental theory |

Instrument of scientific thinking ability that has been prepared will be validation. Validation of research instruments aims to check the instruments’ validity that used for research. Validation of instruments performed by experts [16]. This research involved two experts to validate the instrument.

Data acquisition of students' scientific thinking ability was done before the learning process is started. The experimental data were analyzed by descriptive analysis using SPSS 21 regression test.

3. Result and Discussion

The ability of scientific thinking to be one of the capabilities students must possess, because learners who have high scientific thinking ability have high learning outcomes [5]. The average daily score of students in three schools is presented in Table 2.

Table 2. Average value of students' daily repetitions

<table>
<thead>
<tr>
<th>School Name</th>
<th>Average Value</th>
</tr>
</thead>
</table>

172
The value of students' scientific thinking skills is presented in table 3.

<table>
<thead>
<tr>
<th>School Name</th>
<th>Percentage of Aspects (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inquiry</td>
</tr>
<tr>
<td>SMA Negeri 3 Ponorogo</td>
<td>14</td>
</tr>
<tr>
<td>SMA Negeri 8 Surakarta</td>
<td>14</td>
</tr>
<tr>
<td>SMA Negeri 1 Sewon</td>
<td>17</td>
</tr>
</tbody>
</table>

In accordance with the results of the analysis of the ability of scientific thinking on student learning outcomes obtained R value of 0.371 with anova significance level of 0.001, which means there is an influence of scientific thinking ability to the learning outcomes.

Another strategic value that possessed by the ability of scientific thinking is the ability of scientific thinking which is believed to be the basis for the development of other high-level thinking skills. Which states that the improvement of high-order thinking can be done by empowering the ability of scientific thinking first [10]. In addition, the ability of scientific thinking is believed to introduce the ability of logical and systematical thinking on students.

The efforts to empower the ability of scientific thinking has been done, but the efforts are made only limited to certain aspects. Infrequent research that empowers the whole aspect at once [12]. Some studies only limit their research to several aspects directly. Aspects that are often empowered are aspects of inquiry and analysis (Amsel and Brock, 1996; Klczyinski, 2000; Koslowski, 1996; Masnick and Morris, 2008 in Kuhn, 2010). While (Gopnik and Schultz, 2007; Koslowski, 2010 in Kuhn, 2010) only empower aspects of inference for inductive causal reasoning alone. Besides just referring to the learning aspect, the other empowerment that has been done is by using learning tools or aspects in the learning process.

The learning tool that used to empower the ability to think scientific is project-based authentic assessment using the scientific approach undertaken by Wijayanti (2014). Other learning tools that used to empower the ability of scientific thinking are the development of textbooks and learning media conducted by Fitriyati, Hidayat and Munzil (2017). Based on his research, the development of textbooks and learning media obtained the average score of the feasibility test > 70%. While the learning process that has been used to empower the ability of scientific thinking is the application of learning discovery model ever done by Anas (2016). He stated in his research that the learning model based on scientific approach can effectively empower students' scientific thinking ability. Besides, the research of Thitima and Sumalee (2012) concluded that the learning model based on constructivism also is able to empower the ability of scientific thinking effectively.

Based on empowerment efforts that ever done, effective effort to empower the ability of scientific thinking is through the learning process by using the model of learning. Learning model based on scientific approach and constructivism is effective to empower students' scientific thinking ability. Scientific-based learning model accommodates aspects of scientific thinking ability. Its can teach students to find information and solve problems independently. One of the learning model based on scientific approach and constructivism in which to teach how problem solving process is Creative Problem Solving (CPS) learning model.

CPS is a learning model that is formed from the variation of problem solving learning systematically oriented to the creativity of students in solving problems [15]. Stages of the CPS learning model according to Osborn-Parnes (1963), Isaksen, Dorval and Treffinger (2000) are: 1) Mess Finding; 2) Fact Finding; 3) Problem Finding; 4) Idea Finding; 5) Solution Finding; 6) Action Finding. Each stage of the CPS model generally describes aspects of a scientific approach.
CPS model has advantages that during the learning process students are given problems that must be solved systematically by the students themselves. But this model also has a weakness that is during the learning process students have difficulty in solving problems. Thus to optimize the effectiveness of the implementation of CPS model, there are need to be assistance.

One form of assistance that can be applied is scaffolding. Scaffolding is a gradual relief given gradually to students who challenge the difficulties students encounter during the learning process [17]. Scaffolding is done because scaffolding is one of the elements of learning model that can be done to build knowledge and thinking ability of high level [11]. Scaffolding has three stages: 1) environmental provisions; 2) explaining, reviewing and restructuring; and 3) developing conceptual thinking [12]. Scaffolding is important because it is able to assist students in reactivating the initial knowledge possessed by students and able to help the formation of new knowledge with the help of teachers. Scaffolding is also able to build student motivation in learning and able to reduce the level of frustration experienced by students when unable to solve problems in the learning process [13]. Thus the CPS learning model with scaffolding is expected to accommodate all aspects of scientific thinking so that the ability of scientific thinking.

The owned stages by CPS learning model are combined with scaffolding step, so it can produce new learning stages that facilitate students in learning Biology. Here is an explanation of the learning process stages that used the CPS learning model which is accompanied by scaffolding.

Table 4. CPS Stages with Scaffolding

<table>
<thead>
<tr>
<th>CPS Stages (Osborn-Parnes, 1963)</th>
<th>Scaffolding Stages (Anghillery, 2006)</th>
<th>CPS Stages with Scaffolding</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Explaining, Reviewing and Restructuring</td>
<td>5. Explaining, Reviewing and Restructuring</td>
<td>5. Explaining, Reviewing and Restructuring</td>
</tr>
<tr>
<td>3. Developing Conceptual Thinking</td>
<td>8. Developing Conceptual Thinking</td>
<td>8. Developing Conceptual Thinking</td>
</tr>
</tbody>
</table>

4. Conclusion

Based on the results of the analysis, it can be concluded that the ability of scientific thinking to influence learning outcomes, so the ability of scientific thinking need to be empowered. Efforts to empower the ability to think scientific can be done by using the model of learning CPS. Minimize the lack of CPS learning model then added scaffolding. Merging scaffolding steps and CPS steps are expected to improve students' scientific thinking ability.

5. References


The Importance Of Mitigation Education In Reducing Disaster Risk Based On Local Community Locality

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Abstract. Significance of Disaster Mitigation Education in Reducing Disaster Risk, visible from Over 60% of our country's territory is threatened by earthquakes, in addition to tsunamis, volcanic eruptions, floods, landslides, forest fires, and biodiversity, land degradation. This article focuses on mitigating such natural disasters, especially earthquakes, tsunamis, and volcanic eruptions, through the Disaster Risk Reduction Program (DRR). Until now, no technology can accurately predict when earthquakes and tsunamis will occur. An effective action to anticipate is through continuing education and training programs for children, youth and adults. The goal of the program is to provide it with self-help to save their lives, encourage them to participate in the program, and make adult initiators in disaster management.

1. Introduction

Indonesian is a country with a high degree of vulnerability, in addition to Indonesia being among tectonic plates, Indonesia is also on the Pacific Ring Of Fire (Pacific Ring of Fire) which is the path of active volcanoes of the world. In terms of kegununganapianis the location of the most active volcanoes in the world and the meeting of tectonic plates in the world that potentially cause catastrophic volcanic eruptions, earthquakes, and tsunamis. From the predicate in the last ten years marked by the earthquake and tsunami of Aceh (2004), Yogyakarta earthquake (2006), Tasikmalaya (2009), West Sumatra (2010), Mentawai earthquake and tsunami (2010), Wassior landslide in West Papua 2010) and the eruption of Mount Merapi Yogyakarta (2010) which brought hundreds of lives and hundreds of trillions of rupiah in economic value. The eruption of Mount Merapi that never subsided, further reinforce the predicate that Indonesia is the world's fire belt.

Disaster relief in terms of public perception perspective becomes very urgent and significant to note as the fundamental knowledge to the public about in dealing with disasters. This current study on disaster management is no longer an exact science dominance that its concentration leads to physical development as a way of disaster, but also has expanded to other social sciences such as sociology and anthropology. The discussion of the aspects of disaster management from the perspective of social science will lead to the pattern of behavioralism of a person in perceiving a disaster. According to sociologist Prof. Dr. HeruNugroho (2008), each individual, community and larger social unit developed the capacity of the adjustment system in response to threats. The response is short-term, called a coping mechanism or a more long-term known as adaptative mechanism. This viewpoint is at least important to see the impact of disasters on social life.

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Disaster is no longer considered a sporadic phenomenon, but as much as possible the disaster is managed and reduced. Therefore, disaster is no longer considered a hazard that puts disaster as something absurd to manage. However, how then put the element of safety (safety) in the disaster. The emergence of the idea of “vulnerability” is to accommodate institutions and social units as part of a disaster assessment. Especially to the existence of civilization and human life in the world. The
following disaster triggering factors and their implications for human life need to be reduced or detected as early as possible, thus creating a disaster management scheme. One obvious factor that could explain the premise is the tragedy of the commons. This tragedy refers to an event in which the natural environment becomes corrupted by the act of human greed.

Humans are rational individuals who always make the most profit. Then the implications that arise later are the division or plot of specific locations into economic commodities. The result is that the ecological order becomes damaged by massive exploration and exploitation of nature.

Another real factor is the strengthening of demand in managing the nature that is dominant compared to state way and common pool resources (the way of society) which is more natural view as a source of prosperity. So, when prosperity is dredged from nature it runs out, nature creates latent factors of natural disasters. Local community-based wisdom mechanism is actually a form of awareness to appreciate a balanced relationship between nature and human whose goal is clearly to avoid any destructive impact so that if humans do not appreciate nature properly then it must be ready to accept the consequences.

Local wisdom in disaster mitigation is still rarely studied. The process of studying local wisdom requires deep reflection so that it can be understood rationally. Most of them called local wisdom, it is rarely based on rational thought, since it is generally only associated with myth and reflected on customary norms, adage and custom. How to understand the reason tradition in doing certain rituals in order to avoid disaster? His form of business is a prayer and not a real effort in preventing it. With the fear that "created" by custom, but proven effective in preventing environmental damage.

Most of descriptions of local wisdom, there are many related to nature conservation. The effort of nature conservation in the context of natural disaster prevention is an effort to mitigate the disaster. The book of Local Wisdom in the Middle of Modernization by Nasrulddin, dkk (2011) published by the Ministry of Culture and Tourism of the Republic of Indonesia decreases the article on Local Wisdom and the Challenge of Environmental Conservation which explains that many myths become a belief and indirectly (not even realized by cultural actors the) impact on maintaining local wisdom in the preservation of the environment.

Traditional knowledge that is no longer suitable if applied at this time. But some are still valid because they are general. In order for local wisdom to be effectively utilized again, our task is to "validate" the traditional knowledge to become actual. According SugihBiantoro (2011) there are three steps to revitalize local wisdom: inventory, reorientation, and reinterpretation. Inventory is aimed at collecting the sown by selecting which cultural values are relevant to present and future interests. Reorientation is the actualization and adaptation of local wisdom to be easily accepted by the target community. Reinterpretation is to reinterpret the meanings contained in the local wisdom in order to remain productive.

The process of inventory, reorientation, and reinterpretation of local wisdom has a certain direction so that there should be criteria that guide the three processes. With the assumption that the revitalization of local wisdom will be poured in the form of teaching materials then the criteria to be used is according to the needs of development of teaching materials. The purpose of this study is to: (1) Inventory the form of excellence of a number of local wisdom living in Sundanese society and culture; (2) To formulate the orientation of local wisdom living in Sundanese society in anticipating disaster; (3) Formulate a form of interpretation of local wisdom that can be raised as a teaching material in improving disaster to the disaster.

2. Method

This study builds on the assumption that local Wisdom prevailing within indigenous peoples is packaged in belief and mythology. Its form in the form of customary activities and customary norms such as prohibitions and taboos. With routine traditional ceremonies as well as norms, indigenous
peoples refrain from damaging the environment and accepting what nature gives, albeit in the form of prohibitions and taboos.

The subject of this research is indigenous people that have local wisdom in the research area. Research respondents are community leaders / traditional leaders and a number of community members which considered to know and understand customary traditions. Based on the knowledge, the community members were asked to form a disaster preparedness group (KSB). Then proceed with identification of action plan with PRA method (Participatory Rural Appraisal). Based on the results of the identification of the action plan then conducted a priority community action in accordance with the limited resources available.

3. Results and Discussion
3.1 The Role of Education in Enterprises Reduce Disaster Risk
3.1.1. Reference legislation

The Law of the Republic of Indonesia Number 24 Year 2007 on Disaster Management raises a very basic change in disaster management paradigm. Disaster management activities are implemented through the establishment of development policies that are at risk of disasters, disaster prevention activities, emergency response, and rehabilitation. Development is implemented in line with efforts to reduce disaster risks. An important component of disaster management is mitigation. Article 1 point 9 of the Law of the Republic of Indonesia Number 24 Year 2007 on Disaster Management defining mitigation is a series of efforts to reduce disaster risks, both through physical development and awareness and enhancing the ability to deal with disaster threats.

Law Number 26 of 2007 Concerning Spatial Planning Article 23, paragraph (5). In the law whenever disaster occurs and a disaster area is a danger zone, land use can change function. The result of the change is that the harmful zone switches the function of the cultivation function into a protected function which means it is not allowed for the settlement. Another consequence is that emergency and permanent disaster evacuation rooms in local, regional and national scope should be provided. Under such circumstances, the Provincial Spatial Plan (RTRW) can be reviewed.

3.2.2. Reference concept solution

Extensive coverage for the population at risk requires a concerted effort to reduce disaster risks. Substantially is the effort to create a community that is aware and responsive to disaster through disaster risk reduction education (DRR). The concept of a DRR solution is tailored to the cycle of disaster, pre disaster, disaster, and post disaster as seen in the figure

![Figure 2. Cycles and concepts of disaster solutions. Source (Subandono, 2007)](image-url)
Efforts to improve the community’s capacity to cope with disaster risks require the implementation of DRR (Disaster Risk Reduction) or disaster risk reduction programs in the village. The Community Managed Disaster Risk Reduction (Community Managed Disaster Risk Reduction) training activity is carried out in an effort to improve the empowerment of the villagers. The training activities should be fully understood because the importance of this (disaster risk management training) should be implemented for one month, involving affected villagers.

Beginning to collect villagers affected by the first threat is a landslide in the hilly area of the village that endangers the settlements and agricultural land of the population. The second disaster threat is flooding. Floods once hit the low villages, especially those that became agricultural land and settlements. From discussions with the community will be known threats of affected villages that occasionally hit the village. Villages do not have village spatial policies and long-term development plans in natural resource management. This leads to frequent land conversion and ultimately brings about other excesses in the form of narrowing of agricultural land and the risk of flooding.

In addition, the widespread poverty of the population brings access to the destruction of the ecosystem of the region and the declining carrying capacity of the environment. On the other hand villagers and village governments do not have sufficient knowledge and skills in the area of DRR (Disaster Risk Reduction). For women, there has not been much involvement in strategic planning and policy making on emergency handling and Disaster Risk Management. Nevertheless in the village there is potential that can be developed in matters relating to disaster risk management this can be seen traditionally, people have knowledge and skills in handling emergency although still very limited.

Stages of implementation of the solution tailored to the characteristics of the cycle stages of the occurrence of disaster: (a) When disaster strikes, density of activity in an emergency (b) Post disaster, reducing complications of complexity in reconstruction and rehabilitation (c) Disaster prerequisite, needs thorough planning. Disaster-threatened communities are very diverse. For those who have been educated and who are still untouched formal educations need to understand the importance of disaster risk reduction (DRR). The most strategic means for DRR education is required through formal and informal education channels. Cycles describing a disaster will never stop. With empirical data some disasters can be expected to come again, such as floods and landslides every rainy season will occur. Tsunamis will also happen again. However, no technology has yet been able to accurately detect when an earthquake will occur. The duration of time between the arrival of the earthquake and the arrival of the tsunami is an opportunity for the evacuation of the population in avoiding tsunami hazards. The technology and system to be used are still in trial stage.

In conventional emergency response management, society is not only seen in the aspect of space because it lives in the same zone, but also the same interests. For example, because of the same threat. This view ignores other important dimensions related to interests, values, activities, and similar structures. Society is something complex and often not in the form of a unity of space or location, but because of the bond or togetherness of interest. Society is a dynamic thing, people can gather together for the same specific purposes and can split up once the goal is reached.

The results of previous research conducted by Carlo, et al. (2016) entitled The Vulnerable Community Empowerment of NagariSalayo Towards Resilient Nagari Disaster shows that community empowerment through the learning of potential and disaster threats has contributed to Salayo villagers so that they can identify potential and disaster threats that will occur in each Jorong. Floods, landslides, whirlwinds, and the impacts of climate change are a threat to local communities. In order to reduce the risk of
disaster, community action has been done in the form of mounting signs on JorongGelanggangTangah, SawahSuduik, and BatuPalalo, repairing irrigation channels and providing KSB and KSB members in managing waste with Garbage Bank. The action of tree cultivation on critical land area has been done in JorongBatuPalano and Lurah Nan Tigo. However, the threat to agricultural pests and the installation of water levels as an early warning for flooding cannot be done due to the fact of the implementation of KKN-PPM. It is suggested that the Nagari administration to bring in agricultural experts from the relevant agencies to reduce the threat to community agriculture and the KSB can continue the installation of early warning signs against flooding in JorongGelanggangTangah.

3.2.3. Non Formal Disaster Mitigation Education

To obtain effective results in Disaster Risk Reduction Program (DRR) physically and non-physically, formal education alone will not be enough considering the complexity of the problem. Physically, the most important part is building a decent, secure, safe, and sustainable residence. For example, for the Yogyakarta earthquake of 27 May 2006 the death toll more than 6,000 souls were hit by the ruins of 180,000 houses that collapsed. A proper and earthquake resistant housing program is a top priority for earthquake prone areas. This program has been implemented by training building supervisors and builders with the concept of building Earthquake Resistant Houses Building (BARRATAGA). The program is implemented under the auspices of the Japanese government over the next two years (2006-2007) which is being carried out by the relevant government agencies of the Public Works Department led by Sarwidi (Sarwidi, et al., 2007: 17). Non-physical, for example psychological, social, economic issue much more complicated because that must be built is human resources (HR). For the disaster area due to other causes, for example the threat of flash floods on settlements in the protected area of river banks, volcanic eruption there is no other solution for the population on Ring-I except relocation. The location of the disaster-stricken settlement in the Ring-I is not feasible for the settlement because it is very dangerous. This area is a protected area for the existence and function of river which is very important for life, and material accommodation area of eruption of Mount Merapi.

Learning from the impact of the disaster, the DRR program with the implementation of disaster mitigation program becomes a necessity that must be done through formal and informal education because there are still many that have not been touched by understanding about disaster mitigation. As mandated by Law Number 24 Year 2007 on Disaster Management. The importance of disaster mitigation education can be done formally through education channels in accordance with government regulations. Informally can be through community institutions, community gathering forums or community groups facilitated by related institutions as counselor or communicator of disaster problems.

Evaluation of existing disaster preparedness indicates that there is no standard operational procedure (SOP) or guidance on standard implementation procedures nationally or regionally. Need a fast and accurate communication system in the event of a disaster as an effort to reduce disaster risk. Given the criteria of normal resistivity, alert, alert, and standard alert, national uniformity is required while still considering local wisdom. This is necessary so that the achievement of information to the disaster-endowed population can be fast and accurate. Modern communication and information systems are not sufficient to respond to the needs of the people who are in danger because many live in remote locations and away from DRR facilities. For example, the settlement at the foot of Mount Merapi which at any time can be threatened by eruption disaster, as well as settlement on the beach which also can be threatened by earthquake and tsunami.
Thus, traditional emergency response information systems, such as *kentongan*, are very important to convey information about the rapid and widespread disasters. This system has also been tested; *kentongan* has been able to convey the message in the night (tundan) from the city of Yogyakarta as a command center of resistance against the Dutch occupation to Banaran and Samigaluh in KulonProgo as guerrilla headquarters. Local wisdom with the meaning of the inflated passwords associated with DRR when it is normal (safe), when alert, when to standby and when to look out. At least at regional level having similarities in using local communication passwords with *kentongan*. All these problems will gradually be achieved optimally through formal and informal education channels.

### 3.2. Community Based Disaster Mitigation

Institutional strengthening, whether government, community, or private is a key factor in disaster mitigation efforts. Institutional strengthening in forms of preparedness, early warning systems, emergency response, barrack management and disaster evacuation aims at creating a powerful community that can minimize the impact of disasters. Embodiment A community or community capable of dealing with disasters can be realized through the following Community / Community Based Risk Reduction Cycle:

1. start the process of the risk reduction
2. community profile creation, integration of relationship formation
3. raising awareness about disaster risk
4. the establishment of disaster management community organization
5. community organizing and capacity building
6. laying community
7. empowered community

**Figure 3.** Community Based Disaster Risk Cycle

The following disaster triggering factors and their implications for human life need to be reduced or detected as early as possible, thus creating a disaster management scheme. Relation of power to disaster management is to see how Local Government in overcoming the destructive impact of disaster both from social and ecological aspect and construction of public information presented by Regional Disaster Management Agency to disaster and its impact to society. The issue of justice is concerned with the fulfillment of social needs for the community and its own legitimacy is related to the level of public confidence in the government in tackling disasters (Douglas, 2001: 34).

Risk paradigm emerges as a manifestation of the continued development of modernization of human life in the world. The term risk itself is defined as a possible physical attack resulting from technological developments and processes. That is, the risk of disaster itself occurs from a process of human development in the world and not caused by natural factors of natural disasters. Interesting risk understanding is scrutinized to see the balance of
relations between humans and nature during this time that shows unbalanced symptoms. Recent events such as global warming, greenhouse gas effects, nuclear radiation disaster in Japan in 2011 are a disaster caused by the development of modernity (manufactured risk). Although there are also disasters caused purely by natural factors (natural risks) such as earthquakes and volcanoes erupt. But the understanding of risk itself is more directed to the imbalance of relations between human and nature. One obvious factor that could explain the premise is the tragedy of the commons.

This tragedy refers to an event in which the natural environment becomes corrupted by the act of human greed. Humans are rational individuals who always make the most profit. Then the implications that arise later are the existence of natural plot into an economic commodity. The result is that the ecological order becomes damaged by massive exploration and exploitation of nature. Currently speaking more disasters are dominated by an understanding of resilience, modernity, and ecology that puts disaster as part of the social unit of human life in the world let alone affected by disaster. Modern humans increasingly realize that disaster is something that cannot be inevitable from the present life either in the manifest or the latent (Beck, 1992: 42).

Interpretation of Local Wisdom in Disaster Mitigation

Interpretation in this paper is to interpret something that has not been understood by modern science about the behavior of indigenous peoples. In the interpretation, the authors will look at the two sides of the side per unit of behavior while on the other side is from the aspects of the system built so as to create a community-based mitigation above, per unit of disaster mitigation behavior that should be used as teaching materials in schools include: (1) Bamboo House Building; (2) Spatial & Zoning of Land Use in Micro Scale; (3) Environmentally Friendly Land Management. While the aspects of the system will be discussed from each component involved in the formation and maintenance of local wisdom. This means that some parts of the system in indigenous peoples will be created, preserved, and keep the local wisdom from time to time.

4. Conclusion
From the analysis based on the result of education of disaster mitigation in the context of DRR (Disaster Risk Reduction) and the perspective of local wisdom, as a disaster risk management paradigm can be summarized as follows:

a. For informal education through the National Disaster Management Agency (BNPB) in cooperation with related institution, for example the Ministry of Interior, Ministry of Public Works, Ministry of Health, and Ministry of Transportation. For post-disaster relocation programs it is the responsibility of the Ministry of Manpower and Transmigration (Nakertrans) in cooperation with local governments of origin of transmigrants and local governments of transmigrant destinations. It is necessary to improve the science and technology research related to the DRR program with appropriate technology approach by considering local wisdom.

b. Public perception of disaster are an important role in disaster management. Public characters such as rational, traditional, individualist, or collective influence the planning policy at the district level on disaster, so it needs to be understood to the community and all educational institutions at all levels according to their understanding.

c. The dynamics that developed in society varied considerably between assessing disaster as God's punishment and disaster as a consequence of the development of controlled technology. The implications are seen in treating nature in the human perspective, whether just sitting as a dead object but harboring latent danger or whether it has seen nature as a friend and must be preserved. The construction dichotomy alone has implications for public policy on disasters.
In a society that has a level of modernity and technological progress will see nature as an entity that needs to be preserved. This is evident from the very strong ecological understanding in the community such as from small things such as prohibiting waste in the river to avoid flooding.

d. Disaster has become an issue of routine in everyday life so it is not surprised if there is a disaster because it is predicted and planned disaster management. As for the people who have not made disaster as a public issue. In the disaster handling will look very fatalistic, there is only resigned when the disaster comes while hoping there is a helping hand to come as soon as possible. In the end the pattern is declining in the disaster management regime that places the state as the dominant actor in handling disaster issues.

e. Fatalist behavior will minimize in making emergency effort different from hierarchical behavior that maximize in handling disaster. Likewise, in the context of the behavior of officials who are more flexible individuals in disaster, but less in togetherness and behavior then there are deliberative egalitarians in disasters as well as upholding togetherness in the face of disaster as a commons problem, this is what should be done by the apparatus to the community village

5. Reference

[9] Departemen Kelautan Republik Indonesia
Physics Learning Development Guided Inquiry Model For Impuls And Momentum To Train Science Process Skills At Vocational High School One Surabaya

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Abstract: The ability of analytical thinking is very important for students of Vocational High School in order to overcome the problems encountered in the work. The analytical thinking ability of students majoring in Software Engineering (RPL) and Multimedia (MM) is required in achieving their vocational competencies of creating and analyzing a program and web. The ability of analytical thinking can be possessed by students trained in the science process. This research aims to produce a guided, valid and effective instructional in physics instructional physics model to trace the skill of science process of vocational students. Learning instrument development using 4D model from Thiagarajan with one group pretest-posttest design method and tested on students of Vocational High School One Surabaya. Result collection using validation method, test, interview, observation and questionary. Result analysis techniques using quantitative and descriptive qualitative analysis. The findings of the research results, namely: 1) The validity of learning instrument developed (Lesson Plan, Worksheet, Student Handbook, and Assessment Sheet) are categorized very valid; 2) The practicality of instructional instrument can be seen from the implementation of good categorized learning and the suitability of student activities observed by the inquiry stage and the few obstacles encountered during the learning; 3) The effectiveness of instructional instrument reviewed from: a) improvement of performance, b) improvement of learning outcomes of knowledge and understanding of Science Process Skill, c) and students’ response to learning very well. Based on the results of this study can be concluded that the learning instrument developed valid, practical and effective so feasible to be used to trace the science process skills of students at Vocational High School.

1. Introduction

The policy of the Indonesian government with the opening of free market of MEA (Economic Community of Asean) which has been enforced at the end of 2015 raises various problems in several sectors of national life, ranging from economic, political, socio-cultural and educational aspects. Many outside workers came to Indonesia so that the work competition in the country is getting tighter. To anticipate the problem, the Government of Indonesia has made improvements and renewals gradually and continuously in the field of education. The concrete results of the improvement of education can be seen with the enactment of the 2013’s Curriculum. The 2013’s Curriculum is a revision and refinement of the KTSP’s Curriculum on primary and secondary education.

Implementation of 2013’s Curriculum at school, according to Permendikbud Number 65 in 2013, students are expected to be more active to find out, students are more independent using information and communication technology as a learning resource so that does not depend on the teacher, students can learn scientifically, students are able to master the required competencies each subject, students are able to apply and apply exemplary values both at home, at school and in society, students can develop their creativity, students can respect individual and cultural differences.
Vocational High School is one of the educational institutions that the government is expected to donate qualified specialists and ready to compete with the workforce from outside. In Vocational High School, according to Warner (2008), there are seven important Softskill, including: (1) critical thinking skills and problem solving, (2) collaboration skills / co-operation and leadership skills; (3) adaptability; (4) having initiative and entrepreneurial willingness; (5) effective communication both oral and written; (6) the ability to access and analyze information; and (7) have high imagination and imagination. To practice these skills, According to Mulyasa (2013), "Vocational teachers are professionally sued to design meaningful learning, choose the right learning approach and determine the competencies and success criteria students must have." This is in accordance with the Act number 20 of 2003 on the national education system which states "National education function to develop the ability and form the character and civilization of dignified nation in order to educate the nation's life, aims to the development of potential students to become human believers and piety to God Almighty, noble, knowledge able, capable, creative, independent, and become a democratic and responsible citizen ". This rule is affirmed by the issuance of Government Regulation (PP) no. 32 of 2013 on National Education Standards stating that every student must achieve the Graduate Competency Standards in accordance with their respective courses of study. Graduate Competency Standards are the benchmarks that an educational unit uses to assess and determine a student's passing.

Schools as an educational unit function to control the task of teachers to make planning, implementation and assessment of learning activities. The teacher as a facilitator prepares a learning scenario using an approach that is in line with the 2013’s curriculum of a scientific approach. The scientific approach is part of a pedagogic approach to the implementation of classroom learning that underlies the application of the scientific method. The scientific method is a series of scientific processes beginning with a question, hypothesising as a temporary answer to the question of the question arising, testing the hypothesis through experiments, performing result analysis, and drawing a conclusion in response to the question at the beginning. Learning using a scientific approach consists of several steps, namely: observing, asking, reasoning, trying, and communicating. The steps are in accordance with the science lessons, especially physics that is always associated with all natural phenomena that can be seen directly / fact or indirectly so as to produce a theory, principle and law through by applying the scientific method. This is consistent with the theory of direct engagement learning which states that the knowledge gained will be meaningful, lasting in memory if experiencing, observing, trying, and practicing on its own. The same thing conveyed by Ratumanan (2013) that by using scientific approach is expected to improve student learning outcomes.

Teachers carry out learning scenarios that are made by choosing a learning model that fits the learning objectives and curriculum of 2013. The learning model developed in this study is guided Inquiry. The guided inquiry model is a learning model that uses the steps of the scientific method as a learning scenario so that it is in harmony with the scientific approach. According Kemendikbud (2013), Guided inquiry learning can help balance the ability of students in terms of attitude, skills and knowledge.

Inquiry-based learning can be used to assist students in understanding the concepts in physics. This is in accordance with the opinion of Sanjaya (2006), who argues that by rehearsing the students in a scientific process continually will develop systematic, logical, and critical science process skills so that students can master the subject matter. One of them is the material of impulse and momentum, in which many abstract concepts are found which can be learned through direct inquiry activities so that students are facilitated to obtain evidence and reasoning about the concept using simple instrument.

Several studies using inquiry studies showed positive results. The results of Nurhayati (2011) study on the development of learning-oriented instrument in science process skills with inquiry in biology learning show the results of students' science process skills in both categories. A similar study from Nurmu'ani (2011) on the development of inquiry-based biology learning instrument to trace the science process skills showed 100% results. According to research Burhanuddin (2014), dynamic electrical learning instruments developed eligible to be used to melatihkan science process skills and improve student learning outcomes.
In the implementation of learning using the 2013’s Curriculum, the teacher as a facilitator provides wide opportunities for students to develop the potential that is in him so that students are more active, independent and creative. In fact, this has not been done maximally in Vocational High School One Surabaya. Based on the results of interviews of researchers with physic’s teachers Vocational High School One Surabaya, obtained information that 85% of physics learning activities that have been going on still use the lecture method and 15% of experiments so that students’ analytical thinking has not been properly honed. This ability of analytical thinking can be possessed by students trained in the process of science in finding a fact, principle or concept of physics. Another fact faced by teachers and students, on the learning of physics at Vocational High School One especially the material impulse and momentum is the unavailability of student hand book and worksheet in accordance with that’s Curriculum which can help students learn independently. This leads to a one-way learning of physics where teachers tend to choose to use lectures and have not utilized the actual learning media in the vocational environment so that learning is still impressed monoton and students become passive. That’s what lies behind the author conducted a study with the title "Physics Learning Development Guided Inquiry Model for Impuls and Momentum to Train Science Process Skills at Vocational High School One Surabaya".

2. Research Method

This type of research is development research. This research will develop inquiry of guided inquiry materials with impulse and momentum with 4-D approach according Thiagarajan (1974). The 4-D development stage consists of definition stage, design stage, development stage and desiminate (deployment stage). The desimination stage in this study was not implemented because it was only used for trial school and not disseminated to other Vocational High School. The subjects of the study were 75 students at Vocational High School One Surabaya majoring in RPL and MM. The result collected in this research uses the following methods: (1) Validation, consisting of: validation of RPP, BAS, LKS, and Rating Sheet; (2) Observation on the implementation of Lesson Plan, student activity and science process skill performance; (3) The test includes pre-test and post-test; (4) Questionnaire, used to measure students’ responses to lesson components and teacher’s teaching abilities; and (5) Interviews were conducted to collect qualitative result from students to find out the obstacles experienced by students during the teaching and learning process.

Test Validity of learning instruments developed before the test phase. This validation process is done by 3 competent experts. The results of the validity analysis include: validity of the Lesson Plans, the validity of the Student Handbook, the validity of the Student Worksheet, and the validity of the Assessment Sheet. Analysis of content-validity coefficient of learning instrument from many observer is calculated using Aiken's formula. The result match rate against learning instrument by three validators using statistical analysis of "Percentage of Agreements”.

The learning instrument's effectiveness is derived from the average assessment given by two observers based on certain criteria. The assessment scores given by the observer when observing the learning activity are in the range of values 1 to 4. The calculation of the assessment agreement of the two observers is measured by Emmer and Millet formulas (Good and Brophy, 2008). Student activity during the learning was observed by two observer teachers using student activity observation sheets. Aspects observed include: (1) reading (looking for information etc.), (2) discussing a problem, (3) taking notes or writing, (4) listening, paying attention to teacher lectures and explanations, (5) observing, experimenting or working, (6) asking the teacher, (7) giving opinions or communicating information to the class and teachers, and (8) irrelevant behavior. Observed student activity result is emphasized against the overall student activity. Obstacles experienced by teachers and students during learning are analyzed descriptively qualitative.

An understanding of the science process skill consists of pre-test and post-test using multiple choice questions with five options. Problems used in tests of understanding the skills of the science process must meet the criteria of the sensitivity of the item so that it can distinguish the ability of
students before and after the learning process. The item criteria considered sensitive is $S \geq 0.30$. Increased understanding of science process skills is calculated by the normalized gain score equation. The results of the N-Gain value of scientific argumentation skills of the students interpreted the criteria scored as follows: height $> 0.70$; Being from 0.3 to 0.70; Low $< 0.30$. Assessment of science process skill performance is derived from student performance test during conducting experimental activities.

3. Results and Discussion

3.1 Results of Learning Instrument Validity Analysis

Learning instrument developed in this study include syllabus, lesson plans, Student Handbook, worksheets and assessment sheets using guided inquiry models to trace the science processes skills of students’ Vocational High School. The developed instrument is validated by 3 validators before being implemented in the class. Based on the result analysis of validation syllabus obtained the average score of validity coefficient of 0.84 and Percentage of Agreement of 0.95. These results indicate that the developed syllabus which has a very high validity that is valid and feasible as the guidance of researchers in the preparation of lesson plans. This is in the opinion of Ratumanan & Rosmiati (2014) that the syllabus is the main source in the preparation of the implementation plan of learning. Based on lesson plans validation result analysis obtained the average score of validity coefficient of 0.84 and Percentage of Agreement of 0.91. This shows that the developed lesson plans is very valid and feasible to be used by researchers at the implementation stage and in guided inquiry model. Based on result analysis worksheets validation obtained the average score of validity coefficient of 0.91 and Percentage of Agreement of 0.928. This indicates that the developed worksheets is valid and feasible to be used as the researcher's guide to trained the science process skills to the students at the implementation stage. Based on the analysis of validation result of Handbook obtained the average score of validity coefficient of 0.92 and Percentage of Agreement of 0.938. This indicates that the developed Teachers are valid and fit to be used as a student companion book and worksheets supporters to trace the science process skills to the students during the lesson. Based on the analysis of validation result, the Rating Sheet obtained the average score of validity coefficient of 0.94 and Percentage of Agreement of 0.98. This indicates that the Appraisal Sheet developed is valid and feasible to be used to measure the understanding and performance of sains process skill that students have after learning.

3.2 Result of Practical Analysis of Learning Instrument

The practicality of instructional instrument developed is seen from the implementation of lesson plans, student activities and obstacles encountered during the learning in class X RPL 1, X RPL 2 and X MM 1. The implementation of lesson plans observed by 2 observer teachers from Vocational High School One Surabaya covering the preliminary stage, core activities, closing activities and class management for 3 meetings. In class X RPL 1, in the preliminary activity, the observer scores obtained average of 3.83, 4.00 and 3.83, in the core activities obtained scores of 4.00, 3.96 and 3.96, in the closing activities and class management obtained score of 4.00 for 3 meetings. This shows the implementation of lesson plans in class X RPL 1 runs very well and smoothly. In the class X of RPL 2, in the preliminary activity, the average score of observers was measured 4.00, 3.83 and 3.83, in the core activities obtained scores of 3.91, 3.91 and 4.00, in the closing activities and class management obtained score of 4.00 for 3 meetings. This shows the implementation of lesson plans in class X RPL 2 runs very well and smoothly. While in class X MM 1, in the preliminary activities, core activities, closing activities and class management obtained score 4.00 for 3 meetings. This shows the implementation of lesson plans in class X MM 1 runs very well and smoothly. Based on these result can be concluded that the lesson plans can be done very well in accordance with the planning that has been made by researchers.

The result of observation of student activity in the class showed that the activity of reading students began to appear and observed after each student was given Handbook. Student activity discussions begin to appear in 80% of students at the 1st meeting after the teacher gives the problem to
be searched through experiment, analyzing the result and making conclusions, then at the 2nd and 3rd meeting the discussion activities appear as a whole. The listening activity of the teacher's explanation appears in all students when the teacher performs the preliminary activities, guides the group to experiment and make conclusions. Writing activities appear on each student when retrieving result, processing result and creating individual experimental reports. Student activity observes and performs experiments appearing in all students alternately during learning due to the limitations of the measuring instrument in the test schools. Activity of questioning students appeared alternately during the 53% of learning at the 1st meeting, 66% at the 2nd and 66% meetings at the 3rd meeting. The activity of delivering opinions and information in the class came 66% at the first meeting, 80% at the next meetings of the entire student. There are still many passive students during the group discussion. Irrelevant behavior appears at the beginning of the 1st meeting where 20% of students use experimental equipment outside the procedures at the worksheets. This behavior is reduced to 0% at the next meetings after students are given understanding by the teacher. Based on these results can be concluded that guided inquiry learning can encourage students to be more active and courageous, especially in conveying opinions and information to others.

During the lesson, the obstacles that emerged at the first meeting because not all laptop students installed adobe premier software that is used as a medium for recording and reading experimental result. Another obstacle that arises is the limitations of measuring instrument available in schools so that the use must be alternating and running out of time for the experiment. To overcome this, researchers help students to install premier adobe after the 1st meeting and increase the allocation of learning time.

3.3 Effectiveness of Learning Instrument

The effectiveness of instructional instrument in this research is reviewed from two aspects, namely students' science process skills and student responses. Science process skill tests are used to measure students' science process skills. The tests developed include a performance test and a comprehension test. The multiple-choice comprehension test includes: observing, formulating hypotheses, defining experimental variables, defining operational variables, conducting experiments, interpreting graphs, analyzing result, making conclusions, predicting and communicating. Skills of students' Science Process are analyzed using the degree of N-Gain improvement. The result of the test analysis of students' science skill understanding in class X RPL 1 obtained an average increase of N-Gain by 0.82 with high category, in class X RPL 2 had an average N-Gain increase of 0.80 with high category and in grade X MM 1 experienced an average N-Gain increase of 0.80 with high category. Based on the grain sensitivity analysis the question also shows that the overall grain of test of comprehension of science process skill developed has sensitivity index > 0.3 or sensitive category. This suggests that an understanding of the science process skill test can be used to differentiate the science process skills before and after learning activities. The result of the analysis of students science skill performance test in class X RPL 1 obtained an average N-Gain increase of 0.81 with high category, in class X RPL 2 experienced an average N-Gain increase of 0.82 with high category and in class X MM 1 experienced an average increase of N-Gain by 0.85 with high category. This suggests that guided inquiry learning can improve the understanding and performance of students for science process skills.

Student response to guided inquiry activity is obtained by using questionnaire given to the students after the implementation of learning activities. The students' response to the development of learning instrument was 93% felt interested and 90% felt new to the material, worksheets, Student Handbook, Assessment Sheet and the class's management by teacher. Of the 96% of the student respondents also showed easy skills in the process of science and 97% interested in the skills of the science process trained. So it can be concluded that 93% of students responded well and positively to guided inquiry learning that was used to trained the science process skills. Seeing the response of students and the results of tests can be said that the learning instrument is very effectively used to train science process skills.

4. Conclusion
Based on the results of this study can be concluded that the development of learning instruments using guided inquiry model valid and feasible to be used to train the skills of science students at Vocational High School.

References
**Practicum Design Of Purifying Bioethanol Using Distillation Device With Condenser Of Household Plastic Waste To Increase Student Creativity On Petroleum Materials**

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**Abstract.** This research aim is to obtain practicum design of purifying bioethanol using distillation device with condenser of household plastic waste to increase student creativity on petroleum materials. Bioethanol used is made from fermentation of palm sap produced from Kapuntori District, Buton District, Southeast Sulawesi Province. This research method is ADDIE development (Analysis, Design, Development, Implementation, and Evaluation). However, this research method only did until the implementation step practicum design, where student can create a set of distillation device with condenser from household plastic waste by looking at the description of the distillation device and practicum design which has optimization and valid. In necessity analysis, the researcher analyzed literature study and field study. After this, the next step is design step, in this step the researcher plan a bioethanol practicum work design and a simple set of distillation devices with condensers from household plastic waste then consul about it with an expert lecturer of bioethanol purifying. After the design step, the next is development step, the researcher did optimization process for 3 times. The optimization process aims to obtain optimal results and validity of the practice design to be used as a reference when the process of implementasi in school. After optimization process then implementation in class XI MIA 3 SMAN 1 Kapuntori petroleum material and obtain 3 distillation device with condenser from different plastic household waste and can be used for bioethanol purification process proved with the result obtained.

**1. Introduction**

The development of education in Indonesia is considered not to educate the level of creativity of students because only measure their intelligence through the amount of cognitive value in each school [1]. Creativity aspect assessment is still not optimal, so it is necessary to do a chemistry study that can assess psychomotor student optimally. Creativity students can be assessed through practicum activities. Through practicum learning students practice investigating an experiment, so that teachers can see firsthand the performance of students. The revelation is supported by the opinion of [2] which states that learning practicum can improve student creativity.

Through this journal we designed a bioethanol purification practice using a distillation device with a condenser from household waste. Considering that bioethanol in a pure state can be used as an altruative fuel or sebgai fuel oil mixture, as medical alcohol, cleaning fluid and others [3]. The bioethanol purification process uses a simple distillation device. Bioethanol that we use is palm juice that comes from kecuntatan Kapuntori Buton regency Southeast Sulawesi due to the production of palm juice is very abundant marked by the number of palm trees. In our journal we designed a distillation device with a condenser from household waste, so that students could be skilled in creating...
a set of distillation device by looking at the description of the distillation tool asked by the researcher. Therefore, researchers conducted a study entitled practicum design of purifying bioethanol using distillation device with condenser of household plastic waste to increase student creativity on petroleum materials.

2. Research methods
This research is a development research using ADDIE development method. This model consists of five stages, namely (A) nalysis, (D) esign, (D) evelopment, (I) mplementation, and (E) valuation [4]. But this research only reached the implementation stage.

2.1. Stages of Analysis
At the analysis stage, the researcher analyzed the field study, the researcher reviewed the observation result of the practicum implementation on the petroleum material, reviewed the observation laboratorium and studied the psychomotor level of the students in the school.

2.2. Stages of Design
At the design stage the researchers describe the practice of purifying bioethanol and a simple distillation device. The distillation device in this study was made of unused household appliances and glassware in laboratories such as elemeyer. After the process of making the practicum design and then the design is consulted with lecturers who are experts in the field of bioethanol purification.

2.3. Stages of Development
Practicum design and distillation device made by researchers have been consulted to lecturers who are experts in the field of bioethanol purification. Then do 3x optimization with regard to the results of the destialsi process.

2.4. Stages of Implementation
At this stage students create a distillation device. Maker of distillation device by looking at the distillation device made by the researcher.

3. Results and Discussion
3.1. Stages of Analysis
At this stage only analyze the field study. The researcher interviewed one of the teachers of class XI MIA3 SMAN 1 Kapuntori. Based on the results of interviews practicum activities for petroleum materials has never been implemented in schools this limitation of laboratory equipment and the limitations of time allocation so as to affect the level of student skills on petroleum material. In addition to the assessment of students' skills, the teacher takes the value of the student's home duties and student attendance.

3.2. Stages of Design
At this stage, researchers designed a bioethanol purification practice. After the design process is done then the practice is consulted by experts to validated. The following stages of bioethanol purification practice design have been consulted and validated by the expert with the following working procedures of the stages of the distillation process: (1) Compilation of the distillation device as shown in Figure 1. Figure 1 is a distillation device with condenser using household waste that is used bottle 1.5 L with the following device: elemeyer glass, hose, cover (cardboard), used bottle and thermometer, (2) as much as 150 mL syrup input into the elemeyer near the spritus burner, (3) ignite the fire, (4)
Observe temperature, aren in elemeyer, condensation and distillate yield, (5) heating process carried out for 30 minutes, (6) notes of things that occur during the lab.

Fig 1. Distillation Device With A Condenser From Waste Bottles

3.3. Stages of Development
At this stage, the practicum design that has been consulted and approved by the experts is then optimized as much as 3x with the aim of optimizing the work of the practicum design from distillation equipment with used bottle condenser. The purification result obtained from the distillation process can be seen in table 1.

Table 1. Purification Results of Bioethanol For 30 Minutes

<table>
<thead>
<tr>
<th>Optimization</th>
<th>Level (%)</th>
<th>Volume of Distillate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early</td>
<td>End</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>27</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>29</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>29</td>
</tr>
</tbody>
</table>

Based on data table 1, the purity level increased and the volume obtained was also significant within 30 minutes. Based on this, the distillation device with a condenser of household waste can be used in the optimization process as the student's first overview in the manufacture of distillation devices.

3.4. Stages of Implementation
At this stage students are required to create a distillation device based on a different image 1 of the condenser. This stage students get 3 simple distillation device can be seen in figure 2.
Figure 2. Distillation drawing made by the student

The result of figure 2 a, b, c distillation for 30 minute is shown in table 2 as follows:

Table 2. The result of figure 2 a, b, c distillation for 30 minute

<table>
<thead>
<tr>
<th>Optimization</th>
<th>Level (%)</th>
<th>Volume of Distillate</th>
</tr>
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<tbody>
<tr>
<td>Early</td>
<td>End</td>
<td></td>
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<tr>
<td>a</td>
<td>5</td>
<td>34</td>
</tr>
<tr>
<td>b</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>c</td>
<td>5</td>
<td>37</td>
</tr>
</tbody>
</table>

Based on figure 2 and table 2, students can make a simple distillation device and can be used in the process of purifying bioethanol.

4. Conclusion
The conclusion in this research has succeeded in increasing the creativity value of students, as can be seen in the implementation result, students can create and assemble distillation device.

5. References
The Development Teaching Materials of Biology Integrated Science Literacy Assisted by Macromedia Flash

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Abstract. This research is motivated by the low level ability of student’s science literacy in biology learning, besides that also school less provide teaching materials for students. The research aims is to develop biology teaching material integrated science literacy assisted by macromedia flash is feasible used based on the validity, practicality, and effectiveness to measure student’s science literacy. In this research using 4D development model. The research target is the teaching materials of biology which is tried out to 36 students of class X SMA with research design One-Group Pretest-Posttest design. Data analysis with descriptive qualitative with the result: (a) Validation of teaching materials with a valid category (3,3); (b) Validation of learning media macromedia flash with a very valid category (3,7); (c) adherences to very good learning (3,7); (d) student’s activity reached 95,5%; student’s response positive (100%); (e) The results of students’ learning that has an impact on the increased level ability of student’s science literacy from the beginning level below 1 to 2 increased to levels 3 to 6. The conclusions of this research is that the teaching materials of biology based on science literacy assisted by macromedia Flash is feasible to measure student’s science literacy.

INTRODUCTION

Biology is one branch of science that continues to grow and develop obtained through data collection with experiments on natural phenomena and natural characteristics around the way systematically applied in the environment, through science education, especially biology is expected to become a means for students to better recognize, exploring knowledge and gaining a meaningful understanding of the natural surroundings along with the phenomena that occur and can apply them in everyday life.

Science literacy becomes very important for every learner as a stock to face the challenges of development in this era of globalization. This is in line with the quotation: Treacy et al. (2010): science literacy is directly correlated to building a new generation of strong scientific thoughts and attitudes effectively communicating science and research results to the general public. The concept of literacy is understood as a set of information processing abilities, far above the ability to analyze and understand reading materials not just about reading and writing.

Given the importance of science literacy in the current era, it is necessary for teachers' efforts to spur student literacy, by bringing out the latest innovations in learning. Achievement of educational goals should be supported by the presence of adequate facilities and infrastructure. One of them is teaching materials and instructional media used in every school. Teaching materials are very important in the learning process. Teaching materials is everything that contains learning materials used by teachers to assist in carrying out teaching and learning activities in the classroom (Prastowo, 2012).

The reality of the field, that during the learning process students tend to only listen to material submitted by teachers and students are asked to do the questions given teachers, in addition the school also does not provide textbooks or work sheet for students. This problem causes the students to lack the concept master so that they can not apply the concepts or theories learned in real life. Students are also not accustomed to learning in the face of some cases or phenomena that occur in everyday life, so that many students are lacking in the ability of science literacy. Learners need a new learning process so as not to be monotonous and boring. The possibility of using computer software applications such as macromedia flash, can create a more interactive learning atmosphere,
active and can measure student’s science literacy. Some researchers conducted research using learning media such as research conducted (Rosandi, 2017). The study shows that the use of Flash-based multimedia can improve the ability of students’ science literacy from the first level still below 1 to 2 increased to levels 3 to 6.

In connection with this, biological teaching materials with the help of macromedia flash may be able to assist teachers in delivering material about the virus and help students in understanding the material presented by the teacher. It is expected that students can also trace the science literacy by mastering the concept on viral material and applying it in everyday life.

The research aims is to develop biology teaching material integrated science literacy assisted by macromedia flash is feasible used based on the validity, practicality, and effectiveness to measure student’s science literacy.

**METHOD**

This research is a type of research development (developmental research), by developing teaching materials of biology Assisted by macromedia flash which contains the sub subject of the virus and has been prepared in accordance with the learning tools in the form of silabus, lesson plan, student worksheet, and student’s science literacy instrument. This research was conducted at Universitas Negeri Surabaya and implemented in SMA Negeri 1 Situbondo which was tested on 36 students of class X MIPA 3 even semester of academic year 2017-2018. In this research adapted using 4D development model (four D model) consisting of definitions, design, develop, and disseminate (Thiagarajan & Semmel, Semmel, 1974). In this research only until the stage of development (develop).

Define: aims to define and define the terms of learning. The components that exist in this stage include 1) Needs analysis, 2) Curriculum analysis, 3) Analysis of students, 4) Analysis of tasks, 5) Concept analysis, 6) Formulation of learning objectives.

Design (Design): aims to design teaching materials. In this stage the preparation of tests, media selection, and format selection.

Develop: aims to produce tutoring materials based on macromedia flash that have been revised based on input from experts. The purpose of teaching resource validation is to know the validity of the material before it is implemented in class. Validation is done after the instructional materials macromedia flash reviewed supervisor lecturer and validator. This stage aims to obtain an assessment and suggestion from the expert used to describe the validity of the teaching materials.

Research Design using One Group Pretest - Posttest Design, because the trial is only done on one group only without any comparison group. The research design can be described as follows:

\[
O_1 \quad X \quad O_2
\]

Keterangan:
O1: pretest, aims to determine the level of science literacy on learning materials before treatment is given.
O2: posttest, aims to determine the level of student science literacy on learning materials after being given treatment.
X: teaching and learning activities action using macromedia flash assisted resources

Research instruments are tools for collecting data. The instruments used in this research are validation of teaching materials, validation sheet of learning media Macromedia Flash, observation sheet of learning activity, student activity observation sheet, student science literacy test, questionnaire student response.
Technique of collecting data in this research use some technique that is teaching material validation and learning media macromedia flash, observation, giving questionnaire, and giving test.

Validated materials and media validated with RPP, LKS, and science literacy tests developed, then assessed by three validators according to instruments that have been prepared with a range of 1-4 scores, with categories 1 = invalid, 2 = less valid, 3 = valid, 4 = very valid. The data obtained were analyzed with the average score of each aspect.

RESULTS AND DISCUSSION

The results of the research were prepared based on the results of one trial that has been implemented in SMA Negeri 1 Situbondo Lesson year 2017-2018 with participants as many as 36 students of class X.

The results of validation of teaching materials, learning media, syllabus, RPP, Student Activity Sheet (LKS), and above science literacy instruments can be seen in Table 1.

Table 1. Results of Validation of teaching materials, learning media and devices

<table>
<thead>
<tr>
<th>No.</th>
<th>Aspects that are graded</th>
<th>average rating scores</th>
<th>V1</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Teaching materials</td>
<td>3.1</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Instructional Media</td>
<td>3.6</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Syllabus</td>
<td>3.4</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Lesson plan</td>
<td>3.3</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Student worksheet</td>
<td>3.3</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Science literacy instruments</td>
<td>3.1</td>
<td>3.2</td>
<td></td>
</tr>
</tbody>
</table>

Information: V1= validator 1 V2= validator 2

Validation results by two validators showed the average score of the result of the validation of the teaching materials in the form of content feasibility component, language component, and presentation component on the teaching material of 3.3 with valid category (Ratumanan & Laurens, 2011) with reliability of 96%. The result of validation of learning media macromedia flash with the average score of 3.7 with the category is very valid and the average reliability of 98%. Learning tools used in the use of biology teaching materials assisted by macromedia flash also through the validation stage by two validators. The validation result of silabus is 3.6 with valid category and the average reliability is 97%. The validation result of RPP is 3.3 with valid category with 100% reliability. The LKS validation results show the average score of 3.5 with the valid category and the average reliability of 94%. The result of validation of science literacy instrument obtained the average score of 3.1 with valid category and the average reliability of 92%. In accordance with the statement Borich (1994), that the developed instrument is said to be reliable if it has a percentage of ≥ 75%.
Trials of teaching materials using macromedia flash is done to know the effectiveness of learning using teaching materials developed, assessment of teaching materials with integrated macromedia flash this science can be seen from: Implementation of Learning Implementation (RPP), student activity, student’s science literacy and student response virus material. The results of the RPP observed by two observers during the three meetings on trial 1 presented the average learning implementation score is 3.7 with very good category and the average percentage reliability of 90%. Student activity can be categorized actively because student activity reach 95.5% (> 50%) during learning. In accordance with the main purpose of a media is to provide opportunities for students to learn directly, touch, observe, test try to be curious and to decide (Smaldino, 2012). Students’ responses to the biology-assisted macromedia flash developed materials also look positive.

The results of learning experiments using aided instructional materials macromedia flash is also used to measure students' science literacy, which is presented on the student science literacy test diagram in Figure 2.

![Pretest dan Posttest Literasi Sains](image)

**Figure 2.** Student science literacy test diagram

**REFERENCES**


Influence of Cooperative Learning Model Type Pair Cheks Based Tasks Submission Problems To Student Problem Solving Ability Mathematics

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Abstract. Improving the quality of education, especially in learning mathematics, with the aim of training students' thinking skills. One example of impro the quality of learning using learning models that are appropriate for students. The problem is the problem of simple problem formulation or problem formulation and complex problem solving, the method of using quantitative and qualitative methods in sequence, where at the beginning of the first research was conducted using quantitative methods and in both phases carried out with qualitative methods. Subjects in learning are students from 2nd grade VIII where one class becomes a class and the class becomes an experimental class. The instrument in this study about Pretest and Posttest Instruments. Preliminary data analysis can be used for the results of pre-test normality consistency and average test average. He processed the final data which was done to test the test data from the normality of the test and test the hypothesis. In this study the data were generally analyzed using SPSS 20 Softwar by using cooperative learning models. Periodically 2004 checks were 91.4% and according to classical completeness criteria asan 91.4%. And according to the classical completeness criteria ≥ 85%, it can be concluded that the class is complete. From the results of research that you can conclude, cooperative learning Type Pair Cheks can be used as an alternative teacher, in the learning process.

1. Introduction
The development of science and technology requires the improvement of knowledge and education in order to facilitate the students in the progress of science and technology. In this case the effort to improve the quality of education in Indonesia is to make improvements, and versatile in all aspects affecting education based on Law No. 20 of 2003 Article 1 concerning the National Education System. Various efforts to improve the quality of education continue to be done, especially by the school. One example of quality improvement is done by teachers primarily in using appropriate learning models for students to learn. Syahbani (2005: 7 that mathematics learning emphasizes awareness and the ability to argue and communicate systematically solve problems and apply mathematics to everyday life. Students should be pursued as active learning subjects in constructing or constructing themselves in the understanding of the material under study. Teachers should act as creative facilitators and mediators so that students can learn in a pleasant atmosphere with problem solving.

According to Silver & Cai (in Sarbaini, 2009) the problem is that there are several definitions: first, the formulation of a simple problem or the re-formulation of the existing problem with some changes to make it simpler and understandable in solving complex problems. Second, the formulation of questions relating to the conditions on the completed matter to seek other alternative solutions. Third, the formulation...
of questions from the available information or situation, whether done before, during, or after the settlement of a problem. KRulik and Rudnik (1995, p.4) explains that "A problem is a situation, quantitative or otherwise, that confront an individual "The problem is a situation or the like that is faced by a person or group who wants a decision and that someone is looking for a way to obtain solutions. This also means the problem of the situation (problem) can be found the solution by using a thinking strategy called problem solving.

In learning mathematics, one of the alternative learning models to realize the above is cooperative check type Pair Check model, because by using the Pair Check model, the students do not only work in groups, but also provide the task to share tasks and knowledge with the theme. In this case, the teacher must have broad insight that can be the teacher and can know the limits of material that can be used at all levels of education other than that it can also be accessed by students. One of the learning materials is a two-variable linear abstract system (SPLDV). A two-variable linear abstract system (SPLDV) is a combination of two or more of the same linear one another. Many daily problems can be solved mathematically. One of them is to create a model for SPLDV, then look for the SPLDV solution that is formed. There are several methods for finding SPLDV solutions, namely elimination, substitution, combination and combination methods. Then this was proposed in the eighth grade junior high school. SPLDV Is a material that often appears and also in everyday life. By implementing Cooperative Learning Pair, checks in learning mathematics at school can improve understanding and understanding of problems, groups, activities, and group evaluations. Learning is done in groups by using sheets or other learning tools, students work together (discuss) for the material. They help each other understand the material, so make sure all members of the group have learned the material and what is needed to solve mathematical problems. Based on the description above, the researcher wants to know the Pair Cheks Cooperative Learning Model Based on the Problem Programming Task for Student Mathematics. How to carry out a cooperative type implementation? Check if there is a problem? Mention the problems of students with several types of cooperative learning Type Cheks Pair By Job Submission of Problem Programming Problems for Student Mathematics.

2. Method
This type of research is research. The type of research used in this study is research method of creation of quantitative research methods, (Sugiyono, 2015: 415). In this quantitative research using experimental type experiment with research design using Pretest-Posttest Control Group Design. In this study using two classes, namely 1 experimental class that was taught using a cooperative learning model type pair checks and 1 control class that taught with conventional learning Subjects in this study were students from 2 class VIII junior high school where one class became the control class and the other became experimental class. The instruments used in this research are 1) Pretest and Postes Problems. This supporting instrument was taken to obtain data on the effect of the cooperative model of pair-checks type with the task of problem solving on students' mathematical problem solving. After the comparison problem is said to be valid by the validator, the instrument readability test is carried out. Readability testing is done to junior high school students who are not the subject of research. Test legibility is done to see whether comparative problems can be understood and understood by the students of SMP class VII. If the junior high student can not understand the questions asked in the instrument then the researcher make improvements and consulted to the experts or experts, in this case the lecturer of mathematics education. However, if the junior high students already understand the questions contained in the instrument, then the matter of pretest and postestlayak used as a research instrument. 2) Test. Problem test is arranged to determine the extent to which the problem solving skills of students in finest problem SPLDV which the test questions are prepared and consulted first to the supervisor then will be validated by the validator. Problem of this test will be used to find out how the ability to solve student problems in solving SPLDV problem. 3) Observation sheet. The observation sheet created and consulted with the lecturer is then validated by the validator. This validation sheet will be
used during the teaching-learning process which is used to observe the activities of teachers and students. Activity of teacher observed whether according to phair cehcks learning model while student activity observed during group process work progress. Technique of collecting data in this research is done by test method. Test methods are used to obtain data about the problem solving ability of learners in the process of learning mathematics before an after treatment. The test given is a matter of pre-test and post-test in the form of a description problem. Before the learning begins, the experimental class and control class are pre-tested to measure the initial conditions of the problem-solving ability of the learner. Furthermore, the experimental class is treated with cooperative learning model of pair checks type and control class using conventional learning. After completion of the control class and the experimental class were given a test (post-test) to measure the final condition of the problem-solving ability of the learner after being treated. Data analysis in this research is used to know the difference of problem solving ability of learners in learning of mathematics between experiment group and control group which done with two stages that is initial data analysis and final data analysis. Initial data analysis was performed to test data of pre-test result consisting of normality test and equality test average. While final data analysis done to test data of post-test result consist of normality test and hypothesis test. In this research in general data is analyzed by using SPSS 20 Software.

3. Result and Discussion

In cooperative learning, students can interact with each other and create effective problem solving strategies. Cooperative learning differs from the usual group learning, because in cooperative learning, students are not only responsible for the group. Cooperative learning is a teaching technique. Where students work in a small group of 4-5 people with heterogeneous members. From gender, ethnic social status and learning outcomes. Then they work together or help each other in completing the tasks assigned by Master. Cooperative learning is developed to attain at least three important learning objectives:

a. Learning Outcomes Academic

Although cooperative learning encompasses a wide range of social goals, this model also aims to improve student performance in academic tasks,

b. Social Skills Development

The third important goal of cooperative learning is to teach students the skills of collaboration and collaboration. In the meantime, many young people and adults are still lacking in social skills.

c. Social Skills Development

The third important goal of cooperative learning is to teach students the skills of collaboration and collaboration.

1. Phair checks learning steps
Here are the phair checks steps according to shomin (2014, 119) as follows:
a. Divide the students in the class into groups of 4.
b. For more groups these students become paired. So, there will be a partner A and partner B on both pairs.
c. Give each pair a LKS to work on. LKS consists of several problems or problems (number of even).
d. Next, give the opportunity to partner A to work on problem # 1, while partner B observes, motivates, guides (when needed) partner A while working on question number 1.
e. Subsequently exchanging roles, partner B does number 2, and partner A observes, motivates, guides (if needed) partner B while working on question 2.
f. After 2 questions are resolved, the couple checks the results of their work together with another couple who are a group with them.
g. Each group that gets agreement (equality of opinion / problem solving / problem solving) celebrates their success, or the teacher rewards. Teachers can provide coaching if both partners in the group find no agreement.
h. Steps 4, 5, and 6 are repeated again to solve questions 3 and 4, and so on until all the questions on the LKS are done in each group.

Table 4.1
Data on Student Response Results on Cooperative Learning Model of Pair Cheks Type

<table>
<thead>
<tr>
<th>NO</th>
<th>STUDENT RESPONSE ASPECT</th>
<th>Number of Responses Student</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>1</td>
<td>Did you know that in this lesson use the Cooperative Learning Model Type Pair Cheks?</td>
<td>30</td>
</tr>
<tr>
<td>2</td>
<td>Do you know the benefits of the Pair Cheks Type Co-operative Learning Model that has been provided?</td>
<td>28</td>
</tr>
<tr>
<td>3</td>
<td>Are you happy and interested in learning mathematics by using Cooperative Learning Model Type Pair Cheks on the subject of volume and area of wake up space?</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>Do you feel more appreciated in expressing your opinion by using cooperative type pair cheks learning model on volume subject and area of wake up space?</td>
<td>27</td>
</tr>
<tr>
<td>5</td>
<td>Are you having trouble completing a given task?</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>Can you learn well if you are given other tasks that can support your learning success?</td>
<td>30</td>
</tr>
</tbody>
</table>

1. Data on Student Learning Results
   This data is obtained from the results obtained from the test instrument given to VIII MTs Miftahul Ulum Sekobanah Sampang. The complete test result data is as follows:
   Table 4.2
   Value of Test Results Volume Subject
and Space Sides Build Space

<table>
<thead>
<tr>
<th>No</th>
<th>Student's Name</th>
<th>Value</th>
<th>Completeness</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A F</td>
<td>90</td>
<td>Complete</td>
</tr>
<tr>
<td>2</td>
<td>A S</td>
<td>85</td>
<td>Complete</td>
</tr>
<tr>
<td>3</td>
<td>A W</td>
<td>75</td>
<td>Complete</td>
</tr>
<tr>
<td>4</td>
<td>B Y</td>
<td>69</td>
<td>Complete</td>
</tr>
<tr>
<td>5</td>
<td>B R</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>6</td>
<td>C *A</td>
<td>65</td>
<td>Complete</td>
</tr>
<tr>
<td>7</td>
<td>F R</td>
<td>70</td>
<td>Complete</td>
</tr>
<tr>
<td>8</td>
<td>H SY</td>
<td>76</td>
<td>Complete</td>
</tr>
<tr>
<td>9</td>
<td>HI</td>
<td>49</td>
<td>No Complete</td>
</tr>
<tr>
<td>10</td>
<td>Ht</td>
<td>73</td>
<td>Complete</td>
</tr>
<tr>
<td>11</td>
<td>Kh</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>12</td>
<td>Mhn</td>
<td>60</td>
<td>No Complete</td>
</tr>
<tr>
<td>13</td>
<td>Mki</td>
<td>70</td>
<td>Complete</td>
</tr>
<tr>
<td>14</td>
<td>M. Sn</td>
<td>93</td>
<td>Complete</td>
</tr>
<tr>
<td>15</td>
<td>M. S B</td>
<td>68</td>
<td>Complete</td>
</tr>
<tr>
<td>16</td>
<td>M R</td>
<td>82</td>
<td>Complete</td>
</tr>
<tr>
<td>17</td>
<td>M. Hl</td>
<td>73</td>
<td>Complete</td>
</tr>
<tr>
<td>18</td>
<td>M. B</td>
<td>65</td>
<td>Complete</td>
</tr>
<tr>
<td>19</td>
<td>N H</td>
<td>65</td>
<td>Complete</td>
</tr>
<tr>
<td>20</td>
<td>Ndi</td>
<td>65</td>
<td>Complete</td>
</tr>
<tr>
<td>21</td>
<td>Rhd</td>
<td>80</td>
<td>Complete</td>
</tr>
<tr>
<td>22</td>
<td>Sto</td>
<td>70</td>
<td>Complete</td>
</tr>
<tr>
<td>23</td>
<td>Sdi</td>
<td>85</td>
<td>Complete</td>
</tr>
<tr>
<td>24</td>
<td>S R</td>
<td>90</td>
<td>Complete</td>
</tr>
<tr>
<td>25</td>
<td>S A</td>
<td>65</td>
<td>Complete</td>
</tr>
<tr>
<td>26</td>
<td>Sht</td>
<td>78</td>
<td>Complete</td>
</tr>
<tr>
<td>27</td>
<td>Shn</td>
<td>75</td>
<td>Complete</td>
</tr>
<tr>
<td>28</td>
<td>ST R</td>
<td>69</td>
<td>Complete</td>
</tr>
<tr>
<td>29</td>
<td>ST L</td>
<td>90</td>
<td>Complete</td>
</tr>
<tr>
<td>30</td>
<td>U H</td>
<td>45</td>
<td>Complete</td>
</tr>
</tbody>
</table>

4. Conclusion
Based on the results of data analysis research on the application of cooperative learning model type pair checks on the subject volume and the welfare of classroom VIII MTs Miftahul Ulum Sekobanah Sampang 2012/2013 academic year can be summarized as follows:
1. The response of grade VIII students MTs Miftahul Ulum Sokobanah Sampang during learning with cooperative learning model Type Pair Checks can be stated very well. This can be seen from the average percentage of answers or positive responses of students is 90%.
2. Based on the results of data analysis of student learning outcomes with the implementation of cooperative learning model Type Pair Checks on the subject volume and the wake-side space diproleh percentage of learning completeness classically reach 93.33%. As the formula used to measure mastery learning individually by using KKM.65. Linux classical learning can be achieved if the percentage of learning completeness klasikal (PBK) reached percentage $\geq 85%$. 

5. Suggestion
Based on the result of the research, the researcher can give suggestion as follows: Because the research result shows that cooperative learning of Pair Checks type can increase the activity and result of student learning, so it is expected that the teacher make cooperative learning model Pair Check Type is one of alternative in teaching learning process.

References

Innovation of Lycopene Isolation Procedure from Tomatoes
(Lycopersicum esculentum)

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Abstract. Tomatoes (Lycopersicum esculentum) are horticulture plants frequently cultivated in Indonesia. Lycopene is one of tomatoes largest chemical content in tomatoes. This research had been able to isolate lycopene with extraction method on 65 °C temperature using hexane and methanol antisolvents. Isolation procedure in this research was modification from previous research. Sample in this research were dry tomatoes powder. Research result showed that hexane solvent yielded lycopene level of 3.10 mg/100 g tomatoes powder. Functional group analysis using Fourier Transform InfraRed (FT-IR) spectroscopy detected C = C group at wavelength 1674.91 cm\(^{-1}\) and 1639.65 cm\(^{-1}\), aliphatic CH (stretching) was indicated by the appearance of a sharp absorption peak at number wave 2853.12 cm\(^{-1}\), CH (CH\(_3\)). Indicates absorption at wave number 1378.71 cm\(^{-1}\). The sharp peak at the wave number 2924.16 cm\(^{-1}\) shows the presence of C-H alkene (stretching), and C-H alkene (bending) at the wave number 1498.86 cm\(^{-1}\).

Keywords: Isolation, Lycopene, Lycopersicum esculentum

INTRODUCTION

Tomatoes (Lycopersicum esculentum) are horticulture plants with abundant availability in Indonesia. Tomatoes are also food material with high folic acid, vitamin C, and potassium content. Potassium content within one hundred grams of tomatoes are 245 mg. Potassium could reduce blood pressure by lowering sodium in urine and water with diuretic way [11].

Compound content within tomatoes (Lycopersicum esculentum Mil) amongst them are lycopene, solanine, saponine, folic acid, malic acid, citric acid, bioflavonoid (including lycopene, α and β-carotene), protein, fat, vitamin, mineral and histamine [5]. The most dominant compound is lycopene as of 63.6% [17].

The maturity level of tomatoes affects the lycopene content produced, the young green tomato contains lycopene about 25 ug / 100 g fresh weight, yellowish tomatoes 370 ug / 100 g (fresh weight, red tomato 4600 ug / 100 g fresh weight, and tomato pass mature contains lycopene about 7050 ug / 100 g fresh weight [6]. The tomato skin is dried in the sun, containing crude protein of 13.8 g / 100 g of dry matter, lycopene 112 mg / 100 g dry matter [3].

Lycopene frequently referred to as α-carotene, bright red pigment carotenoid that mostly encountered within tomatoes and another red fruits. Lycopene in nature are in form of trans which is stable form thermodynamically, dissolve in non polar solvent and found in 446-50nm wave length range. Light and heating existence potentially turn trans isomer into cis [15].

Based on previous research, [2] had been able to isolate lycopene from tomato sauce with solid liquid extraction method and crystallization using methanol and carbon tetrachloride mixture solvent yielding extraction yield of 2.313 mg/100 g of tomato sauce. [13] were able to perform extraction
with soxhlet and antisolvent (methanol) method with hexane, ethyl acetate and ethanol solvents with Ethyl Acetate extract yield of $4.39 \pm 0.27$ mg/g, Hexane: $3.38 \pm 0.38$ mg/g, Ethanol: $1.25 \pm 0.29$ mg/g. [18] successfully isolated lycopene from tomato juice using liquid-liquid method, using methanol and ethanol as antisolvent with the results of 3.2 mg / 150 ml and 2.8 mg / 150 ml. Therefore isolation procedure innovation are necessary to obtain higher lycopene compound content.

**Table 1. Tomatoes Nutrition Content within 100 gram of Tomatoes [14]**

<table>
<thead>
<tr>
<th>Nutrition</th>
<th>Unit</th>
<th>Content per 100 grams tomatoes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin C</td>
<td>mg</td>
<td>22.8</td>
</tr>
<tr>
<td>Vitamin B-6</td>
<td>g</td>
<td>0.078</td>
</tr>
<tr>
<td>Folic</td>
<td>g</td>
<td>13</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>IU</td>
<td>489</td>
</tr>
<tr>
<td>Lycopene</td>
<td>g</td>
<td>3,041</td>
</tr>
<tr>
<td>B-carotene</td>
<td>g</td>
<td>293</td>
</tr>
<tr>
<td>Lutein</td>
<td>g</td>
<td>94</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>mg</td>
<td>0.56</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>g</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Lycopene is carotenoid with $C_{40}H_{56}$ and has 536.85 g / mol molecule weight with the following structure formula:

![Lycopene Chemical Structure](image)

Lycopene is non polar compound easily dissolved in chloroform, hexane, benzene, ethyl acetate, petroleum ether and others [9]. Method used in this research was liquid-liquid extraction. Liquid-liquid extraction is separation carried out should the separated mixture is homogenous solution (liquid – liquid) in which one component’s boiling point with other component consisted within mixture are nearly similar or adjacent.

Antisolvent crystallization stage carried out with methanol addition as antisolvent. Antisolvent crystallization is an effective separation and purification method. Antisolvent usage in this crystallization reducing certain dissolved substance solvability and forming crystal in timely manner. Crystallization experiment parameter highly affected particle formation mechanism and regulated crystal size form and its distribution. Generally, antisolvent include hydrophilic stabilizer such as surfactant absorbed on crystal surface to block crystal growth [1].

This antisolvent crystallization benefit is that the process could be carried out on temperature close to room temperature. This is highly comfortable for heat-sensitive substance. In addition, this process require low energy compared to solvent evaporation process [12]. Methods in this research were extraction using reflux and tomatoes powder. In reflux there is warming of mixture of simplicia and solvent in a round bottom flask. The solvent condenses with the coolant in the condenser through which the solvent vapor passes [8].

**Figure 1. Lycopene Chemical Structure**
MATERIALS AND METHODS

The materials used are n-hexana, methanol, aquadest, and fresh tomatoes which are washed using water, tomato seeds are discarded. Tomato is cut and dried using an oven for 3 days at a temperature of 60°C until a moisture content of around 0.8% is obtained. Then the dried tomatoes are ground. The tools used are: Blender, 1 set of reflux tools, scales, beaker glass, erlenmeyer, measuring cup, drop pipette, separating funnel, FT-IR spectroscopy.

100 grams of tomatoes powder inserted into 500 ml round flask bottom, added with 300 ml of hexane, that subsequently extracted on 65 °C temperature for 3 hours. Extract then separated from its raffinate. The obtained extract then added with 100 ml aquadest to eliminate impurities included with extract then separated using separating funnel. Subsequently, 100 methanol were added as antisolvent, that it produced lycopene crystal. Obtained lycopene crystal in optimum condition then analyzed using Fourier Transform Infrared Spectroscopy (FTIR).

RESULT AND DISCUSSION

FTIR spectrophotometry is a method that observes the interaction of molecules with electromagnetic radiation in the wavelength region of 0.75-1000 µm or at wave numbers of 13,000-10 cm⁻¹ [7]

FTIR (Fourier Transform Infra Red) characterization result of lycopene extract from tomatoes using hexane solvent with methanol addition as antisolvent, aimed to identify lycopene compound functional groups. FTIR (Fourier Transform Infra Red) result is presented in the following figure 2.

![Figure 2: Characteristics of FTIR (Fourier Transform Infra Red) Lycopene in Comparison of 1: 3 Feed and Solvent (F / S) with Antisolvent volume: 100 ml](image)

Figure 2: Characteristics of FTIR (Fourier Transform Infra Red) Lycopene in Comparison of 1: 3 Feed and Solvent (F / S) with Antisolvent volume: 100 ml
Table 2. Results of Characteristic Analysis (Fourier Transform Infra Red) of Lycopene Based on Its Function Group.

<table>
<thead>
<tr>
<th>Functional groups</th>
<th>Wavelength (cm(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kamil et al (2011)</td>
<td></td>
</tr>
<tr>
<td>Bunghez et al (2011)</td>
<td></td>
</tr>
<tr>
<td>Lycopene results from Analysis</td>
<td></td>
</tr>
<tr>
<td>Aromatic ring stretch (C=C)</td>
<td>1510</td>
</tr>
<tr>
<td>Symmetrical of CH(_2) lycopene</td>
<td>1444</td>
</tr>
<tr>
<td>Stretching OH</td>
<td>3450</td>
</tr>
<tr>
<td>CH(_2) assymetrical</td>
<td>2856</td>
</tr>
<tr>
<td>R-CH=CH-R lycopene</td>
<td>960</td>
</tr>
<tr>
<td>C-H bending</td>
<td></td>
</tr>
<tr>
<td>C-C and C-C-H Stretching</td>
<td></td>
</tr>
<tr>
<td>C-O stretching</td>
<td></td>
</tr>
<tr>
<td>V(C-O-C)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 shows the results of the functional group analysis on lycopene crystals from tomato extract through FTIR spectroscopy performance which showed that lycopene has a double bond C = C at a wavelength of 1537.09 cm\(^{-1}\). There is a symmetric functional group of CH\(_2\) lycopene at a wavelength of 1498.86 cm\(^{-1}\). O-H range groups occur at a wavelength of 3435.48 cm\(^{-1}\) which allows water vapor to be included in lycopene. The R-CH group = CH-R in lycopene has a wavelength absorption of 959.27 cm\(^{-1}\). Whereas the bent C-H group in lycopene is located at a wavelength of 1498.86 cm\(^{-1}\). In the C-C and C-C-H strain groups, each occurs at a wavelength of 1262.15 cm\(^{-1}\). For strain groups C-O has a wavelength of 1166.85 cm\(^{-1}\) and for stretch vibration C-O-C has a region with a wavelength of 959.27 cm\(^{-1}\) which indicates that there are residues of solvents and other compounds that are joined with lycopene.

Based on these comparisons it can be concluded that lycopene has been analyzed according to standards based on previous research.

In general, maximum carotenoid absorption is at three wavelengths that appear in the form of three spectrum peaks. Compounds with a greater number of conjugated double bonds have a higher wavelength value. Lycopene with 11 conjugated double bonds absorbs at the highest wavelength compared to other carotenoids.

The solvent used is very influential on the amount of lycopene obtained, this is because the interaction of the lycopene compound with the solvent used is the dispersion of solvent molecules. Lycopene compounds tend to be perfect if the solvents used are non-polar. This happens because the intermolecular forces between similar compounds tend to have the same strength. This tendency causes the rules "like dissolves like".

Antisolvent crystallization is a method of separation and purification which is an effective way to produce nano-sized particles [19]. The use of antisolvent in the crystallization process reduces the solubility of solutes in the solution and causes rapid crystallization. The crystallization parameter greatly influences the mechanism of particle formation, crystal size, and distribution [16]. So from the research that has been done, it can be concluded that the results of the research are in accordance with the theory.
CONCLUSION

Based on the results of research and analysis of FTIR (Fourier Transform Infra Red) spectroscopy it could be concluded that lycopene level obtained using hexane and methanol as an antisolvent were as of 3.10 mg/100 g (tomatoes powder).

REFERENCES


[14] Nutrient Data Laboratory, ARS, USDA National Food and Nutrient Analysis Program Wave, Beltsville MD, 2001


An Analysis of Ethnomathematic Activities in the Making Process of Tulungagung Marble

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Abstract. As time passes, mathematics is not only a mandatory learning at school which merely studies aspects and concepts but also unconsciously it is closely related to some activities in life and culture of society. Aspects, concepts and mathematical activities that related to culture can be studied and it is called as Ethnomatematics. The purpose of this research is to study and analyze the form of ethnomatematic activities in the process of making ornament motif in Tulungagung marble craft. Qualitative explorative was used as research method in this study. Ethnomatematics bridges between mathematics and culture. Ethnomatematic activities consist of 6 activities, namely counting, measuring, locating, designing, playing and explaining. The results of this study showed that the process of making marble in Tulungagung especially ornament motif contains mathematical activities. The etnomatematic activities in making process of marble includes counting, measuring, designing, and explaining.

Introduction
Mathematics is no longer just the mandatory counting lesson that has to be taken in every level of education, now is the time to realize that mathematics is unconsciously closely related to the daily life and culture of society. In fact, when examined more deeply, the concept of mathematics is often naturally used in a society. Society uses mathematical concepts for various activities, for example; counting, measuring, trade, construction, traditional games, and other forms that rely on mathematical concepts. However, not only in daily activities, this mathematical concept is also closely related to the culture of a society. Mathematical concepts can be studied along with the development of a culture. The study of mathematics from a cultural perspective is called ethnomathematics. The term ethnomathematics was introduced in 1977 a Brazilian mathematician known as D’Ambrosio [10] who defines ethnomathematics as follows: ethno, on broad terms refers to the members of a socio-cultural environment that are identified by cultural traditions, codes, symbols, myths, and the specific ways they live their life. On the other hand, the origin of the world mathema is still not much known; it tends to be used to explain, know, understand and perform activities such as computing, measuring, classifying, summarizing and modeling. [7] argues that the word Ethnomatematics can be used as a mode, style, and technique (tics) to explain, understand, and deal with the relation between natural and cultural environment (mathema) in different cultural systems (ethnos). [10] emphasizes that Ethnomathematics also studied aspects of mathematics; where ethnomatematics presents the mathematical concepts in the school curriculum, these concepts relate to cultural experience that enables learners to enhance their ability to describe meaningful relationships and deepen their understanding of mathematics. [11], the
culture provides a study on mathematics by connecting mathematical concept with culture and experience. [9], mathematics is regarded as a cultural construction, thus ethnomathematics is a product of cultural development. In contrast to [6], cultures are created, developed and debated through mathematical systems. This means the creation of culture is through mathematics. [5] states that the current ethnomathematics have been integrated into every mathematics class in every level of education.

**Ethnomathematics Activity**

([2],[3]) summarised the six activities as:

<table>
<thead>
<tr>
<th>Activities mathematics</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counting</td>
<td>The use of a systematic way to compare and order discrete phenomena. It may involve tallying, or using objects or string to record, or special number words or names.</td>
</tr>
<tr>
<td>Locating</td>
<td>Exploring one’s spatial environment and conceptualising and symbolising that environment, with models, diagrams, drawings, words or other means.</td>
</tr>
<tr>
<td>Measuring</td>
<td>Quantifying qualities for the purposes of comparison and ordering, using objects or tokens as measuring devices with associated units or ‘measure-words’.</td>
</tr>
<tr>
<td>Designing</td>
<td>Creating a shape or design for an object or for any part of one’s spatial environment. It may involve making the object, as a ‘mental template’, or symbolising it in some conventionalised way.</td>
</tr>
<tr>
<td>Playing</td>
<td>Devising, and engaging in, games and pastimes, with more or less formalised rules that all players must abide by.</td>
</tr>
<tr>
<td>Explaining</td>
<td>Finding ways to account for the existence of phenomena, be they religious, animistic or scientific</td>
</tr>
</tbody>
</table>

(from [2],[3])

[1] identifies the following six activities:

<table>
<thead>
<tr>
<th>Activities mathematics</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counting</td>
<td>Quantifiers (each, some, many, none); Adjectival number names; Finger and body counting; Tallying; Numbers; Place value; Zero; Base 10; Operations on numbers; Combinatories; Accuracy; Approximation; Erros; Fractions; Decimals; Positive, Negatives; Infinitely large, small; Limit; Number patterns; Powers; Number relationships; Arrow diagrams; Algebraic representation; Events; Probabilities; Frequency representations.</td>
</tr>
<tr>
<td>Locating</td>
<td>Prepositions; Route descriptions; Environmental locations; N.S.E.W. Compass bearings; Up/down; Left/right; Forwards/Backwards; Journeys (distance); Straight and Curved lines; Angle as turning Rotations; Systems of location: Polar coordinates, 2D/3D coordinates, Mapping; Latitude / Longitude; Loci; Linkages; Circle; Ellipse; Vector; Spiral.</td>
</tr>
<tr>
<td>Measuring</td>
<td>Comparative quantifiers (faster, thinner); Ordering; Qualities; Development of units (heavy - heaviest - weight); Accuracy of units; Estimation; Length; Area; Volume; Time; Temperature;</td>
</tr>
</tbody>
</table>
Weight; Conventional units; Standard units; System of units (metric); Money; Compound units.

Designing
Design; Abstraction; Shape; Form; Aesthetics; Objects compared by properties of form; Large, small; Similarity; Congruence; Properties of shapes; Common geometric shapes, figures and solids; Nets; Surfaces; Tesselations; Symmetry; Proportion; Ratio; Scale-model Enlargements; Rigidity of shapes.

Playing
Games; Fun; Puzzles; Paradoxes; Modelling; Imagined reality; Rule-bound activity; Hypothetical reasoning; Procedures; Plans Strategies; Cooperative games; Competitive games; Solitaire games; Chance, prediction.

Explaining
Similarities; Classifications; Conventions; Hierarchical classifying of objects; Story explanation; logical connectives; Linguistic explanations: Logical arguments, Proofs; Symbolic explanations: Graphs, Diagrams, Charts, Matrices; Mathematical modelling; Criteria: internal validity, external generalisability.

(from [1])

Method
This research uses descriptive qualitative approach. The research was conducted to gather information on ethnomathematic activities in the process of marble craft, focusing on marble ornamental patterns. Sources of data in this study include the marble artists and mathematicians. The data were gathered through observations, documentation and speeches from the interview during the crafting process.

Result and Discussion
This article will discuss the ethnomathematic activity in the process of making marble-crafting, focusing on the creation of patterns by the marble artists. Marble ornament patterns are created through the following 6 stages:

<table>
<thead>
<tr>
<th>No.</th>
<th>Stages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Deciding the theme or pattern</td>
</tr>
<tr>
<td>2</td>
<td>Pattern Formation</td>
</tr>
<tr>
<td>3</td>
<td>Pattern cutting</td>
</tr>
<tr>
<td>4</td>
<td>Uniting the patterns according to the design</td>
</tr>
<tr>
<td>5</td>
<td>Polishing the patterns</td>
</tr>
<tr>
<td>6</td>
<td>Ornament patterns are done</td>
</tr>
</tbody>
</table>

Table 1. Six stages on the creation of marble patterns

Ethnomathermatic activity consists of 6 activities; counting, measuring, locating, designing, playing and explaining. [4] stated that ethnomathermatic activity consists of counting that develops number language, number imagery and number system; locating develops spatial language, images and coordinate system; measuring develops images, shapes and geometrical ideas. Playing seems to develop the idea of 'game'. The results of exploration of ethnomathermatic activity in the process of marble creation emphasizes that the process involves mathematical activity. The ethnomathermatic activity of the marble-making process are counting, measuring, designing, and explaining.
1. Counting and measuring

Figure 1. Uniting the patterns on the marble according to the design

Figure 1 is the process of unifying the pattern on the marble according to the design. Before the process, the pattern was designed first, marble stone was measured and cut according to design. The process shows that there is ethnomathematic activity in the form of counting and measuring. Counting and measuring in this process is found in the measurement of size and calculation of the patterns that will be made. The design is a two-dimensional rectangular pattern with the size of 1 m x 1 m, 2.5 m x 2.5 m to 11 m x 8 m according to the order. Next stage in the process of cutting the pattern there is also a calculation of the pattern that has been formed, cut, and calculated in regards to the pattern arrangement.

2. Designing

Figure 2. The process of designing pattern

Figure 2 is the process of designing pattern. At this stage, the pattern is determined or sketched in advance. Patterns are made in accordance with predetermined designs. These patterns contain Geometric aspects; a geometric transformation consisting of reflection, dilation, rotation and translation. This process is called designing.
3. Explaining

In the process of pattern uniting, the patterns are arranged into the marble. At this stage, the mathematical concept is clearly visible in the form of geometric transformation. According to Massarwe, Verner, & Bshouty (2011), a culturally meaningful geometric pattern has an interesting shape and symmetrical transformation. In other words, ornaments which shapes are geometrically symmetrical in terms of mathematics and are considered beautiful in terms of culture, is a fusion between mathematics and culture, this is why the ornament was created through geometric transformation. Geometric transformation includes shift (translation), reflection, rotation, and enlargement (dilation). It can be seen clearly in Figure 4 that there is an ethnomatematic activity in the form of explaining.

In the process of pattern creation on marble, among six mathematical activities only four is applied; among them are counting, measuring, designing, and explaining. There are two activities that are not applied: locating and playing. This is due to the pattern unable to be used to determine location and playing. Thus, only four mathematical activities were applied.

Conclusion
The process of making marble ornament patterns involves ethnomatematics, especially the mathematical activities consisting of 6 activities; counting, measuring, locating, designing, playing and explaining. The results of this study stated that in the process of marble creation in Tulungagung especially marble ornamental patterns involves ethnomathematic and mathematic activities. However, among the 6 activities, only four were applied as follow; counting, measuring, designing, and explaining.

References


The effectiveness of using science students’ book based on learning cycle models integrated with ethnoscience to improve critical thinking skill of primary school students

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*Corresponding author: dessywidy213@gmail.com

Abstract. The purpose of this research is to produce the product in the form of Textbook and related learning package such as syllabus, lesson plan, Student Activity Sheet (LKS), and Critical Thinking Skills Sheet by applying learning cycle integrated of ethnoscience to improve critical thinking skill in fourth grade students Primary School on Natural Resource materials. The research method used is the development method. This development study refers to the model of 4-D model development by Thiagarajan consisting of (1) define; (2) design; (3) development; and (4) disseminate. Trial design using One Group Pre-test Post-test Design. The instruments used in this research are pretest-posttest sheet and questionnaire. The results showed that the effectiveness of science students’ book based learning cycle integrated of ethnoscience get very good category. Based on the results of critical thinking skills test analysis, obtained a significant improvement with good category. This means that science text books developed with integrated learning-based cycle ethnosains effectively used in learning activities.

Keywords : science students’ book, learning cycle, ethnoscience, critical thinking skill

1. Introduction

The education system in Indonesia should be focused and lead to life skills for future success of learners. Critical thinking skills is one of the provisions that must be given to students. This is in line with the opinion Apriyanti (2013: 1) critical thinking required students to sort out the correct information for logical reasons amid the swift information currently available. Therefore, it is necessary to inculcate critical thinking skills early on for primary school students. Critical thinking skills are a skilled and active interpretation and evaluation of information, argumentation, observation and communication (Fisher, 2008: 10). Critical thinking skill is very important so that students are able to analyze, evaluate and make decisions of an information that he received more rationally and logically. Critical thinking skills are essential so that students are able to analyze, evaluate and make informed decisions of information that they receive more rationally and logically. Science learning in elementary schools is still theoretical and lacks the development of critical thinking skills (Wahyuni, 2015: 48). Learning tends to explain only the facts of knowledge in the form of memorizing theories and concepts. Learning does not relate the content learned to everyday life so that students have difficulty applying real-life knowledge.

Constraints in science learning that students are less able to apply knowledge, attitude, and skills in real life even though students have a good cognitive aspect. To teach the concept of science to students, it can study the concept of science by utilizing an environmental approach that raises local wisdom or so-called ethnoscences. According to Sudarmin (2015: 16) Ethnoscience is the science of a society in which part of the custom (tradition) of society has certain ways and procedures, and the truth can be tested based on experience and self-discovery (empirical). Ethnoscience need to be preserved as a more massive effort through education. According to Gondwe and Nancy (in Parmin, 2017: 32) science learning that integrates ethnoscience is expected to have an effect on the urge to study science.

This ethnoscience learning activity will be applied to the learning cycle model as a bridge for students in finding their own knowledge. Learning cycle learning model is one of the learning model with the learning cycle that provides ease in mastery of finding new concepts and rearranging (constructing) his
own knowledge. Stages of the learning cycle model are five, namely 1) engagement, the teacher prepares the students by generating and developing the students interest in the material to be delivered so that the teacher knows the initial knowledge of the students; 2) exploration, checking the knowledge that the students have is correct or still wrong by testing the hypothesis and solving the problem; 3) explanation, teachers encourage students to explain a concept with their own thinking; 4) elaboration, students apply the concepts and skills learned in new situations; and 5) evaluation, teachers observe and observe the application of new concepts to students' knowledge, whether the students have correctly understood the material that has been submitted.

The discovery of new concepts of science-based learning ethnoscience with learning cycle learning model will be poured into the development of students' books. The students' books developed are tailored to the characteristics of students and the environment of the area. With the development of students’ books, the learning process can provide early knowledge, plan, investigate, explain, apply, assess and broaden the understanding of science learning through the potential of local wisdom. Therefore, the learning process is a conceptual discovery on the involvement of students directly and actively, not just the transfer of knowledge from educators to learners. Acquiring concepts through direct student involvement can foster critical thinking skills in students.

Based on the results of research conducted by Sihotang (2016) explained that the achievement of students using contextual students’ books than students’ books with the effectiveness of the use of students’ books of 78.38%. The purpose of this study is to describe the effectiveness of science students’ books based on learning cycle integrated of ethnoscience to improve critical thinking skills of fourth graders in primary school. The results of this study is expected to be used as a reference for other researchers who conduct research relevant to this research.

2. Method

This type of research is a research development using 4D models, which is developing a science students’ book based on learning cycle integrated of ethnoscience for fourth grade students of primary school with natural resources subject. The subject of the research is the science students’ book based on learning cycle integrated of ethnoscience to train critical thinking skills on natural resource subject that will be tested in fourth grade students of SDN 1 Kelutan, Trenggalek year 2017/2018. The research was conducted at SDN 1 Kelutan, Trenggalek 2nd semester of academic year 2017/2018. This activity will be held in four meetings, with details of one meeting for observation and three meetings for learning. The selection of schools as research sites is based on consideration of school openness to education innovation efforts. This study uses a research design that adheres to the Thiagarajan model, Semmel (1975: 5) known as the 4D Model. 4D model there are 4 stages, namely 1) Define; 2) Design; 3) Develop; 4) Disseminate. The test of the device is done by using One Group Pretest-Posttest Design research design. The research instrument used is a student response questionnaire and a pretest-posttest skill critical thinking sheet. Data collection techniques include student response questionnaires and pretest-posttest sheets. Data collection techniques used questionnaires and tests. Data analysis technique used qualitative descriptive analysis and quantitative descriptive analysis.

3. Results

The effectiveness of students’ books can be seen from tests of critical thinking skills and student responses. Critical thinking skills are assessed by the assessment rubric which is then presented in numerical form. The pretest and posttest result of students' critical thinking skill by learning using science students’ book based on learning cycle integrated of ethnoscience is shown in Table 1.

<table>
<thead>
<tr>
<th>Students Name</th>
<th>Indicator</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>0 1 0 0 1</td>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>B</td>
<td>1 0 1 1 0</td>
<td>3</td>
<td>60%</td>
</tr>
</tbody>
</table>
From the pretest data of the students, the result of the achievement of the critical thinking skill indicator covering five aspects tested in 10 students, that is 7 children able to answer the indicator 1, 3 children able to answer indicator 2, 6 students are able to indicator 3, 5 children able to answer indicator 4, and 7 children able to answer indicator 5. Researcher set Minimal Exhaustiveness Criteria (KKM) achievement of indicator of critical thinking skill that is ≥75%. There are 2 students who can answer the five indicators with the percentage value of 80%. While the average student who is able to answer pretest with five indicators that is equal to 56%. Therefore it can be concluded that the data pretest critical thinking skills of students is still low because it has not been able to reach the determined KKM.

From the posttest data of the students, the results of the achievement of the critical thinking skills indicator which are five aspects tested on 10 students, 10 children are able to answer indicator 1, 8 children able to answer indicator 2, 10 students are able to indicator 3, 8 children able to answer indicator 4, and 10 children able to answer indicator 5. Researcher set Minimal Exhaustiveness Criteria (KKM) achievement indicator of critical thinking skill that is ≥75%. All students are able to answer the five

<table>
<thead>
<tr>
<th>Student Name</th>
<th>Indicator</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 1 1 1 1</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>B</td>
<td>1 0 1 1 1</td>
<td>4</td>
<td>80%</td>
</tr>
<tr>
<td>C</td>
<td>1 1 1 0 1</td>
<td>4</td>
<td>80%</td>
</tr>
<tr>
<td>D</td>
<td>1 1 1 1 1</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>E</td>
<td>1 1 1 1 1</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>F</td>
<td>1 0 1 1 1</td>
<td>4</td>
<td>80%</td>
</tr>
<tr>
<td>G</td>
<td>1 1 1 1 1</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>H</td>
<td>1 1 1 0 1</td>
<td>4</td>
<td>80%</td>
</tr>
<tr>
<td>I</td>
<td>1 1 1 1 1</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>J</td>
<td>1 1 1 1 1</td>
<td>5</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>10 8 10 8 10</td>
<td>46</td>
<td>92%</td>
</tr>
</tbody>
</table>

Information:
Indicator 1 : Give a simple explanation
Indicator 2 : Building basic skills
Indicator 3 : Summing up
Indicator 4 : Provide an advanced explanation
Indicator 5 : Setting strategies and techniques
indicators with a percentage value of ≥80%. While the average student who is able to answer the postest with five indicators that is equal to 92%. Therefore it can be concluded that the postest data of students' critical thinking skills is very good because it is able to reach the determined KKM.

From the table above, it can be concluded that there is an increase in student learning outcomes from pretest then posstest. When pretest assessment, many students have not been able to solve the problem with five indicators of critical thinking skills. After giving pretest, students are given material exposure with students' book development. After that students are given posstest, and the result is many students who are able to solve the problem with five indicators of critical thinking skills.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1 Give a simple explanation</th>
<th>2 Building basic skill</th>
<th>3 Summing up</th>
<th>4 Provide an advanced explanation</th>
<th>5 Setting strategies and techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
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</table>

From the table above, it can be concluded as an improvement in the achievement of indicators of pretest and postest. The indicator gives a simple explanation for the n-gain of 1.00 with the high category. The indicator builds the basic skill of getting 0.71 with high category. The indicator summing up of getting n-gain of 1.00 with high category. The indicator gives an advanced explanation of the n-gain of 0.60 in the medium category. And indicators of n-gain setting strategy and technique of 1.00 with high category. It can therefore be agreed that the indicator mode of negative thinking is of the high category. The conditions that occurred increased significantly from the pretest and postest results.

<table>
<thead>
<tr>
<th>Student Name</th>
<th>KKM</th>
<th>Result Pretest</th>
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<th>Completeness</th>
<th>N-gain</th>
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<td>75</td>
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<td>60</td>
<td>85</td>
<td>C</td>
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### Table

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Information:
C = Complete
UC = Uncomplete
C = Category

Giving pretest and posttest tested on 10 students SDN 1 Kelutan. In the provision of pretest obtained the results of the 10 students there are only two students who are able to reach KKM is 75 with complete category. After being given treatment and given posttest, all students were able to complete the learning and reach the determined KKM that is $\geq 75$. A total of 6 out of 10 students get high category with N-gain $\geq 0.75$. And as many as 4 out of 10 students get the medium category with N-gain $\geq 0.50$. From the discussion, it can be concluded that students’ critical thinking skills are increasing.

Student responses were obtained from student questionnaires given to students after the trial was limited to 10 students. Student response contains sheets to find out what students’ opinions are about whether or not they agree on the learning process. From the questionnaire obtained the percentage mode $\geq 70\%$ with positive category. Therefore, from the above data, it can be concluded that the students are satisfied with the students book developed by researchers in the positive category.

### 4. Conclusion

The effectiveness of science students books based on learning cycle integrated of ethnoscience to improve critical thinking skills has met the criteria of effectiveness, including the results of student responses to students books getting a mode with positive category, and the results of critical thinking skills tests show that there is an increase in student learning outcomes from pretest to posttest . Pretest data of students earn 56\% percentage and increase in posttest data to 92\%. The n-gain value of each indicator and the learning completeness also obtained the high category.

### 5. Acknowledgements

This research itself can not be separated from the help and support from SDN 1 Kelutan so the authors are grateful to the principal, fourth grade teacher, and fourth graders student of SDN 1 Kelutan who has helped launch the research activities undertaken.

### 6. References


