CONTEXTUAL TEACHING AND LEARNING (CTL) MODEL DEVELOPMENT IN APPLIED PHYSICS

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ABSTRACT: Applied Physics is a basic course in engineering science. As an applied science, it is hoped that in the provision of instructional materials it looks its application to the skills required of the graduates. Contextual teaching and learning is a learning concept that can help teachers connect between the material they teach and the students' real-world situations and encourage students to make connections between their knowledge and application in their lives. CTL model does not have a syntax so for Applied Physics learning will be developed CTL model that has a syntax and has a component as a new model. The instructional development model used is IDI (Instructional Development Institute) which consists of define, develop, and evaluate. From this development result obtained a model based on CTL that has syntax Display, Inquiry, Learning Community, and Authentic Assessment (DILA). The model's theoretical structure has been validated by the experts into the hypothetical model structure that will be tested for its application. After the Forum Group Discussion was conducted with experts and conducted a small test. The instrument validation result of DILA model using Aiken formula is 0.9, it means the instrument is very valid. The DILA Model validation results by the experts obtained a value of 0.93 so that the DILA Model can be used for small trials. The results of DILA Model implementation on a small scale are at 0.98 and the practicality of DILA Model is 0.89. These results show that the DILA Model which is the development of the Contextual Teaching and Learning Model is very appropriate to be used in Applied Physics learning in the Department of Mining Engineering. DILA model is constituted by contextual theory, student centered learning and collaborative. The syntax of the DILA learning model trains students to discovery, collaboration and assessment..

Keywords: Model DILA , Applied Physics, Aiken Formula, Contextual Teaching and Learning.

1. INTRODUCTION

The issuance of the Presidential Regulation (Perpres) of the Republic of Indonesia (RI) number 8 year 2012 and the Regulation of the Minister of Education and Culture of the Republic of Indonesia (Permendikbud) number 73 year 2013 obligated universities, college or institutes (the following referred to Higher Education (PTI)) to undertake simultaneous curriculum redesign with the Indonesian National Qualification Framework (KKNI) which has begun not later than 2016/2017 [1].

The Diploma (D3) Program Department of Mining Engineering is one of the study programs under the Department of Mining Engineering which was established since 2001. One of the learning achievements that must be met for the diploma (D3) graduates are: mastering the concept of theoretical in general natural science, engineering principles, engineering science and engineering design that is required for the analysis and design systems, processes, products or components. One of the special skills that must be owned by the graduates is: being able to apply math, natural science, and engineering principles and engineering practice to solve well-defined problems in a specialized field they face; and one of the most common skills that the diploma (D3) graduates must have in accordance with (Permenristekdikti) 2015 is "being able to solve the problem of work with character and context that suits the applied field in accordance with logic, innovative, and responsibility about the result independently."

Applied Physics courses are included in the compulsory courses of Sciences and Skills (MKK) given in the 2nd semester. The expected course learning outcomes (CLO) are: (1) Students can apply the concept of unit system, vector, mechanics (Motion straight, Curved motion, Circulation, Style, Balance, Effort, Energy, Momentum), Fluid (Statics & Dynamics), Thermo physics (Temperature & Heat, Expansion), Elasticity, Waves, and Simple Electric Circuits in Mining. (2) Having a critical attitude that is contextual with the profession as an *madya* expert.

From the research that has been conducted, the phenomenon that occurs in Applied Physics are students get less satisfactory mark, from the competence of lecturers and good lecture materials, from the teaching and learning process where the lecturers using less media, and from the students' learning attitude, the students are still less confident in expressing opinions, not creative, having difficulty in practicum and not concentrating in learning and wanting a project work that supports Applied Physics learning [2].

Physics should be given more by the accompanying mathematical data and theoretical lectures, and concepts of Physics should be supported with applied activities [3].

In vocational education, vocational education needs to be taught in the context of practical problem-solving, and that high-quality vocational education is almost always involves a blend of methods - something which is broadly hands-on, practical, experiential, real-world as well as and often at the same time as something which involves feedback and reflection [4]. Vocational education needs to be taught in the context of practical problem solving, and that high-quality vocational education almost always involves a mix of methods - something that is broadly manual, practical, experiential, real-world and also involves feedback and reflection.

So, the development of learning model in accordance with Applied Physics course is the development of Contextual learning model. The essence of the CTL approach is the interrelationship of each learning subject or topic with real life. To link it can be done a variety of ways, other than because the material is studied directly related to factual conditions, it can also be tricked by providing illustrations and examples, learning resources, media and so forth, which is either directly or indirectly related or has something to do with real life experience [5].

2. RESEARCH METHODS

This research produces the product and develops the learning model so that this type of research is included in the type of research and development, in accordance with Sugiyono's statement [6]. The development model generated by instructional development of IDI (Instructional Development Institute) consisting of define, develop, and evaluate. The development procedure is explained in the chart below:

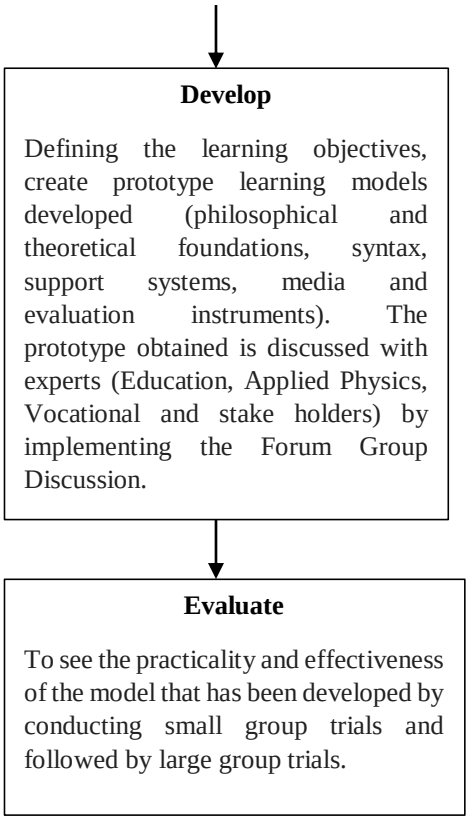

Fig 1. The development model generated by instructional development of IDI (Instructional Development Institute)

2.1 Define

The defining stage aims to obtain useful data for designing research products in order to solve the problem of Applied Physics learning. The way in this defining phase is to provide a questionnaire to students about the teaching and learning process that has been going on for this and about their expectations about Applied Physics learning later. This stage also analyzes the student's conditions and the management of tasks that should be done**.**

2.2. Develop

Stages of this research have arrived at the hypothetical model obtained from the FGD results with the experts.

Define

Analyzing the needs of curriculum, materials and students' needs

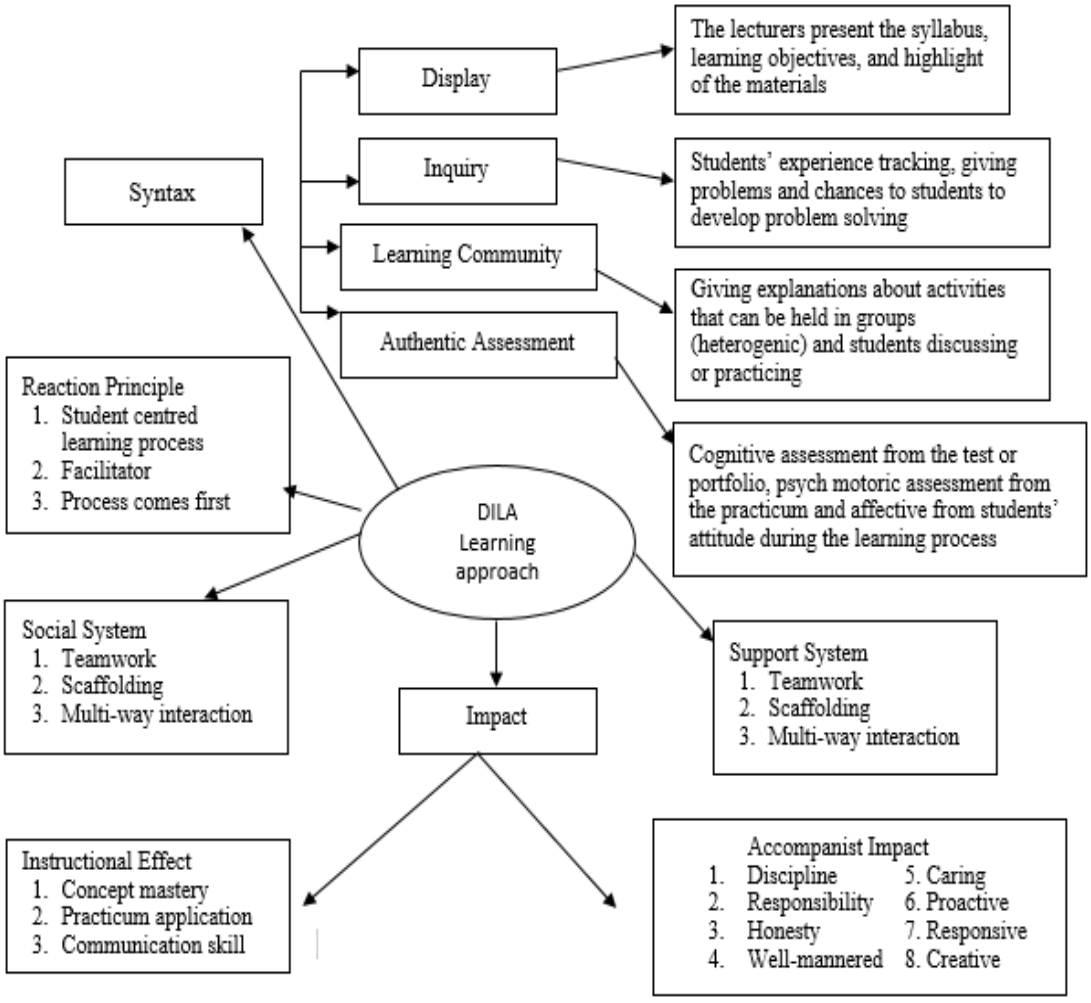

Fig 2. Prototype model of CLT learning development

The Group Discussion Forum was conducted with 8 experts in Education Technology, Vocational Education, Science Education, Applied Physics, and Entrepreneur. FGDs result in the need for a philosophical foundation of the models and theories that support this learning model.

Stages of learning (sintak) should also be supported by the theory so that the importance of the syntax is present. This learning model is a development of the CTL model, but the CTL model has not had a clear learning syntax. So in this model made learning stages (sintak) so that each teacher is more directed in provide learning.

FGD results also direct how the form of inquiry provided and the authentic assessment to be performed. From the FGD results obtained by Hypotetic Model Structures as in Fig. 3.

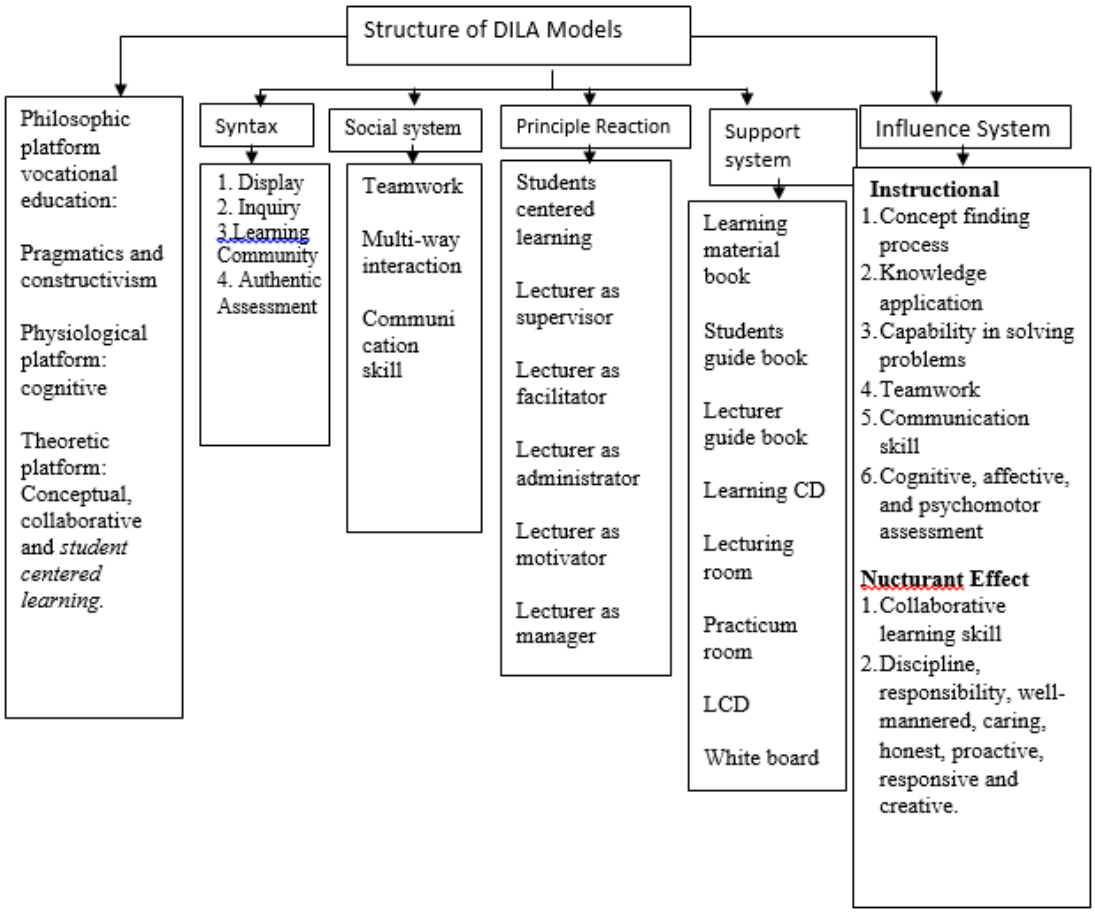

Fig 3. Hypothetic model from the development of CTL learning model

At the development stage validity test is conducted against the model that has been developed. The validity test is performed on the validation instrument itself and the validation model. There are 5 validators consisting of educational technology experts, vocational technology experts, Physics education experts, Applied Physics experts and from the company (stake holder). Aiken (1985) formulates the Aiken's V formula to compute the content validation coefficients made on the assessment results from the expert panel of n people against an item of which aspect represents the measured constants. The formula proposed by Aiken is as follows [27] .

$V = \Sigma s / [n (c-1)]$
$S = r - lo$
Lo = the lowest validity score
C = highest validity score
R = number given by the appraiser

Instruments used to validate instruments DILA Learning Model has indicators on feasibility of presentation, content feasibility, construction and language used. The validation result of validation of model validation instrument using Aiken formula is 0.9 so that the instrument used to measure the validity of the DILA learning model is valid for use. For instruments of validity assessment of the DILA model explaining the rationale of the DILA Model, the DILA Model meaning, purpose of the DILA Model , the DILA Model benefit , the theoretical base of the DILA Model, the learning objectives, the syllabus, the role of the lecturer, the role of the students, the role of learning materials and the components of the DILA Model (syntax, reaction principle, social system, support system, instructional impact and companion impact). Validity values obtained for the validation of this DILA learning model at a price of 0.93 using the Aiken formula. This means that the valid model is used for Applied Physics learning.

2.3 Evaluate

The last stage in IDI is evaluation. The practicality and practicality of the DILA Model can be observed after being piloted in small groups of about 5-10 people. Here the researchers took the trial as many as 7 people. Trials conducted in 5 times face-to-face meeting on Applied Physics lectures. The instrument validation result of DILA Model implementation by experts is at 0.96 using Aiken formula. The validation result of DILA Model practicable by experts is 0.9 using Aiken formula. So the instrument to assess the implementation and practicality of the DILA Model can be given to students taking the test.

The implementation of DILA Model is seen from the application of the model by lecturers and students. Lecturers provide learning according to the DILA syntax preceded by the Display (display). Here the lecturer explains the learning outcome of the learning materials and shows the video or illustration related to the learning materials. Inquiry (find), lecturers provide questions relating to the impressions displayed to students relating to learning materials. Here students will find a link between instructional materials with enforcement in the mining industry or in daily life. Students then display experiments related to the material so that students also find the concept of learning materials in the experiment. Learning Community (group learning), lecturers divide students into several groups, then lecturers explain learning materials and provide practice questions that are done in groups. Authentic assessment, assessment not only in terms of cognitive, but also in terms of affective and psychomotor of students. In the instrument of implementation of this model will also see the lecturer function as a facilitator. The DILA Model implementation results obtained 0,98 stated that all available syntax is implemented in the application of Applied Physics learning.

The practicality of DILA model is seen from the use of time, model ability in achieving learning objectives, implementation of DILA syntax, DILA model ability to make students active, creative, explore and elaborate, confirm, and have positive attitude in learning. The ability of the DILA model to create contextual, meaningful learning enables students to construct their own knowledge, and make learning fun. And the use of media in helping learning. The result of this practicality questionnaire obtaining an average of 0,89 means that students strongly agree on the use of DILA models in Applied Physics learning.

3. DILA MODEL

3.1. Philosophical Ground

In vocational education, Miller (1994) advocated pragmatism as the most effective philosophy for education for employment. Miller (1994) advocates pragmatism as the most effective philosophy for education-for-work. He states that vocational educators have been successful in terms of pragmatism as a frame-of-reference and a basis for workplace education [7]. He stated that vocational educators have been successful in maintaining their practice and relevance, using the principle of pragmatism as the frame of reference and the basis for workplace education. Pragmatism, as defined by Miller, balances the philosophy of essentialism and existentialism and allows new ideas to be considered for practice (within its philosophical framework). Pragmatism has been responsible for the development of innovative programs such as technological preparation that enable vocational education to meet future workplace needs.

The paradigm of Constructivism and Cybernetics is a philosophical foundation in the development of this DILA model. Constructivism is a fraction of cognitivist that focuses on developing the learners ability to build or construct their own new knowledge through the process of old synthesize thinking and new knowledge and experience. People of this genre are John Dewey, Jean Piaget, Maria Montessori, and Lev Vygotsky [8]. With Input and Learning Community syntax seen how this constructivism understanding is implemented in this DILA model. Inquiry make students to find out whether the knowledge by experimenting or from lecturer guided questions. In the Learning Community students in groups build knowledge by finding solutions to the problems and design project tasks as an application of the gained knowledge.

This cybernetics sees the human brain actively processing information just like information technology or computers, yet human beings actively seek, not only passively accept. Learners capture the stimuli of the five senses, either in the form of objects, data, or events then pay attention or neglect, choose some or receive the whole, and make a reaction by making the responses. People of this genre are Hilda Taba and David Ausebel.

In the learning process, teachers draw the attention of learners so that their mind, physical, and attitude are focused on the learning materials that will be discussed. The readiness of learners to learn is built as early as possible by linking the material to be discussed with material that has been mastered by learners and more focused on understanding rather than memorization.

4. 2 Theory Platform

4.2.1 Contextual

Contextual means "relating to context". Contextual teaching and learning is a learning concept that can help teachers relate between the material they use for teaching and the real-world situations of the students and encourage students to make connections between their knowledge and application in their lives as family members and society [5].

Contextual learning philosophy is rooted in the idea of progressive John Dewey [5]. Progresivism combines theory with practice. In essence, students will learn well if what they learn is related to what they know, and the learning process will be productive if the students are actively involved in the learning process in school. Learning using a contextual approach will make it more meaningful for students.

Ausebel in [9] states: Meaningful learning is a process of linking new information to relevant concepts contained in the cognitive structure of the learners. The learning process is not just memorizing the concepts but there are also activities linking the concepts learned with the learning experiences that the learners have.

The standard of learning process according to Permenristekdikti No. 44 year 2015 article 11 states that the characteristics of the learning process is interactive, holistic, integrative, scientific, contextual, thematic, effective, collaborative, and student-centered. Contextual is meant here states that the achievement of graduate learning is achieved through a process of learning tailored to the demands of ability to solve problems in the realm of expertise.

4.2.2 Student Centered Learning

Harden and Crosby [10]: *Student-centered learning as focusing on the students' learning and 'what students do to achieve this, rather than what the teacher does'. This definition emphasizes the concept of the student 'doing'.* SCL focuses on student learning and what students do to get it compared to what the teacher does. This definition emphasizes the concept of students doing things.

Students centered that the achievement of graduate learning is achieved through a learning process that prioritizes creativity, capacity, personality, and student needs, and develops independence in seeking and finding knowledge (Permenristekdikti No 44 year 2015 article 11).

4.2.3 Collaborative

John Myers points out that the dictionary definitions of "collaboration", derived from its Latin root, focus on the process of working together. Collaborative learning advocates distrust structure and allow students more if forming friendship and interest groups. Student talk is stressed as a means for working things out. Discovery and contextual approaches are used to teach interpersonal skills [11]. "Collaborative learning" is a general term for various educational approaches involving shared intellectual effort by students, or students and teachers together. Typically, students work in two or more groups, seeking mutual understanding, solutions, or meanings, or creating a product so the key to collaboration is positive dependence, interaction, individual accountability and social skills. Collaborative states that the achievement of graduate learning is achieved through a joint learning process that involves interaction between individual learners to generate capitalization of attitudes, knowledge, and skills (Permenristekdikti No 44 year 2015 article 11).

Collaborative learning is in accordance with the *zone of proximal development* (ZPD) expressed by Vygotsky, in which the intent of ZPD is: *"the distance between the actual developmental level as determined by the problem solving under adult guidance , or in collaboration with more capable peers* "[15]. Vygotsky describes the level of current or actual student development and the next level that can be achieved through problem solving facilitated by an adult or a competent partner. The idea is that the best individual learns when working with others, and through such collaborative efforts with more skilled people so that learners learn and internalize new concepts, tools, and skills.

4.3. Learning Model Structure

Based on the rationale and theoretical foundations that support the model, the DILA Model was visualized in Figure 2 where the structure of this model refers to Joyce and Weil 1989.

4.3.1 Syntax

DILA model based on CTL has syntax with the following steps, namely; (1) Display, (2), Inquiry, (3), Learning Community, and (4), Authentic Assessment.

4.3.1.1. Display

Showing here has a meaning to give an idea of the material to be studied in general. At this stage the lecturer shows a video on the application of materials related to the mining industry. Students observe the video and relate it to the material they are going to study.

If we look at the theory of cognitive information processing [16], Memory consists of three parts: sensory buffer, working memory, and long-term memory. According to Mohammad Surya [17] the initial stage in this process is the perception that makes us to detect perceptual stimuli by paying attention to the stimuli. A number of stimuli in the environment are obtained through hearing, sight or other sensing. This stimulus is then transferred in a process called storage (storage). Then proceed with pattern recognition process or pattern recognition. The next step is the process of assignment of meaning or meaning task is to make decisions about giving meaning to the stimulus by combining a number of existing knowledge.

This display is in line with the psychological flow of cybernetics. This genre sees the human brain actively processing information just like information technology or computers, yet human beings actively seek, not only passively accept. Learners capture the stimuli of the five senses, either in the form of objects, data, or events then pay attention or neglect, choose some or receive the whole, and make a reaction by making the responses.

The different communication media (videos, photos, texts, animations and tests feedback) help the construction and learning process of the Physics teaching-learning process [18]. Most of the methods developed computer technology and multimedia to give interactivity and visualization. The methods of students' performance and developed skill among students [19]. From some research results, visual media such as video can help learners in constructing knowledge can be found, representing concepts and improving skills.

4.3.1.2 Inquiry

Inquiry comes from the word to inquiry which means participating or involved in asking questions, seeking information, and conducting an investigation [20]. At this stage the students find the concept by experimenting or answering questions from lecturers. The lecturer serves as the facilitator.

One of Merrill's five principles of quality improvement learning is Integration Principle where learning should enable learners to create, discover, or explore personal ways to use their new knowledge or skills. Schwab, 1965 in Joyce et.al [22] explains: invitations to inquiry: engages students in activities that enable them to follow and participate in logic / reasoning related to the object of research or problem methodology. Today's knowledge is a science based on well-tested facts and concepts that we have today. Each lesson illustrates the concepts and methods of a particular discipline. Providing examples per instance of the process itself and involving student participation in the process will enhance students' understanding.

Inquiry as did the Prophet Ibrahim AS in search of his God (Surah Al An'am .76-80) observed the existing phenomenon and draw conclusions. Inquiry is encouraged in science learning by using examples of daily practice and freely exploring existing phenomena so that students will see the relevance of the material to the existing context. [4] [15] [23]

4.3.1.3 Learning Community

Leo Smenovich Vygotsky, a Russian psychologist stated that the knowledge and understanding of children is sustained by the many communications with others. At this stage, the groups are looking to apply in accordance with the activities in the mining industry. They can do practicum or carry out project work to apply the lecture material that has been obtained. So carrying out authentic tasks is one constructivism approach where learners are active in performing tasks because learning is centered on him and he also directs it himself [20] [18] [25].

4.3.1.4 Authentic Assessment

Assessment is the process of collecting various data and information that can provide an illustration or clue to the student's learning experience. Authentic assessment is defined as a form of assessment that requires learners to carry out real-world tasks that demonstrate meaningful application of an essential knowledge or skill [26]. At this stage the lecturer assesses students both cognitively through tests and

psychomotor and affective assessments through the rubric that has been provided.

The DILA model is student-oriented (Student Centered Learning) so that the assessment model that considered appropriate to assess the learning process is Authentic Assessment. The Authentic Assessment consists of three basic activities, namely (1) the lecturer gives the task, (2) the learners show their performance, and (3) the lecturer with the student evaluates the performance based on certain indicators with the instrument called rubric [1].

4.3.2 Principles of Reaction

The developed DILA model requires that learning should be centered on the students. Lecturers act as facilitators, motivators, administrators, managers, and drafter.

4.3.3 Social System

The social system in this DILA Model is cooperation, multi-direction interaction, and communication skills.

4.3.4 Supporting System

The supporting system in this DILA model is learning materials for lecturers and students, guidebooks for lecturers, student manuals, DILA Model books and learning media in the form of CDs and lab facilities available in Physics laboratory FT UNP.

4.3.5 Impact of Implementation

This DILA model is designed to train students to make inventions based on observations and experiments as well as their application in accordance with their expertise. Creating teamwork to solve problems and get better results and train communication skills both orally and in writing. Learning outcomes can be measured either cognitively or psychomotor so that the student's ability will be seen as a whole part.

The nucturant effect seen from this model is the mastery of collaborative skills, whether in respecting the opinions of people, issuing opinions that will arise attitudes (affective), among others discipline, responsibility, courteous, honest, caring, proactive, responsive and creative.

4. CONCLUSION

DILA learning model (Display Inquiry Learning community and Authentic Assessment) is present to answer the problem about learning support course for technical student especially. Such as Applied Physics study, Applied Chemistry, and Applied Mathematics. The syntax contained in the DILA Model will guide learning to be student-centered and the overall assessment, not just cognitive, psychomotor and affective are taken into account. The results show that the implementation shows 0,98 and practical value is 0,89, which means DILA Model can be implemented in Applied Physics learning so that students can better understand and apply the Physics in daily life and in the world of work.

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