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The International Conference on Indonesian Technical Vocational Education and Association (APTEKINDO 2018) was held in Surabaya, Indonesia, July 11 - 14, 2018. The conference included an impressive collection of presenters and speakers from across the globe, to explore topics such as:

**Technical and Vocational Teacher Competencies
Education Curricula and Models**

Technical and Vocational Education Models, Education Evaluation, Policy,
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International conference of Indonesian Technical Vocational Education and Association (APTEKINDO) 2018 is conducted within a theme “Revitalization of Technical and Vocational Education to Face Industrial Revolution 4.0”. The theme is chosen as a response to the development and acceleration of industrial revolution 4.0, which has spread to every single country. Information technology has become the vital necessity of human life. The use of computer-based tools or devices makes people borderless and able to access unlimited information. Such phenomena might hamper human’s activities especially in the field of science and technology and higher

education. The challenges of industrial revolution 4.0 must be responded fast and precisely. Henceforth, planned and structured efforts should be initiated to guarantee that technology and vocational education can produce globally competitive graduates. In coping with facing the industrial revolution 4.0, Indonesian government, especially Indonesian Ministry of Industry has programmed "Making Indonesia 4.0". Currently, the government focuses on industries that support the development of industrial revolution 4.0, such as food and beverage, electronic, automotive, textile and clothing, and chemical industries. Vocational education takes a significant role in preparing competitive workforces in accordance with the present era. Therefore, this conference is expected to come into useful to gather ideas, to share thoughts, and to initiate efforts for the sake of better vocational education in facing industrial revolution 4.0.

This conference invites competent speakers whose expertise is on the scope of technology and vocational education such as: 1) Prof. Dr. H. Muhadjir Effendy, MA, Indonesian Minister of Education and Culture; 2) Michael Freiherr von Ungern, Sternberg, Extraordinary and Plenipotentiary Ambassador of the Federal Republic of Germany to Indonesia, ASEAN and Timor-Leste; 3) Dr. Jun Javines, Vice President for Academic Affair, University of San Carlos, Education Department Cebu City, Philippines; 4) Prof. Dr. Wenny Rahayu, Head of School of Engineering and Mathematical Sciences La Trobe University Victoria, Australia; and 5) Prof Dr. Muchlas Samani, M.Pd., the Rector of Universitas Negeri Surabaya for 2010-2014 periods, Indonesia.

The conference was held in Surabaya, Indonesia, on July 11-14, 2018, participated by 615 participants from sixteen universities covering domestic and foreign institutions. There were 227 papers submitted to the committee, of which each paper was first selected by peer-reviewed process conducted by two reviewers. Finally, only 82 papers were accepted to be published in this proceedings. The topics of the papers included Technical and Vocational Teacher Competencies, Technical and Vocational Education Curricula, Technical and Vocational Education Models, Technical and Vocational

Education Evaluation, Technical and Vocational Education Policy, Public-private Partnership in Technical and Vocational Education, Technical and Vocational Education Management, Technopreneurship, and Competencies Certification. Faculty of Technique, Universitas Negeri Surabaya, is the organizer of APTEKINDO 2018. We would like to thank all the invited speakers and whole participants for sharing and contributing actively to the conference. We also greatly thank to the organizing committee, the members of scientific committee, reviewers, and sponsors for the priceless and never ending supports. We also want to express our gratitude for the authors who contribute to the conference. Special thanks go as well to Mr. Zeger Karszen from Atlantis Press for his support in publishing the conference proceedings.

Prof. Dr. Ekohariadi, M.Pd.
Chairman of Organizing Committee

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High School in Indonesia

Aye Mon, Lilik Anifah

Vocational education is one solution to improve the quality of human resources in Indonesia. The challenge as well as the advantages for Indonesia is a large demographic area, so that the standardization of vocational education is needed. In this study, it is discussed how the perceptions of standard...

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The Influence of Creativity and Ability Effort towards the Successful Efforts of Fashion Designer

Ratna Suhartini, Ekohariadi Ekohariadi

In running a business in the field of fashion, it takes creativity and ability effort. This research aims to know the influence of creativity against the success of the effort, influence the ability of the effort towards the success of the effort, influence creativity against the success of the effort. The...

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The Contribution of Vocational Competence Learning to the Creativity in Apparel Making among Vocational School Students

Sitti Aisyah, Djoko Kustono, Syamsul Hadi

Creativity is very fundamental in apparel making and can be developed

through appropriate learning processes. The question that needs to be addressed is how to develop students' creative potentials through learning processes, especially in the vocational school for fashion design. This study aims to...

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The Social Support Influence for Prospective Teacher on Their Teaching Career Perceptions

Herwanto Heru, Sigit Purnomo

The purpose of this study is to explore how much influence of social support on teacher career perception of prospective teachers. This research uses descriptive correlational method with quantitative approach. The population of this research was 129 students of the 5th semester of Informatics Engineering...

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Developing Integrated Curriculum with Environmental Education at Vocational High School

Warju Warju, Sudirman Ariyanto, Lutfi Muzaki

The issue of the environment is an important topic that needs serious attention. Global warming and environmental pollution is one proof that human activity has a direct impact on environmental preservation. The purpose of this study was to determine how the ideal concept of curriculum development of...

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Learning Type, Learning Motivation, and Grade Performance Achievement of Students in Vocational Higher Education

Anas Arfandi, Akshari Lopa

Learners have different ways of understanding a subject matter. Teacher adjustment to the characteristics of learners greatly helps learners in achieving mastery learning. Learners who are highly motivated in learning have a great opportunity in obtaining high learning achievement. The purpose of this...

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The Contribution of Pattern Making Knowledge and Sewing Skill to the Outcome of Women's Blazer Making

Irmayanti Irmayanti, Syamsul Hadi

The objective of this study is to understand the direct contribution of basic pattern making knowledge, drafting and sewing skill to the outcome of women's blazer making. The results showed that (1) knowledge of pattern making directly and significantly contributed to the outcome of women's blazer making;...

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The Opportunity of Vocational Technology Education Study Program: Curriculum Development and Learning Program

Riana Mangesa, Abdul Mappalotteng, Ruslan Ruslan

Efforts to improve the learning program to support the revitalization of vocational education is an opportunity for vocational technology education (PTK) study program. The purpose of this research is to analyze the potential of PTK study program in preparing the learning program and the ability to develop...

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Perception towards Transferable Skills in Indonesian Universities

Agus Setiawan, Iwa Kuntadi, Masriam Bukit

Having transferable skills is very important in the 21-st century. However, there is limited information about the perceptions of which transferable skills are needed in the workplace. This study aims to explore the transferable skills among students and lecturers in universities in Indonesia. Transferable...

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Vocational Education in the Era of Industry 4.0: An Indonesia Case

Muchlas Samani

In coping with the industrial era 4.0, the concept of 'competency' in vocational education must be converted into 'capability' to enable graduates engage with the latest work patterns. Vocational education must be flexible by the application of modular patterns combined with block system. It further...

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The Practicality of Learning Module Based on Jigsaw-Cooperative Learning Model in Media Education Course

Zonny Putra, Arwizet Kaharudin, Bulkia Rahim, Rahmat Nabawi

Educational factors that are less appropriate in the delivery of materials and the selection of instructional media causes lesson objectives are perfectly acceptable by students. The educational factors here are defined as the facilities needed in the learning process such as learning media used by lecturers....

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Employing ANDI Learning Model in Culinary Arts Course: How Does It Contribute to Emulation Ability and Students' Creativity?

Andi Hudiah, Marji Marji, Eddi Sutadji, Titi Kiranawati

This study aims to investigate the contribution of ANDI learning model to emulation ability and its impact to students' creativity in culinary arts course.

It involved 131 students majoring in culinary taken randomly from four state and private universities in different cities in Indonesia. The data...

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Digital Game-Based Learning in Arabic Language Learning and its effects on Students' Academic Performance

Annas Azizt, Subiyanto Subiyanto

Arabic, since 1971, has been an official language of the United Nations alongside English, French, Spanish, Russian, and Chinese. Students' motivation and achievement in Arabic learning as second language learning is decreasing with age. This paper presents the effectiveness of Digital Game-Based Learning...

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The Application of Problem-Based Learning Model to Increase Students' Activity and Learning Outcomes in Basic Process of Metal Treatment

Ambiyar Ambiyar, Arwizet Kaharudin, Refdinal Refdinal, Mia Hermawati

Based on the researcher survey, it appears that many students were passive, daydreaming, and busy with cellphone and non-related activities during the learning process. The purpose of this research is to improve learning activities and learning outcomes through the implementation of Problem-Based Learning...

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Development of Human Mechanic Interface Auotonics S070 Trainer for Electric Motor Installation Learning

Supari Muslim, Karno Budi, Widi Aribowo, Fandi Achmad

This study aims to determine the performance and feasibility of Media Learning Trainer Human Mechanic Interface on Electric Motor Installation subjects. This research is done through the following stages: (1) analysis; (2) design; (3) implementation; (4) validation; (5) testing; and (6) experiments in...

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Augmented Reality Technology for Vocational Education the Disruption Era

Ulfah Arief, Hari Wibawanto, Azzizah Nastiti

The purpose of this paper is to explain information and communication technology that can support the field of education in the disruption era, namely Augmented Reality (AR). The contribution of AR in education can provide a learning experience. Vocational education is an education that requires balance...

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Implementation of Project Based Learning Model to Increase Students' Competence in Machining Work

Wahyu Kurniawan, Agung Budiono

Students' skills in machining work are low. Although they are able to complete the worksheet, the result is much deviate from the science of machining process. In other words they use the principle of origin (size of not precision) without based on the rules in the machining process. The purpose of this...

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Strategy to Develop the Ability of Creative Thinking Using Problem-Based Learning Model in Light Vehicle Engineering Competences of Vocational Education

Suparji Suparji, Luthfiah Nurlaela, Bima Putra

The results of several studies revealed that the level of creative thinking ability of middle school students is still low, including ones of vocational high schools. Therefore, learning strategies that can improve the ability of high-level thinking, one of which is the ability of creative thinking,...

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Inquiry-Based Learning to Students' Creative Thinking Skills in Vocational High School

Luthfiah Nurlaela, Suparji Suparji, Karno Budi, Sheila Pratama, Yuyun Irawati

Based on the observation in the vocational high school, the students' creative thinking skill was still low. This is because there is no collaboration between learners and teachers to solve problems. Also, there is lack of opportunities given to learners to find their own knowledge. This study developed...

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Higher Order Thinking Skills to Enhance Millennial Students Through Active Learning Strategies

Ita Romadhoni, Luthfiah Nurlaela

This study aims to reveal the application of active learning strategy type student created a case study to improve motivation and learning outcomes. The research subject is a culinary education of home economics students. It was observed by tests, field notes, profile documentation. The analyzes were...

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Implementation of Pneumatic Module Based on Interactive Computer Learning

Agung Budijono, Wahyu Kurniawan

Using Module Based on Interactive Computer with FluidSIM-P3 Pneumatic System Simulation Software becomes the media for students to explore more experiences related to Hydraulic System. The objective of this study is to improve quality of learning based on activities, motivation, responses and learning...

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Development of Course Module Machine Element Design Based On Project – Learning

Djoko Suwito, Agung Budijono

In designing a machine based on effectiveness of technology, students have difficulty in integrating the theories that have been learnt and the type of engine that will be made (project). Hence, it takes course module machine element design to help them design the machine. It is expected that by using...

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Implementation of Computational Thinking Concepts in ICT Learning Using Scratch Programming

Rina Harimurti, Anita Qoiriah, Ekohariadi Ekohariadi, Munoto Munoto

Computational thinking (CT) is a fundamental skill that everyone should have, dealing with problem solving, designing systems, and understanding human behavior by drawing on fundamental concepts to computer science. This study aims to apply the concept of computational thinking in ICT learning in secondary...

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Development of Learning Tool Control with Inquiry Based Learning To Improve Student Motivation Learning Oriented Industrial Needs

Subuh Haryudo, Imam Agung, Rifqi Firmansyah, Mahendra Widyartono, Widi Aribowo

The objective this study is to arrange and develop control technique device learning to motivate students industry-oriented with Inquiry Based Learning. The development of this learning tool resulted in a learning module trainer equipped with trainers in accordance with the demands of the curriculum...

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Acne Facial Skin Care with the Beauty Electrical Tool Through Problem Based Learning

Nia Kusstianti, Luthfiyah Nurlaela, Ekohariadi Ekohariadi

This research aims to know whether there is a difference between using problem based learning and direct learning instruction towards students' learning result of acne facial skin care with a beauty electrical tool. This research is an experimental one using quantitative approach with post test only...

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Assessing Student Acceptance of Digital Repository as Knowledge Management System to Support Research

Activities

Yeni Anistyasari, Ari Kurniawan, Imami Rahayu, Amalia Ruhana

Digital repositories play an important role for knowledge management. They propose a useful infrastructure through which to store, manage, and reuse digital materials. Studies in exploring digital repositories have been applied in several higher educations. However, the acceptance of digital repositories...

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The Evaluation of Occupational Health and Safety (OHS) Implementation in Vocational High School Workshop, Surakarta

Basori Basori

The high number of work accidents due to human error or other factors is one the needs to be considered in the framework of both industry and educational institutions. This study is intended to determine the effectiveness of the level of implementation of Occupational Health and Safety (OHS) regulations...

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The Study of Vocational School Development at Makassar Using Interpretative Structural Modelling (ISM)

Mohamad Mandra

Vocational School is one of the institutions which have the responsibility for the preparation of human resources in accordance with their fields. The

purpose of this study is to describe the general description of vocational schools in Makassar today. The data collection used questionnaire, whereas...

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Principal's Leadership in Developing Critical Thinking Ability to Improve Work Productivity

I Made Sudana, Delta Apriyani

School is a place used to gain knowledge. A good school will also be able to produce good graduates. To make it real, the school must have staffs that are professional in their respective fields such as principal, teachers as well as employees to create such school. Principal is the leader key who will...

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Assessing Computational Thinking using Pseudocode Programming Instrument

Ekohariadi Ekohariadi, Yeni Anistyasari, Ricky Putra, Ibnu Kurniawan

the purpose of this research is to create an instrument to measure understanding of computational thinking concept and independent programming language that would not be biased by any computer's programming language. Computational thinking can be taught through programming of visual language Scratch...

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Level of Thinking in Exams and Assignments as Assessments in the Civil Engineering Department, State University of Malang, Indonesia

Sutrisno Sutrisno, Antelas Winahyo, Ahmad Dardiri

This research aimed to shed light on the application of thinking order concepts in exams and assignments based on student needs of hard-skill development. This research was a descriptive ex-post facto research. The samples taken consisted of 36 lecturers in charge of constructing exam questions and assignments...

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Identification of Component of Technical Assessment and Employability Skills Based on KKNi (Indonesia National Qualification Framework)

Rina Febriana

This study aims to identify the components in the assessment model of Technical skills and employability skills based on KKNi. The method used is Research and Development (R & D) by adopting the model Borg & Gall. The validation of conceptual and hypothetical models is done through assessment. The effectiveness...

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Assessing Programmable Logic Controller Skill of Electrical Engineering Student

Puput Rusimamto, Ekohariadi Ekohariadi, Munoto Munoto

Measurements in education can not be separated from the measurement of the students' capabilities of educator candidates. The ability of prospective students can be measured by using a measuring instrument (test). A lecturer should know the scoring theory used to measure the ability of his students....

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A Tracer Study of Fashion Design Education Program at State University of Surabaya

Irma Russanti

In accordance with developing curriculum, it is necessary to conduct a tracer study at fashion design education program, Universitas Negeri Surabaya. This study focuses on the profiles of the graduates programs, the relevance between graduates' jobs with their academic backgrounds, and the satisfaction...

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Analysis of Bakery Production Units Using Quality Function Deployment (QFD) Method

Yatti Sugiarti, Shinta Maharani, Widia Ayudia, Ana Ana

Bakery's production unit is a business activity that is implement by the competency of Agricultural Processing Technology expertise in SMK Negeri 2 Cilaku Cianjur to develop the student's competence work in the field of bakery. The performance of production units improvement, need to be prioritized in...

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Development of Entrepreneurship Training Based on Life Skill for Islamic Boarding School Students

Siti Saidah, Sri Handajani

Education in boarding schools aims to realize a religious generation that is self-reliant and beneficial to society. One of them seeks entrepreneurship skills through training with appropriate training tools. The purpose of this study was to describe the feasibility of life skill based entrepreneurship...

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The Role of Government and Industry toward Vocational Schools and their Impact to Graduates' Quality of Culinary and Hospitality Students in Makassar

Nahriana Nahriana, Andi Palerangi

This study aims to investigate the contribution or the role of government (X1), industry (X2) toward vocational school (Y) and their impact to graduates' quality (Z) both direct and indirect contribution. It is a quantitative study. The population of this study was 335 Culinary and Hospitality students...

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Production-Based Curriculum Development in Vocational High Schools for Preparing Skilled Labor in Industry

Yoto Yoto

The development of Vocational High Schools (VHS) aims to create a qualified, sophisticated, independent, and modern Indonesian society that contributes significantly to the achievement of overall national development goals and to improve the nation's dignity. VHS development covers a wide range of dimensions,...

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A Subak Analogy Model in Computer Network Subject for Vocational Student

Ketut Agustini, Gede Saindra, Nyoman Sugihartini, Gede Indrawan

In a computer network concept, there are abstract and concrete materials. The abstract concept might lead students to misconceptions. This can be avoided by the students' prior knowledge gained from everyday activities in accordance to the culture and environment. In bridging the abstract concepts into...

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Less Teaching and The Effect on Psychomotor of Wood Building Practices in Product Education Techniques of Undana Building

Harijono Harijono

This study aims to test the effectiveness of teaching methods and timing of feedback. The design used is experimental research. The results showed that there was an increase in learning. After students engaged in teaching and learning process using feedback method, the learning media teaching method...

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The Implementation of LAVIR Networking Model at Vocational School (efforts to foster students' learning responses through visual literacy)

Sapto Haryoko, Hendra Jaya

This study aims to determine the process of application of lavir networking model in learning. This research is a type of quantitative research with quasi experiment method. The data were analyzed descriptively and hypothesis test (anova) then further tested using scheffe test and tukey test. The results...

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The Effectiveness of Plagiarism Checker Implementation in Scientific Writing for Vocational High School

Hakkun Elmunsyah, Hary Suswanto, Khoirudin Asfani, Wahyu Hidayat

The development of information technology today has negative impacts for education. These negative effects, among others, that hamper the quality of education are soft skill, especially honesty and self-confidence in their own work and copyright awareness. There are numerous plagiarism cases in Indonesia....

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Professional Teacher Guidance in Indonesia

Mochamad Cholik, Triyanto Pristiwaluyo

The population in this research is all teachers who receive professional

allowance in 2016 in all provinces of Indonesia. Samples of province were 13 provinces and those of teachers were 195. Data collection used was self-assessors. The data were analyzed descriptively, both quantitative and qualitative....

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The Best Practice of Vocational Education Development in Developed Country: Reference Framework for Developing Vocational Education in Indonesia

Edy Sulistiyo, Djoko Kustono

Efforts to be made in the development of Vocational Education in Indonesia include creating a roadmap for SMK development and refining and aligning the SMK curriculum with competencies according to the needs of the graduates (link and match) to increase the relevance of vocational education not yet in...

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Industrial Perspective on Public Private Partnerships Model in Indonesia

Ngo Thi Thom, Arie Wardhono

The partnership model between vocational educational institutions and industries, known as Public-Private Partnership (PPP), plays an important role to overcome the skill gaps requirement between vocational educational institutions graduates and industries. The aim of this research is to provide

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Teaching Factory-Based for Entrepreneurship Learning Model in Vocational High Schools

Hasanah Hasanah, Muh. Malik

The purpose of this research is to develop teaching factory-based for Entrepreneurship Learning Model in Vocational High Schools. Furthermore, the model is named "TEFA-Entrepreneurship Model". The type of research is research and development (R & D). The development process followed Plomp model development...

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A Design of Partnership Model of Vocational High School with Business and Industrial World

Purnamawati Purnamawati, Syahrul Syahrul

This study aims to design a partnership model of Vocational High School with Business and Industrial World. The stages of model development used Plomp model design. The object of the research was in Vocational High School in Makassar City. The result of partnership model design based on need analysis...

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Bridging the Skills Gap Through Teaching Factory (TEFA)

Mukhidin Mukhidin, Jonah Mupita

In most developing countries the vocational curricula are still lagging behind in terms of linkage and matching with skills needed by the industry. Teaching factory is a suitable learning and training model that can produce graduates who are competent with industry desirable skills. Teaching factory...

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Constructivist Approach: Students' Attitude towards the Physics Learning in Vocational High Schools

Tuwoso Tuwoso, Widiyanti Widiyanti, Andika Putra

The principles of constructivism have been widely used in science education. Constructivism emphasises knowledge as students' active construction. A teacher acts as a mediator, convinces what students know, and organises tasks so that students can build knowledge. Students work out meaning in a small...

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Effect of Experiential Collaborative and Self-Efficacy on Technical Skills for Vocational School Student

Yetursance Manafe, Marzoan Marzoan, Lukas Boleng

Experiential Collaborative provides opportunities for students to learn more actively to work together in groups in order to achieve a goal. Self-efficacy reflects the level of confidence in executing certain tasks. The purpose of this research is to see the impact of group cooperative and self-efficacy...

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Development of Talking Chips Basic Learning Model in a Vocational High School (SMK) in Medan

Ana Rahmi, Siti Sutantie

This study aims to describe how the application of Talking Chips learning model to improve motivation and learning outcomes of basic culinary art students of SMK Negeri 8 Medan. This research type is Research

development. It consists of four stages, namely the stage of planning, development, implementation...

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Applying The Problem-Solving Method to Improve Student Learning Achievement in the Concrete Construction 1 Course

Suparno Suparno, Bambang Supriyanto, Sudomo Sudomo

This classroom action research aimed to improve the quality of student achievement and instructional process in the Concrete Construction 1 course by implementing the problem-solving method. This study was done through four steps namely planning, implementing, observing, and reflecting. The research...

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Innovation In Learning Through Digital Literacy at Vocational School of Health

Yasser Djawad, Sutarsi Suhaeb, Hendra Jaya

This study aims to facilitate learning, therefore all existing technologies and educational technology products must be selected and built on the needs analysis of a particular learning environment. E-health learning media is an Android-based Application. As we know that Android is one of the most widely...

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Integrated Learning to Improve Creative Thinking Skills in Learning Media Course

Pudji Astuti, Sita Nurmasitah

Education is a gateway to the achievement of the nation's ideals. Qualified education enables to produce reliable nation successors. There are many aspects related to qualified education, including learning activities. The challenges faced by education world are increasingly complex. In the industrial...

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What do Vocational Teachers, Industries, and Experts View about the Future Learning of Vocational Schools?

Pardjono Pardjono, Wardan Suyanto, Herminato Sofyan, Wagiran Wagiran

This research was the preliminary study of a multi-year designed research. The research aims to explore experienced vocational teachers, industry and vocational education experts for vocational learning. This study used quantitative inquiry approach with questioner or inventory and Focus Group Discussion...

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Management Model of Community Relations and Industries in Community College

Andi Irfan, Andi Idkhan, Eddy Sutadji, Sunardi Sunardi

This study aims to validate the management model of public relations and industry measurement in Community College in South Sulawesi. This research was conducted on Community College Sidenreng Rappang State and Community College Enrekang State in South Sulawesi Province. This research uses quantitative...

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Students' Characteristic Analysis in the effort of Applying Total Quality Management (TQM) in Learning Process

Wawan Purwanto, Bahrul Amin, Nuzul Hidayat, Erzeddin Alwi

Learning management plays an essential role in creating an atmosphere of learning in improving the graduates' competency. Total quality management (TQM) is a management system that can be applied in a learning process. The purpose of the paper is to describe the initial situation of the student, than...

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Analysis of Vocational School Supervision Planning

Eka Daryanto, Darwin Darwin

The objective of the research is to know the policies used in determining the need of supervisors in North Sumatera Province. The research also aims to

know the process of determining the need of the supervisors. This research uses qualitative approach with descriptive method. The subjects of the research...

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The Effective Leadership of Vocational High Schools' Principal To Improve Teachers' Performance

Rusli Ismail

There have not been any indications showing that leadership models applied by a principal in leading education unit (SMKN Technology) affects teachers' performance. The common problem to be studied is how the implementation of models of effective school leadership on teachers' performance. This study...

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Determining Priority Scale in Information Management System in Planning Of Developing Infrastructure in Vocational High School

Sucipto Sucipto, Tri Rahardjo, Martono Martono, Sugiharto Sugiharto

Low and insufficient school infrastructure has negative impact on students learning and graduation. Many factors contribute the emerging of infrastructure gap in education. It is caused by the lack of maintenance and old developing, the ineffectiveness of government planning. It needs planning of proposing...

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Model Proportion of Expertise Competence As Industry Recommendation In Industrial Selection Practice Program

Novianto Laksana, Ratna Wardani

This research aims for developing and implementing the proportion of field competency model that can be used as Industrial Market recommendation for determining the result of industrial practice selection that is appropriate with the criteria. The development design was grouped into three developmental...

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The Changes in Aspergillus Sp Population and Biochemical Changes During The Process of Controlled Corn Flour Fermentation and The Rheological Properties of Corn Flour Produced

Andi Sukainah, Reski Putra, Husnul Hatima

This study aims to determine changes in Aspergillus sp population and biochemical changes during the process of controlled corn flour fermentation. The research is divided into two stages. The first stage was the making of starter by adding aquades as much as 100 ml into 50 g of corn flour. Furthermore,...

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Development of The Nutrition Pocketbook as a Nutrition Education Media in School

Esi Emilia, Risti Rosmiati, Rachmat Mulyana

The objectives of the study were to develop the nutrition pocketbook regarding dietary guidelines for adolescents and do the pilot test of the nutrition pocketbook to analyze the nutritional behavior of junior high school students. The research was conducted from March to August 2016 at Three Junior...

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Islamic Wedding Attraction in Entrepreneur Vocational Perspective

Mutimmatul Faidah, Imami Rahayu, Amalia Ruhana, Lilik Rakhmawati

This study aims to describe form and meaning of the Islamic wedding in Lumpur Village. This research is a qualitative descriptive research. The data were collected using interviews, observation, and documentation. The result of this research is Pencak Macan (a wedding ceremony based on Javanese tradition)...

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Entrepreneurship Intent on Vocational High School Education: The growth of new Entrepreneurs in Indonesia

Achmad Agung, Amat Mukhadis, Eddy Sutadji, Purnomo Purnomo

Entrepreneurship education in vocational schools is necessary, with an understanding of how to develop and encourage the birth of potential young entrepreneurs. The purpose of this study to see the determinants of entrepreneurial intentions can be interpreted as the process of seeking information that...

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Competence Profile of Indonesian Food Chefs in Malang Based on Educational Background

Rina Mariana, Nunung Nurjanah, Ahmad Dardiri

This study aimed to identify the professional competence of chefs in traditional Indonesian restaurants in Malang city. The study was conducted in two stages involving 12 selected restaurants. The first stage was identifying the profile of chefs, while the second stage consisted of in-depth interviews...

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The Effectiveness of Work Safety Training Among Workers with Low Educational Level towards the Attitudes of Work Safety Priority in Small, Medium and Large-Scale Industries

Djoko Kustono

The high rate of work accidents in East Java is mainly due to human factor, in this case, related to the low level of workers' attitudes towards the priority of work safety (MKK/Memprioritaskan Keselamatan Kerja). Theoretically, work safety training (PKK / Pelatihan Keselamatan Kerja) is able to improve...

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The Effectiveness of Clothing Pattern Making Training with CAD-based System on Fashion Students

Hamidah Suryani, Imayanti Imayanti, Muhammad Yahya

This descriptive research aims to give an overview of the effectiveness of clothing pattern making training with CAD system on Fashion students viewed from the result of knowledge test and performance test and the students' response result. Techniques of collecting data obtained in research were documentation,...

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The Development of Gluten-Eggs Free Cookies as Functional Food

Mutiara Nugraheni, Sutopo Sutopo, Sutriyati Purwanti, Titin Handayani

This research aims to develop gluten-eggs free cookies based native Maranta Arundinaceae flour and Maranta Arundinaceae flour rich in RS3, to analyze the chemical composition, and to know the hedonic of semi trained panelists against cookies as well as in vivo evaluation in diabetes mellitus mice. Self...

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The Development of Collaborative Jig Saw Project-Based Learning Model to Improve Students' Learning Outcomes in Thermodynamics on Vocational College

Arwizet Kaharudin, Nizwardi Jalinus, Ambiyar Ambiyar, Remon Lapisa

This paper describes the development steps of The Collaborative Jig Saw Project-Based Learning (CJPjBL) Model in thermodynamics on vocational college. The development of the CJPjBL model applies five steps of the ADDIE model ie: 1) analyzing current thermodynamics learning model, 2) designing the new...

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Interactive Multimedia about Reproductive Health Education: Revealing its Effectiveness in Preventing Students' Premarital Sex

Choirul Afifah, Mutimmatul Faidah

this article aims at examining the effectiveness of interactive multimedia about reproductive health to enhance senior high school students' understanding about premarital sex among youths in Indonesia. This study used Plomp's model to develop the multimedia which covered five phases namely investigation,...

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Development of Neural Network Controller for A Two-Link Flexible Manipulator

Mohammad Khairudin, Totok Maryadi

This paper discusses a neural network (NN) control of a two-link flexible robot manipulator. The PID controller was formerly used to solve nonlinearities problem. One more efficient solution for nonlinearities problem is NN. An evaluation was conducted to assess the performances of the controller in...

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Skill Competency Test Model (UKK) Graduates of Partnership-Based SMK: Preparing Graduates Facing the Fourth Industrial Revolution

Muhammad Rais

The challenge faced by Indonesian education nowadays is the swift development of industrial revolution that is entering the 4th generation. The education at all levels of the educational units, including Vocational High School (SMK) is continuing to work early preparing itself facing the era of Industry 4.0.

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Development of Visual Block Programming Software for Supporting the Basic Programming Class in Vocational High School

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Rustam Asnawi, I Gede Nuarsa

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This study aims to design and develop the learning media of visual block programming, and to know the level of eligibility of instructional media for the Basic Programming subjects in vocational high school. The research approached to Research and Development (R & D). The overall stages in this research

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Social E-Book Reader: Development of Interactional Model and

Quality Analysis User Experience of E-Book Reader based Social Learning

Osiany Nurlansa, Ratna Wardani

This research aims to develop and produce user interface recommendation of Social E-Book Reader application that can accommodate two-way interaction model and learning style in social learning according to user's habit and requirement tested with User Experience Questionnaire (UEQ) standard. The development...

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DILA Learning Model based on Contextual Teaching and Learning in Applied Physics Course at Mining Engineering

Fadhilah Fadhilah, Z Mawardi Efendi, Ridwan Ridwan

Applied physics as a science is used to understand other sciences and as a basis for technological development. Learning Physics not only learns facts, concepts, principles, and laws, but also learns how to learn physics to gain information, scientific work steps, and the application of science and technology...

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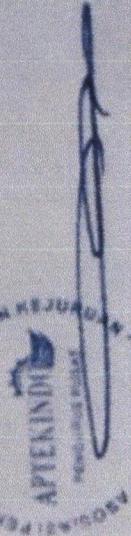
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Assessing Programmable Logic Controller Skill of Electrical Engineering Student

Puput Wanarti Rusimamto¹, Ekohariadi², Munoto³
Electrical Engineering Department^{1,3}
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 Surabaya, Indonesia
 puputwanarti@unesa.ac.id

Abstract— Measurements in education can not be separated from the measurement of the students' capabilities of educator candidates. The ability of prospective students can be measured by using a measuring instrument (test). A lecturer should know the scoring theory used to measure the ability of his students. Scoring theory includes classical test theory and modern test theory. Each of these test theories has advantages and disadvantages. Test theory developed in Indonesia today is a classic test theory. Modern test theory has developed in some advanced countries. The progress of information technology has had an impact in the development of modern test theory. The process of calculating the scores of test takers using modern test theory is more complex than using classical tests. In this study, the test items of programmable logic controller (PLC) of electrical engineering students were analyzed using classical test theory approach and grain response theory. The grain difficulty statistics on the classical test theory is the p value, which is calculated based on the proportion of students who correctly answer a test item. Parameter b is a location parameter, indicating the position of the grain characteristic curve in relation to the scale of ability. The correlation between the values of b and p is $-0,980$ of the 38 PLC test items, there are 1 non-fit test items based on the Rasch model. Parameter b has a starting value of $-3,07$ to $4,24$. The parameter of p grain has a value from $0,03$ to $0,97$.

Keywords— *assessing PLC, classical test theory, modern test theory*

I. INTRODUCTION

There are two kinds of theory about measurement, that is Classic Test Theory and Modern Test Theory. Classical Test Theory is also called Classical True-Score Theory (CTT), called Classical Test Theory because elements of this theory have been developed and applied for a long time, but still survive until now. Modern Test Theory is also called Latent-Trait Theory because this theory assumes that the performance of the subject in performing a test can be predicted from latent or persistent ability. Modern Test Theory is also often called the Item Response Theory (IRT), meaning the subject's response to an item indicates its cognitive abilities.

Modern Test Theory appears to address the limitations of Classical Test Theory, that is, the parameters in Classical Test Theory are characteristic of an item dependent on the sample group used to calculate it, besides that Classic Test Theory also requires equality of measurement error for all

subjects subjected to the test, the definition of parallel in Classical Test Theory is also very difficult to fulfill in practice. With the presence of Modern Test Theory can answer all these limitations, but keep in mind that Modern Test Theory is not practical, from all the limitations of Classical Test Theory need to be seen also the advantages of Classical Test Theory that is, Classic Test Theory has been developed since the first so that has succeeded in putting the basic concepts of measurement, in addition the Classical Test Theory also has a high practical value.

The classical test theory has grown widely and has become a major flow among psychologists and educators, as well as other areas of behavioral studies. CTT has a weakness because it is examinee sample dependent and sample dependent items [7][8][9]. This weakness triggers a new theory that is more adequate, namely the theory of modern tests, also known as the theory of item response or item response theory (IRT) and also known as the latent traits theory.

Unlike CTTs that focus on information at the test level, IRT mainly focuses on information at the item level so it is expected to cover the shortcomings of CCT. The implementation of the IRT model is based on several postulate assumptions: (1) a participant's performance on an item can be predicted by a set of factors called traits, latent traits, or capabilities; and (2) the relationship between the participants' performance on an item and an underlying latent ability can be described by a monotonic appealing function called item characteristic function or item characteristic curve (ICC) [9]. So the ICC is a depiction in the form of a curve that explains the relationship between latent traits and the performance of the subject on an item. [9] states that the assumptions underlying IRT are unidimensional, local independence, and parameter invariant. Meanwhile, [6] mentions that the most important assumptions are: (1) each item has a item characteristic curve (ICC) and (2) local independence.

Based on the background, conducted research on Assessing Programmable Logic Controller Skill of Electrical Engineering Student

II. LITERATURE REVIEW

A. Classical Test Theory

Theory of measurement, there are 2 kinds, namely Classical Test Theory (CTT) and Modern Test Theory or Latent-Trait Theory. Elements of this classic test theory has been developed and applied for a long time, but still survive until now. The classical test theory is carried out with a conventional quantitative approach to test the reliability and validity of the scale based on the item. The classical test theory is easy in its application as well as a useful enough model in describing how errors in measurement can affect observational scores. The classical test theory assumes that each observed score (X) on the instrument is a combination of the true underlying score (T) on the error score (E). The equation is as follows:

$$X = T + E \quad (1)$$

The thing to note is that the raw score (X) is the only real score; whereas pure score (T) and error score (E) are latent, can not be observed directly. Information obtained from the observation score can be used to test the consistency of the test (reliability). Another assumption to note is that the error score (E) in CTT is random and does not correlate with X or T, and the approximate value is 0 (zero).

Based on the above assumptions, the variant of the raw score is a combination of pure score variant and error score: $\text{Var}(X) = \text{Var}(T) + \text{Var}(E)$. Since the values of T and E are hidden and searched in one test are the individual pure scores (T), the assumptions set forth in the error score (E), get us the test reliability equations: $R = \text{Var}(T) / \text{Var}(X)$. Since pure scores can not be obtained directly; then another way is used to obtain the value of the reliability, ie through two tests the same concept and quality, the correlation between the results of both tests will show the same value with the reliability of the exam.

B. Test Item Analysis

Modern test theory is often also called Latent Trait Theory is the subject's performance in a predictable test of latent ability. Or better known as the Item Response Theory (IRT) is the subject's response to items that show cognitive. Excess performance of the subject can be seen with Item Characteristic Curve (ICC). This means that the better the performance of the subject will be more responses (answers on the test items) are correct.

Theoretical elements in modern tests include: (a) items (test items), (b) subjects (responses), (c) content of subject responses. Assumptions in modern tests are as follows: (a) the problem item and ability parameters are invariant. This means that the problem created has a positive correlation with the measured ability, (b) unidimensionality, meaning 1 item measures one ability. This assumption is less proven because basically between item 1 with other complement each other, (c) local independence, meaning the response to an item will not affect other items.

The size or rules used to find out which questions are valid (usable) and where the questions are invalid (unusable). The rules are 3, namely: (a) the power of differentiation of the problem, It means the item of question can be considered

good if the item can be used to distinguish between high-ability subjects from low-ability subjects, (b) level of difficulty problem, if the item is not too difficult and not too easy, (c) happen to answer correctly. This means that the problem item can detect a subject who answered randomly and accidentally true.

IRT aims to overcome the weaknesses found in classical measurements. In the IRT, the true student response opportunities, grammatical characteristics or parameters, and the characteristics or parameters of the test participants are linked through a model formula that must be adhered to by either the test group or the test group [9]. That is, the same grain to different test participants must be subject to the rules of the formula, or the same test participants to different test items must also be adhered to the formula. In this process there is what is called invariance between test items and test participants. In modern measurements, the grain difficulty level is not directly related to the ability of the respondents.

The fundamental difference between classical and modern measurements lies in the invariance of scanning, where modern scanning is invariant (unchanged or fixed) to test items as well as to test participants. According to reference [13] that the invariance of test item parameters through group of test participants is the most important characteristic of IRT. It is generally said that the index of difficulty of the test item as the correct proportion of answers makes it difficult to imagine how the test difficulty index can be invariant to the group of test participants of different levels of ability.

C. Rasch Model

Rasch modeling emerged from an analysis performed by Dr. Georg Rasch on his own test results. Dr. Rasch did two tests on grade 4, 5 and 6 elementary school students. He found that grade 6 students made less mistakes than grade 4 and 5 on the same problem. Then he describes the graph to show the results of both tests, and finds that the error of one test corresponds to 1.2 errors in the other test, comparing the same in the three classes tested. This means that the degree of difficulty between the two tests has been obtained. In order for this ratio constant to occur, the probability of answering the problem correctly should be the same when the student's ability is the same as the difficulty level. In other words, students have a 50% chance to answer correctly when the students' ability is the same as the difficulty level.

The simple and precise idea of examining the results of the examinations and graphics he made Dr. Rasch make a popular statement, that 'the opportunity to solve a problem depends on the ratio between the person's abilities and the degree of difficulty of the matter'. After that Rasch modeling continues to be developed into various branches to date. But the basic principle is the same, that is the probabilistic model defined as: "a person having a greater ability than another person should have the greater probability of solving any item of the type in question, and similarly, one item being more difficult than another means that for any person the probability of solving the second item is the greater one" [1].

D. Programmable Logic Controller

Programmable Logic Controller (PLC) is a computer specially designed for use on machines (industry). This computer has been designed for use in industrial

environments, equipped with special input/output and a programming language for control.

a) *Hardware*

PLC is a type of control system that has input device, controller and output device. The equipment connected to the PLC which sends a signal to the PLC is called the input device. While the controller is to perform the calculation, decision-making, control of the input to be issued in the output. How the PLC works can be explained through the block diagram in Figure 1 below.

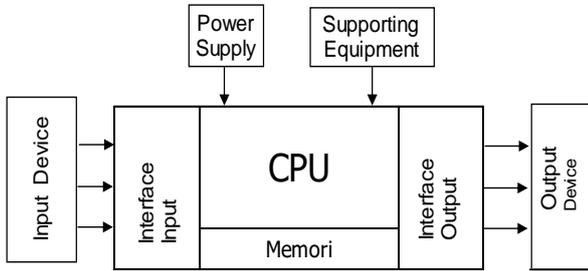


Fig. 1. Block Diagram PLC

From Figure 1 shows that the PLC construction consists of CPU, input device, output device, supporting equipment, and power supply. Explanation of each component as follows:

1) *Central Processing Unit (CPU)*

PLC consists of CPU (Central Processing Unit), memory, input interface, and output interface. The CPU is a microprocessor that coordinates the work of the PLC system. It executes programs, processes input/output signals, and communicates with outside equipment.

Memory is the area that stores the operating system and user data. Real operating system software system that coordinates PLC. There are two types of memory: ROM (Read Only Memory) and RAM (Random Access Memory). ROM is a memory that can only be programmed once. Storage program in ROM is permanent, so it is used to save the operating system. There is a type of ROM, EPROM (Erasable Programmable Read Only Memory) whose contents can be removed by irradiating using ultraviolet light and then recharged using PROM Writer. RAM is memory that can be read or writeable, only used to store data temporarily. The data in RAM will be erased if the power supply is lost.

Interface is a circuit used to adjust the signal on the outside equipment. The input interface adjusts the signal from the input device with the signal required for system operation. The output interface adjusts the signal from the PLC with the signal to control the output equipment. The number of available input/output (I/O) terminals depends on the PLC brand. For example OMRON brand PLCs on one unit are available 10, 20, 30, 40 or 60 I/O terminals. The number of I/O terminals can be developed by installing an Expansion I O Unit so that it is possible to have 100 I/O.

2) *Input Device*

The input device is what gives the signal to the PLC and then the PLC processes the signal to control the output of the device. The types of input devices include:

- Different types of switches, buttons, switch, limit switch, level switch, push switch, proximity switch.
- Various types of sensors, such as light sensors, temperature sensors, level sensors.
- Rotary encoder
- The types of input devices can be seen in Table I.

3) *Output Device*

Automation system is incomplete without any output device controlled. The type of output device can be seen in Table I.

The input or sensor unit equipment, controller, and output can be seen in Table I.

TABLE I. EQUIPMENT INPUT, CONTROLLER, AS WELL AS OUTPUT PLC

INPUT DEVICE	CONTROLLER	OUTPUT DEVICE
Circuit Breaker	Counter	Alarm
Level Switch	Logic Unit	Control Relay
Motor Starter	Relay	Fun
Proximity Switch	Timer	Horn
Push Button		Light
Photoelectric Switch		Motor Starter

4) *Supporting Equipment*

Supporting equipment is the equipment used in the PLC control system, but not part of the system in real terms. That is, this equipment is used for certain purposes that are not related to peggadalian activities. Supporting equipment, among others:

- various types of programmers, ie computers, ladder software, programming console (PC), programmable terminal, and so on.
- Various ladder software, namely: SSS, LSS, Syswin, and CX Programmer.
- Different types of external memory, ie: diskette, CD, flash disk.
- A variety of printing devices in computer systems, such as printers, plotters.

5) *Power Supply*

PLC is a digital equipment and every digital equipment requires a DC power supply. This power supply can be supplied from the outside, or from within the PLC itself.

b) *Basic Instruction*

Basic instructions that exist in programming using PLC are as follows.

1) *LD (Load)*

LD instruction is required if the sequence on a control system requires only one logical condition and is required to output. Logically like NO relay contacts.

2) *AND*

This instruction is required if the sequence of a control system requires more than one logical condition to be fulfilled in order to output an output. Logically like NO relay

contacts. The AND directive on the ladder diagram is mounted on the series in series (AND logic) in the previous circuit with the corresponding bit.

3) *OR*

This instruction is required if the sequence of a control system requires only one of several logical conditions to output an output. Logically like contact NO relay. The OR directive on the ladder diagram is mounted on the circuit in parallel (OR logic).

4) *OUT*

This instruction function output if all logical conditions of ladder diagram have been fulfilled. Logically like contact NC relay. So the OUT instruction is used to output the result of a circuit.

5) *AND NOT*

This instruction is required if the sequence of a control system requires more than one logical condition to output an output. The logic is like a contact NC relay. The AND NOT instructions on the ladder diagram are mounted on a series in series (AND NOT logic). So this instruction is used to write NC contacts on the ladder diagram.

6) *OR NOT*

Same as the AND NOT instruction, for OR NOT the ladder diagram is mounted on the circuit in parallel (OR NOT logic). So this instruction is used to write NC contacts on the ladder diagram.

7) *TIMER (TIM)*

Timer has a limit between 0000 to 9999 in the order of 100ms. As for the counter has a number order and has a limit between 0000 to 9999.

8) *COUNTER (CNT)*

Timer/Counter on the PLC numbered 512 pieces numbered TC 000 to TC 511. If a number has been used as a timer / counter then the number should not be used again as a timer or counter. So in one program there should be no same timer / counter number.

The timer / counter value of the PLC is countdown from the initial value set by the program. After the countdown reaches zero, the NO timer / counter contact will be ON.

3) *Ladder Diagram and Mnemonic Code*

To make it easy to write and insert program on PLC then needed some basic stage. Ladder diagram of a program is made first to facilitate the preparation of mnemonic code. The program form mnemonic code can be directly inserted into the CPU via a PC.

The ladder diagram consists of a line extending downward from the left side with its branches towards the right. The line extending down on the left side is called the busbar. While the branches are called the instruction line. Along the line of instruction are placed conditions leading another instruction line on the next right side. The logic combination of these conditions determines when and how the instructions on the right side are executed.

There are five ways to program PLC:

- Programming Console (PC).
- Prompt Writer.
- Sysmac Support Software + Personal Computer.
- Factory Intelligent Terminal (FIT).
- Graphic Programming Console.

III. METHOD

The test is made by the author in order to conduct research Assessing the Skills of Programmable Logic Controller Student of Electrical Engineering. The PLC skills test consists of 40 multiple choice items. The test measures PLC knowledge. The test assesses PLC hardware topics, basic PLC instructions, ladder diagrams, mnemonic code and PLC software. Student responses to the next 40 test items were analyzed using computer program Test Analysis Program [3] and ConQest [17].

Test Analysis Program is used to estimate grain difficulty parameter (p) based on classical test theory, while ConQest is used to estimate grain difficulty parameter (b) based on grain response theory.

Performed analysis of PLC instruments. The test results were analyzed using Rasch model response theory. The fit analysis is used to check the unidimensionality of PLC test items. Unidimensionality is a very important assumption on the grain response theory. Test items are unidimensional meaning that the grains measure one ability [10]. One indication of whether the test item is unidimensional is fit data with the Rasch model [16]. To find out whether the Rasch model can predict the response of each respondent, it is used infit mean-square and out-mean-square statistics [16]. STI and CSO statistics are a measure of the degree of compatibility between observational data and the values predicted by the model.

The test items used in this study fit the Rasch model. Selected test items are based on the value of STIs and CSOs. [12] constructed tables to interpret the meaning of the value of STIs and CSOs. Table 2 shows the significance of IMS and CSO values. The test items used have STI and CSO values ranging from 0.5 to 1.5.

TABLE II. RANGE OF IMS AND OMS VALUE

Value	Application for Measurement
>2,0	Destructive measurement system
1,5 - 2,0	Has no meaning for measurement
0,5 - 1,5	Useful for measurement
<0,5	Not beneficial for measurement but not destructive.

IV. RESULT AND DISCUSSION

The test consists of 40 items of choice response (RP) or multiple choice. Responses to 40 test items were then analyzed using the QUEST computer program [1]. There are 2 numbers that the system automatically removes because they are not working. Namely the numbers 35 and 37, so the total number of test items amounted to 38. Table 3 shows the estimation results of the selected response type grain parameters. There are 38 grain difficulty parameters (b).

TABLE III. PARAMETERS OF THE DIFFICULTY OF THE TEST SELECTED RESPONSE TYPE

No Butir	Par b	Kesukaran	No Butir	Par b	Kesukaran
1	1.2	0.36	20	0.37	0.56
2	3.52	0.06	21	-0.12	0.67
3	-3.07	0.97	22	1.75	0.25
4	-0.4	0.72	23	-0.88	0.81
5	2.75	0.11	24	-1.08	0.83
6	1.6	0.28	25	1.91	0.22
7	0.25	0.58	26	-1.56	0.89
8	-1.89	0.92	27	-0.55	0.75
9	-0.55	0.75	28	1.6	0.28
10	2.75	0.11	29	0.84	0.44
11	-1.89	0.92	30	-3.06	0.97
12	1.6	0.28	31	-0.88	0.81
13	0.84	0.44	32	-0.88	0.81
14	-0.55	0.75	33	-1.56	0.89
15	-1.56	0.89	34	0.25	0.58
16	-1.81	0.89	36	-1.08	0.83
17	-2.33	0.94	38	-0.63	0.75
18	-0.71	0.78	39	-0.04	0.64
19	1.6	0.28	40	4.24	0.03

The grain difficulty parameter is the point on the scale of ability in which the probability of answering correctly is 0.5. The parameter is the location parameter, which indicates the position of the grain characteristic curve in relation to the scale of ability. The greater the grain difficulty parameter value, the greater the ability that the test taker needs to obtain a 50% chance of answering the item correctly. The leftmost curve has a location of -3.07 and the rightmost curve has a location of 4.24. According to a classical test analysis, the grain difficulty has a range from 0.03 to 0.97.

The relationship between the parameter b and the difficulty of the grains is shown in Figure 2. The correlation between the values of b and p is -0.980.

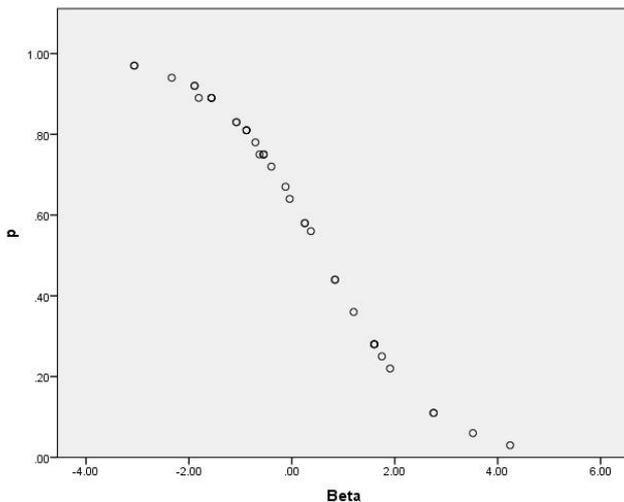


Fig. 2. Relationship between b and p

An important characteristic of a set of test items measuring a construct is that they are unidimensional. In Rasch analysis, if all coherent grains form one scale, they are unidimensional. Reference [10] proposed that the grain fit c is used to examine unidimensionality. Fit grains were analyzed using the Quest [1] program. There are two sizes of fit grains namely Mean-Square lenses (IMS) and Outfit Mean-Square (OMS). The analysis results are shown in Table IV.

TABLE IV. FIT GRAIN ANALYSIS RESULTS

No Butir	IMS	OMS	No Butir	IMS	OMS
1	1.02	1.02	20	1.05	1.05
2	0.74	0.96	21	0.98	0.97
3	0.79	1.01	22	1.17	1.08
4	0.96	0.98	23	0.75	0.85
5	1.33	1.01	24	0.98	1
6	1.36	1.17	25	1.48	1.15
7	1.08	1.07	26	0.67	0.89
8	1.07	1.05	27	1.01	0.99
9	0.95	0.96	28	1.13	1.09
10	0.9	0.97	29	1.07	1.07
11	0.85	0.95	30	0.43	0.95
12	1.16	1.08	31	0.92	0.96
13	0.97	0.98	32	0.94	0.96
14	1.02	1	33	0.84	0.93
15	0.71	0.9	34	1.04	1.04
16	0.68	0.92	36	0.79	0.88
17	0.56	0.93	38	1.23	1.13
18	0.98	0.98	39	1.06	1.04
19	0.91	0.95	40	0.77	0.98

The value of STI and CSO close to 1.0 indicates a small distortion for the measurement system. A value of 1.0 is the expected value. If the fit observation data with Rasch model then the expectation value is 1.0. The value of STIs and CSOs listed in Table 5 shows that almost all of the test items are useful for measurement. There is no STI value above 1.5. The non-fit items are number 30 which has an STI below 0.44.

V. CONCLUSION

The grain difficulty statistics on classical test theory are p values, which are calculated based on the proportion of test participants who correctly answer a test item. Parameter b is a location parameter, indicating the position of the grain characteristic curve in relation to the scale of ability. The correlation between the values of b and p is -0.980. Of the 38 PLC test items, there are 1 non-fit test items based on the Rasch model. Parameter b has a starting value of -3.07 to 4,24. The parameter of p grain has a value from 0.03 to 0.97.

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