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Developing a Computer-Assisted Instruction Model for Vocational High Schools

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ABSTRACT - *This study aims to systematically develop a CAI model for vocational high school and develop a CAI model for VHSs which is valid, practical, and consistency and see CAI of aspects of the display, programming, materials, and aspects of learning*

This study was a research and development study for the program of electric energy use in VHSs of Technology expertise in program of Electrical Engineering. This study was carried out in three state VHSs in Makassar and Gowa.

The results of the study are as follows: Systematic steps in developing a CAI model for VHSs began with a preliminary study in the form of a needs analysis for the client, followed by a learning system design and lesson planning, and materials development; Learning aspect, content aspect, display aspect, programming aspect; the integration of learning methods made through the strategies in CAI, namely Tutorial, Drill & Practice, Games, Problem Solving, Simulation, and Testing; Integration of constructivist learning theory in the development of CAI in VHSs models made through the interactivity of the CAI program was developed in the form of Interactive CD; The users' responses to the CAI product were very good; The developed CAI model was valid, practical, and consistency.

Keywords - *Model development, CAI, VHS, Learning aspect, content aspect, display aspect, programming aspect*

I. INTRODUCTION

Learning today face two challenges. The first challenge comes from the change in perceptions about learning itself and the second challenge comes from the information technology and telecommunications, which shows a remarkable development. Basically constructivism have answered the first challenge to redefine learning as a constructive process in which information is converted into knowledge through a process of interpretation, correspondence, representations, and elaboration. Meanwhile, advances in information technology and telecommunications are so rapid that offers a variety of new ease of learning enabling a shift in the orientation of the outside-guided learning to be self-guided and possession of knowledge as a knowledge as construction[1]. Moreover, this technology today are also often ask important role in updating the original conception of learning which focus on learning as merely a presentation of a variety of knowledge into learning as a guidance to be able to explore the rich socio-cultural knowledge.

Technology in learning is basically nothing more than a tool or media. The use of technology or media that are not appropriate will almost certainly not result in a productive learning environment that ensures the learning better. Schramm [2] describes the availability of media in the learning process is very important in order to stimulate a child's attention, so as to increase the motivation to learn, helping to facilitate the understanding of a given learning materials, which can ultimately improve learning outcomes. A challenge and a golden opportunity to forward that information technology is growing to be one of the alternative options that can be utilized in education, especially in the classroom, both in general education especially in vocational education. Media use of multimedia in vocational education is a very important, especially at the level Vocational High School (VHS).

At vocational schools, lab facilities is an absolute must. Instructional media is also a tool that must be met. Because the result would be skilled workers, then by itself in the process of learning requires better facilities. Planning and development of learning was different from the public schools. Vocational technology education is closely related to the world of work, so that its instructional design is slightly different from the instructional design in general. Vocational school experience given under conditions that approach as close as possible to the conditions encountered in the work-learning where learning is given.

Through these realities, can be overcome with the procurement of complete equipment, steady teacher education, support-adequate managerial support, and the use of technology, especially information technology in teaching and learning. Associated with the development trend of information technology, the benefits of these technologies in education needs to be studied and further developed to aid the learning process, and to improve the quality of teaching and learning process. Thus in a series of educational achievement, especially in vocational schools, it is essential to do a maximum effort to use more of the information technology, such as software or hardware.

Software/hardware-based technology is expected to be used in an attempt to develop a more productive learning environment is video discs, multimedia/hypermedia, e-mail and the Internet, in addition to software Computer Assisted Instruction (CAI)/Intelligent Computer Assisted Instruction (ICAI) is available in CD-ROM form. These devices provide the convenience of learning through the ability to provide relevant information in the form of documents, photographs, transcripts, and video or audio clips. Via e-mail, discussion groups, tasks and personal communications between learners can be done online. While it provides a computer-based multimedia learning resources in various forms: text, images, video, sound, and is entirely software can be downloaded to allow too does the distance learning

Furthermore, from preliminary research conducted at SMK Negeri 3 Makassar showed 58.1% of respondents said desperately need a CAI modeling especially in subjects Programmable Logic Control (PLC). Other findings are not complete laboratory facilities, no adequate media and the level of abstraction of these subjects is high, so that the states need media that they can use to more quickly understand the material presented in these subjects. Teaching and learning process in the classroom has not experienced problems when teachers presented learning materials still can be replaced using conventional media. Instead the teacher will have difficulty learning material described if the teacher is an abstract object or objects that are not allowed to be brought into the classroom, the teacher usually only a portrait of the model object / object and try to explain as best he could. Moreover, students cannot repeat what has been described by teachers without a media that utilizes computer technology [3].

II. PROBLEMS

These issues show that, it takes other instructional media that is more appropriate to allow the learner to understand the learning materials quickly and precisely. Various phenomena above missed if used in teaching and learning computer technology that allows the presentation of a variety of learning models with appropriate creations. Based on the descriptions above, this study will examine and develop a computer-assisted learning model for vocational high schools, particularly in the electrical engineering program. Thus the issue in this study is: "How to develop a computer-assisted learning model in Vocational High School?"

III. RESEARCH OBJECTIVES

This study aims to: (1) Identify the steps systematic development of CAI model, (2) Integrate multiple teaching methods in the development of CAI model in the VHS, (3) Integrating constructivist learning theories into CAI model; (4) Develop a CAI model for vocational schools are eligible validity, practicality and consistency.

IV. LIBRARY STUDIES AND FRAMEWORKS THINK

4.1. Learning Media

Learning Media is part of the educational technology. While educational technology by (Newby: 2000: 10) "is the bridge between those who conduct research on human learning (eg psychologist, linguists) and those who are teaching and learning". According to educational technology is the bridge that connects the people who do research in the study of human (such as psychologists, linguists) and those in the field of teaching and learning. In line with these opinions Heinich, Molenda, & Russell [3] write "applying scientific knowledge about human learning to the practical tasks of teaching and learning", which means the application of scientific knowledge about the fields of human study on the practical task of teaching and learning . The experts stated that learning technology is indeed a connection between the drive or the researchers or scientists to those who teach. This learning technology produces a medium used in teaching and learning.

Computer media in this case may represent multimedia, can produce media that can be seen, heard, and done. In relation to the media, a cone which was introduced by E. Dale in 1969 [5].

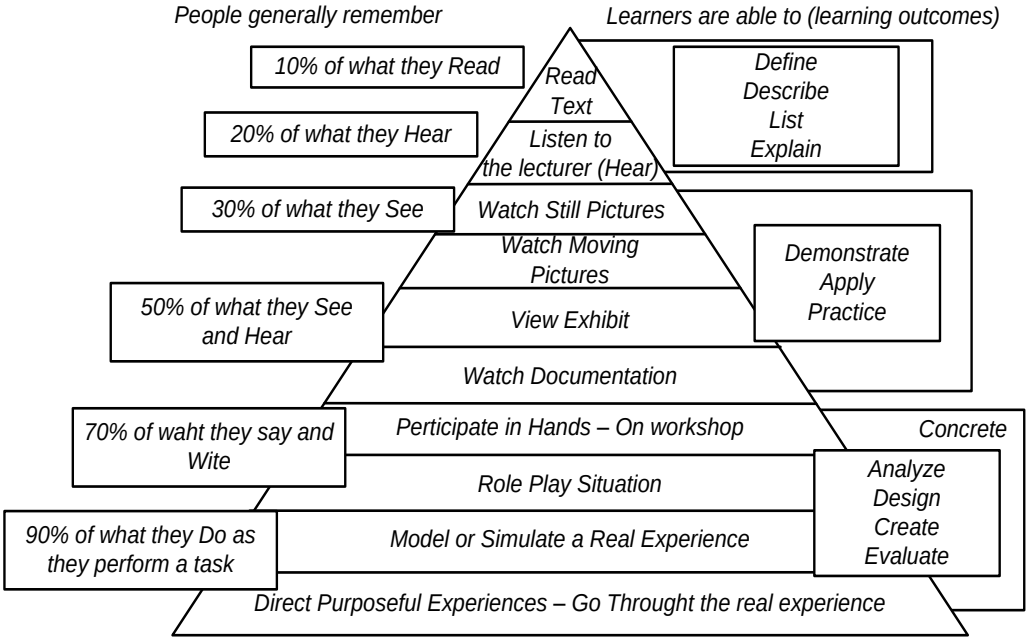

Figure 1. Cone of Experience E. Dale [5]

Knowledge of the functions and capabilities of the media, it is very important if the media is an integral part of learning as the basis for policy in the selection, development, and utilization of media cannot be separated from this knowledge. Based on this, the media is a very important in the delivery of the material. Moreover, computer media is a medium in which the child immediately perform her job. This is considered to provide contribution according to the cone of experience E. Dale (Figure 1).

4.2. Computer Assisted Instruction (CAI)

Support Learning Theory at CAI

Learning theory underlying CAI. (1) Behaviorists, on behaviorist learning theory, the theory of which is considered the most influential on the development of educational technology is the theory of operant conditioning by Skinner with the concept of stimulus-response and reinforcement factors [4]; [6], (2) Cognitive, cognitive learning theory, be used to supplement deficiencies in learning theory behaviorists, because behaviorists have not been able to solve the problems of complex learning. Among the cognitive learning theory which often form the basis of media usage is Peaget developmental theory. According Heinich [4] with cognitive learning theory Peaget there will be a gradual process in the brain to the acceptance of the material in accordance with learners and learner abilities. Other cognitive learning theories that influence CAI is a theory of meaningful learning Ausubel, it is because in this theory organizational structures that exist in the memory which can be integrated separate elements into a conceptual unit, which will convey the same meaning CAI function itself, (3) Constructivism, Constructivism is based on a firm knowledge base of learning theory derived from cognitive psychology [7]. Nature theory of constructivism is the idea that learners must make it his own information. Leinhardt has synthesized the cognitive research that supports constructivism and summarized the implications around three fundamental aspects: multiple forms of knowledge, the role of prior knowledge, and the social nature of knowledge and its acquisition. Constructivist theory of learning look continuously checking new information against old rules and improve the rules [8]. This view has deep involvement in teaching, advocating a more active role for learners in their own learning compared to what is currently implemented on the majority class. With constructivist learning, learning is not focused on the teacher or teachers, constructivist help learners internalize and transform new information. On learning this, PBK will be able to construct knowledge learners with various learning models, (4) view of Lev Vygotsky, According to [1] Vygotsky offers a theory which says that the potential for cognitive development is limited to a certain range and unique for each bersifaf individual learning. Theory known as the "zone of proximal development/ZPD" can be defined as the range between the actual developmental level of intelligence (without guided instruction) and a potential intelligence (determined by problem solving abilities under the guidance of assistants or more capable peers); (5) view Gagne, Gagne On learning model based on a hierarchy of skills that are organized according to the level of complexity. Therefore, instructional design constructed efficiently by 9 order, namely (1) gain attention,

(2) identify objective, (3) recall of prior learning, (4) present the stimulus, (5) learning guide, (6) elicit information , (7) provide feedback, and (S) assess performance, and (9) Enhance retention.

Based on the findings above, the computer-assisted learning should be designed consists of (1) learning requires learner readiness (readiness emotionally) in receiving new information in addition to the need for a conducive learning environment, (2) provide learning options are diverse which not only allows the learner to draw connections between the knowledge and experience that have been previously owned by the receipt of new information, but more than it is able to also accommodate the learning preferences that exist in each individual learner, (3) provide both ease of learning sequentially guided through the process and independent learning, and (4) provide a variety of challenging tasks and are "ill-problems" that are expected to foster creativity in solving a variety of problems that are contextual.

Definition of Computer Assisted Instruction

Pramono [9] provides that the term limit for a specific computer-based learning package is CAI (Computer Assisted Instruction), CAL (Computer Assisted Learning) or CBL (Computer Based Learning). These packages are not explicitly include multimedia in it. So could these packages is a multimedia in a broad sense (containing text, audio, animation, video, and even simulated) or limited only contain some media such as text and images alone. Whatever media they contain, all three are explicitly designed to emphasize the learning in it. In other words, in the development of CAI, CAL or CBL became an instructional design framework that characterizes these packages. Package designed behaviorist approach is different from the package with the cognitive approach. Even though all three have in common but the name contains all three have different meanings.

In connection with the terms concerning computer-assisted learning, Cotton (2001), and then provide a summary of limits based on studies that have been done by Bangert-Drowns, Kulik & Kulik (1985), Batey (1987), Grimes (1977), Samson et al (1986), and Stennett (1985) with some terms that [9]: "Computer-based education (CBE), Computer-based instruction (CBI);. Computer-assisted instruction (CAI;) Computer-managed instruction (CMI), Computer-enriched instruction (CEI) "

Based on some of the restrictions provided by the experts, basically CAI learning model emphasizes the use of computers as a medium in the present study. The successful use of computers in the learning process is very dependent on cognitive factors in learning and learner motivation.

Computer Assisted Instruction Model

To realize CAI model, Romiszowski [10] divides 6 computer-assisted learning model, ie testing mode, drill and practice mode, programmed tutorial mode, conversational or dialogue tutorial mode, simulation mode, and the mode of inquiry or database search. Houghton [11] also mentions 6 categories, but the division is not as mentioned by Romiszowski. These six models proposed by Houghton [11] is a drill and practice, tutorials, games, simulation, discovery, and problem solving.

Model Development of CAI

There are several models of learning development for education in general, such models Kemp, Kemp and Carey and IDI, or models of Briggs, H. Bla Banathy, Kep, Gerloch and Ely, as well as Dick and Carey, Philip R. Teske, Calhoun (1976), Ronald Ribler (1983), model of ISD (1960), Coit Butler (1972), Bryl Shoemaker (1979), Robert Mager (1967) and PPSI models (1975), as well as development of models Romiszowski (1986).

Kemp and Dayton [9] provides a step-by-step planning and production of instructional media namely: (1) prelimenary, (2) the kinds of media, (3) designing the media, (4) production the media, and (5) using media and evaluation. Another development model provided by Sadiman et al. The measures provided by Sadiman, [11] namely: (1) identification of needs, (2) the formulation of objectives, (3) the formulation of the material, (4) formulation of gauge success, (5) screenwriting media , (6) tests/trials, (7) the script ready production, (8) production prototype, (9) test, (10) revision, and (11) the final program.

Another model that is more complex given by Romiszowski as shown in Figure 2. Romiszowski said that the product of this development when applied in learning integrated into the methods and media will cause learning to be efficient: “The multi-media package adopts several presentation media not so much to add variety to the lesson (though this is itself valuable) but because analysis of the subject and field testing has indicated that a particular method and medium ensures efficient learning of the particular concept or task” [11]

Basically the models on the development consists of preliminary planning, preparation of materials, design, preparation of material, programming/digitization, and validation. Thus in the development of good learning model in public schools and in vocational schools should have the planning stages, preparation of materials, design, development, programming, validation and field testing.

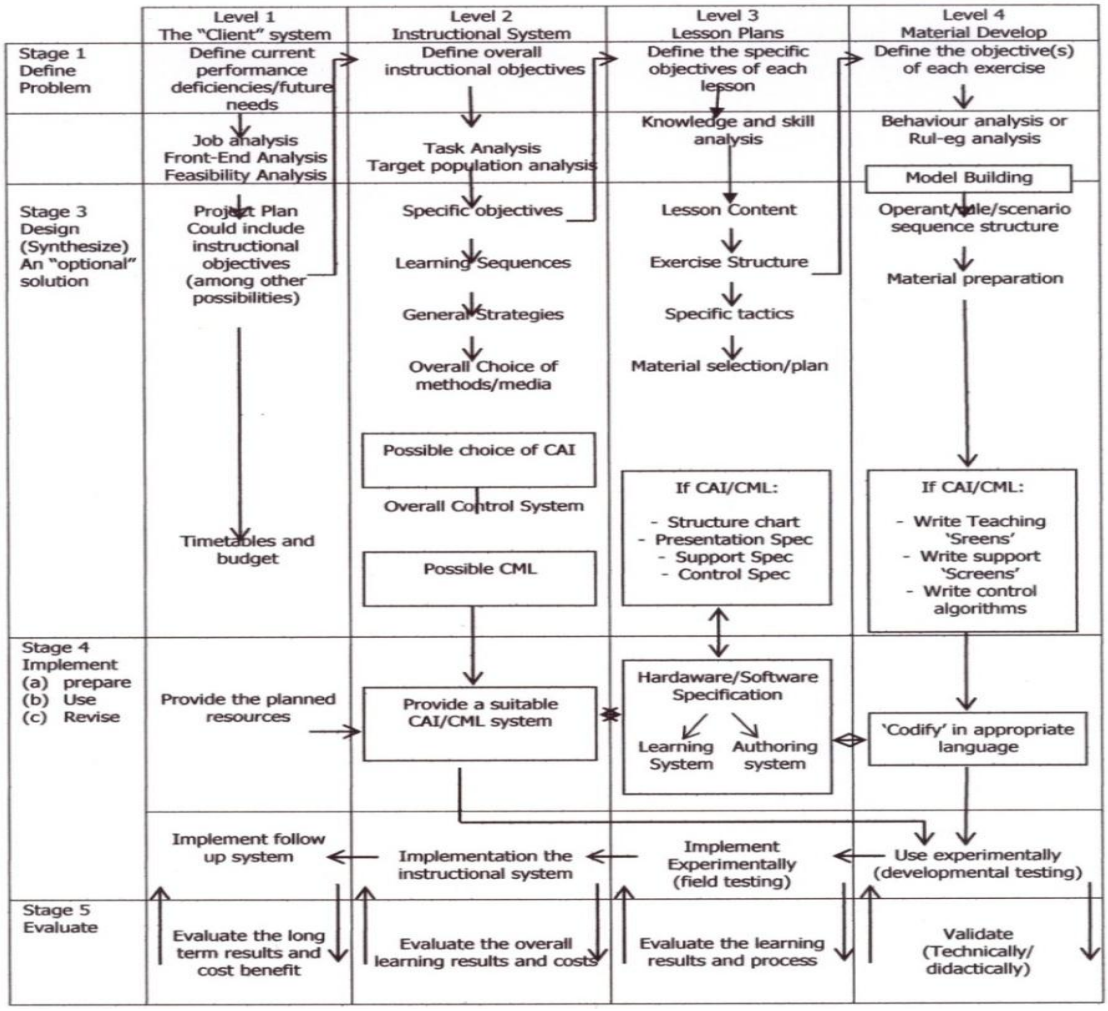

Figure 2. Romiszowski models of development (1986)

Considerations in Designing Aspects of Computer Assisted Instruction Program

In order to improve the quality of learning CAI, CAI should be designed according to the principles of good teaching. Thus CAI must have certain characteristics. CAI typically characterized as characteristics possessed by programmed instruction.

Aspects of the assessment in the development of instructional media summarized as follows: (a) Aspects of Software Engineering/Programming: Effective and efficient, Reliable, maintainable, Usability, The proper selection of type application/software/tool for development, compatibility, Packaging media integrated learning program and easy in execution, documentation program; (b) Aspects of Learning Design and Material Content: Clarity of learning objectives (formulation, realistic); Relevance learning objectives with Competence standard/base competence/Curriculum; scope and depth of learning objectives; Appropriateness use of learning strategies, Interactivity; motivation to learn, Contextuality and actuality, completeness and quality of learning support materials; Conformity materials with the purpose of learning, depth material, Easy to understand, systematic, continuous, clear logic flow; clarity of description, discussion, examples, simulations, exercises; Consistency of evaluation with learning objectives; accuracy and provision of evaluation tools; Giving feedback on the evaluation results (c) Aspects of Visual Communication/Display: Communicative; according to the message and; acceptable/in line with the wishes of the target; Creative ideas pouring in following ideas; Simple

Alluring; Audio (narration, sound effects, back sound, music); Visual (layout design, typography, color); media moves (animation, movie); Interactive Layout (navigation icons).

4.3. Vocational Education

Slamet cites the opinion of Evans vocational education is part of the education system that prepares a person to be able to work on a single occupational group or an occupation than other creative fields. While according to the United States Congress (1976) vocational education is an educational program that is directly associated with the preparation of a person for a particular job or for additional preparation for one's career. The purpose of vocational education according to Evans in Slamet is to (1) meet the manpower needs of the community, (2) increase the educational options for each individual, (3) serve as a motivating force to improve all types of learning [13].

Things that need to be taught to students based four concepts: (1) teach something that has not been taught outside of school, (2) teaching based on common culture wherein learner request will live, (3) teach general concepts, (4) every learner must understanding, is able to control, and confident in their environment.

Based on a review of the definition, purpose, philosophy, principles and characteristics of vocational education at the top, then the development of innovative learning models and the use of technology is very beneficial to the educational advancement. In this case the use of computer media as a form of learning in vocational education models will give you the reality of life, modeling of form, structure, color, dimensions, or utensils simulation of the work piece to be used.

4.4. Relevant research

One of the investigations conducted by Kulik, JA [14] produces some interesting facts related to the effectiveness of CAI or CBI and CMI. Kulik found that when the results of 175 studies summarized using meta-analysis procedures and the learners are taught with computers reached a value of about 0.29 SD higher in the way the achievements of the learners who are taught with methods without involving a computer. The meta-analysis conducted by Kulik, JA (1983) in a meta-analysis "Synthesis of research on computer based instruction", the 48 studies that looked at the effects of computer-based instruction (CBI). CBI result considerably improves performance, quite positively influence academic attitudes, and a very positive influence attitudes toward computers. Furthermore, the results of research conducted by Hasselbring (1984) who conducted research on the effects of CBI on achievement of learning outcomes and attitudes result in the use of CBI is more fun than traditional learning.

Results of other studies that specifically examined the vocational education provided by Susan Imel (1992) with the study of computer assisted instruction in vocational education: practice application brief. Concluded CAI can be effective in vocational education but need to prove its superiority compared to other methods. Also according to Susan CAI role in vocational education should be developed and expanded. CAI can be as a tool to teach students about the applications that will be used in the industry. Furthermore he stated components in CAI Drill and Practice is perfect with competency-based learning, such as vocational. In addition, some of the results of research studies pertaining to the development of CAI was also assessed as the result of research Herman DS. [15], research conducted Pramono [16], Zulkardi [17], Mills, Rick [18], research conducted [19], Ani Cahyadi [20], Research conducted by the University of Southern Maine, and research conducted by Linda L. Wade [21].

4.5. Conceptual Framework

Learning in vocational teaching aids requires an appropriate device, especially for productive subjects. This is because not all practice equipment is mainly used in industry can be presented in schools. One of the learning tools that can be used is the media, especially media with the help of computers. Because these devices can be made an equipment modeling, animation, and even up to two or three-dimensional simulations. To build a CAI tools, the development model is needed, in the form of systematic measures so that the product right and interest to students.

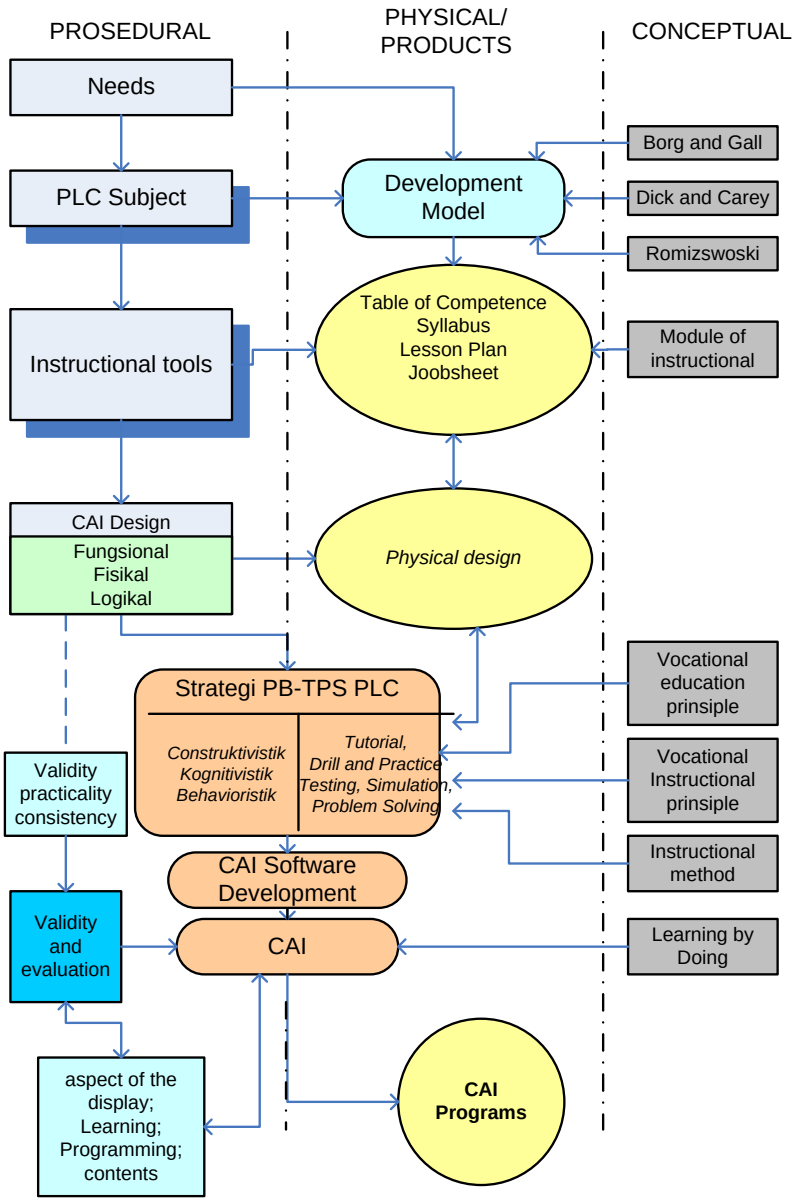

Figure 3. Framework CAI Model (Mappalotteng, 2011)

For systematic measures, necessary to study the development of conceptual models, whereas the attractiveness assessed from four aspects, namely the learning aspect, the material aspect, the aspect of the display and programming aspects. The development framework contained in an image as shown in Figure 3.

4.6. Research Questions

Based on the problems and mindsets that have been at the top, then the question in this study can be formulated as follows: (a) What measures systematic development of CAI in VHS?; (B) What kind of equipment resulting from development CAI, (c) How to integrate learning methods in the development of CAI model in VHS?; (d) How to integrate constructivism learning theory into the CAI model in the VHS?; (e) How do users respond to aspects of the display, programming, learning, and aspects of product CAI contents?; (f) How can the validity, practicality and consistency in learning models PBK Vocational School?

V. RESEARCH METHODS

This study is a research and development program on the utilization of electrical energy expertise VHS who has training programs Electrical Engineering/Electrical. The research was conducted in three VHS in Makassar and Gowa. Stages of development takes place on four levels starting from the level of client systems, system-level instructional, lesson plan level and the level of material development. Each level contains activity

problem identification, problem analysis, design, implementation and evaluation. Products resulting from these stages validated the media experts and subject matter experts to test individual, small group testing and trials expanded. To determine the validity, practicality and consistency of CAI, conducted the analysis using inter-rater Percentage of Agreements, CAI developed consistency, consistency can be seen in the results of assessments carried out by the subject try. Consistency of assessment results can be seen from the high correlation coefficient similarity assessment results that inter-rater agreement in scoring the assessment of the performance object.

5.1. Research and Development

5.1.1. CAI Model Development Program

Results Development of CAI Model includes three types of models, namely: 1) conceptual model, 2) procedural models, and 3) physical models. The final result in the form of physical products tested to vocational students to gain validity, practicality and consistency.

Conceptual model refers to the frame as shown in Figure 3. Procedural model embodies the design stages of learning to design software CAI. This procedural model output produces physical models (CAI Program). Based development model that was obtained procedural development model as shown in Figure 4.

Furthermore the physical model of the physical form of the product in the form of CAI. This product is tangible interactive multimedia program that is packaged in the Compact Disk. This results in a physical model of flow charts and storyboards.

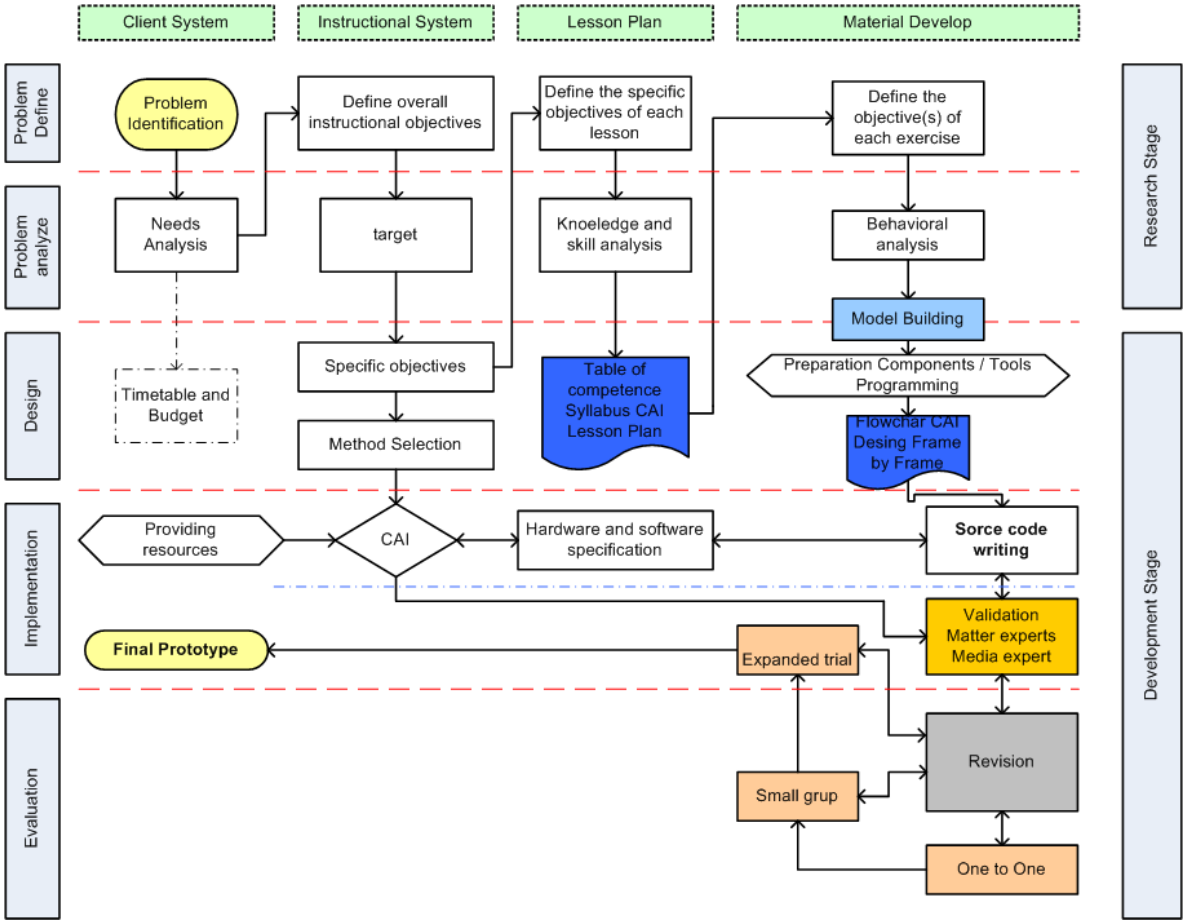

Figure 4. CAI Development Model (Adapted from Borg and Gall, Dick and Carey and Romizswosky)

5.1.2. Pre-Development CAI Model

Basically the analysis at the first level, the client system requirements analysis procedure is the development of the vocational level. Therefore the first level of the model is the development of a needs analysis can be described as follows:

a) Needs Analysis, fieldwork activities for the needs analysis was conducted involving 31 respondents, consisting of 4 electrical teachers and 27 students. Results of the analysis to the 31 respondents found 58.1% stated in desperate need of a computer-aided modeling of learning in subjects PLC. The reason is because according to them the most difficult subject to understand, it is seen that the subjects electric machine operation with PLC control (EMO-PLC) is difficult to understand. Subsequent analysis found the reason why the subject is so difficult to understand, 41.9% of them stated the incompleteness of practice equipment, 29% expressed a high level of abstraction, 25.8% said the unavailability of adequate media, 12.9% stated that the level of knowledge of teachers the low and 9.7% stated lack of concern about a student teacher. Furthermore, if only subjects EMO-PLC in question, 35.48% of subjects expressed PLC rapidly absorbed, while the remaining 64.52% did poorly absorbed. The reason they put it in relation to the above question. A total of 32.26% stated that lack of teacher knowledge, 16.13% expressed a high level of abstraction, 45.16% did not complete practice equipment, and the balance of 6.45% unavailability of adequate media.

Based on the needs analysis, subject in the development of this learning model is EMO-PLC. Furthermore, there are two other subject are involved in the development of this learning model, ie, electric machine operation with electromagnetic control (EMO-EM) and electric machine operation with electronic control (EMO-EL). Both subject which must be passed before the subject EMO-PLC.

b) Learning System, the second level of the model used is the development of instructional systems. At this point the development of computer-assisted learning model has resulted in subjects overall purpose, objectives, and targets students who will use it. Regarding this goal is one of the materials that will be poured into the competency table, syllabus, lesson plans, and modules along with products produced at the next level. While the selection of CAI method has also been determined at this level, so it seems the strategy used to achieve the goals set out as a strategy tutorial, drill and practice, games, Testing, Problem solving, and simulation.

c) Lesson Plan, the third level is the development model lesson plan (lesson plans), which is defined at the level of the specific objectives of each lesson and then analyze the knowledge and skills that determine what materials are delivered to students. Physical product phase lesson plan outlined in Table Competence, CAI Syllabus, Computer Assisted Instruction Implementation Plan (CAI-IP) and Module. Specified in the CAI syllabus learning strategies or methods used. Strategies such as tutorial, drill and practice, games, and simulations.

5.1.3. Development of Computer Assisted Instruction (CAI) Programs

The initial stage is the development of CAI materials, products of the stages of development are: (1) Flowchart program (CAI-FP), (b) the Storyboard. Further programming activities throughout the plan/design that was created earlier in the flowchart and frame into a computer program. Further facilities and content developed in CAI based storyboard, frame-by-frame design to the menus as follows: (1) Wellcome page, (2) Home, (3) Introduction, (4) Software Support; (5) Authors; (6) subjects.

On every page of subjects, accessible menus associated with subjects. The menu can be described as follows: (1) competence, (2) purpose, (3) material, (4) Games; (5) Exercise, (6) Simulation; (7) Evaluation; (8) Help.

5.1.4. Product Trial

Product validation

Tests done by first validating products that have been developed to media experts and subject matter experts. For validation of the product, used 10 assessors expert consisting of expert assessors material, peer assessors and appraisers media expert. Six people appraiser expert in materials and four experts in the media. 3 people matter experts drawn from universities. Matter experts to evaluate two aspects of the learning aspects and aspects of the content. Media experts to evaluate two aspects, namely the aspect of the display and programming aspects of Phase validation by subject matter experts is the first assessment after the product is built. This validation stages beginning with preparing all the documents and CAI programs.

Testing one-to-one

After doing some revision on the advice and judgment of media experts and subject matter experts, the trial was conducted involving students as users of the CAI program. To test the need for this one, taken three students who assess the CAI subjects, thus the number of student respondents were included in this single trial by 9 people. Evaluation of students concerning learning aspect, the content aspect, the aspect of the display and programming aspects. The instrument used was adjusted to the students' abilities.

Assessment results on test subjects try one-to-one discussion with the expert comprising both practitioners and academics from VHS teacher, and lecturer on the topic developed. This is done through focus group discussions. The test results of the assessment showed students a deeper concern about the substance of the material as the main component of a dish learning aspect of practice questions and tests, determination problem formulation; aspects of programming such as Games, transitions, animations and efficiency.

Small-group trial

Small group trial involving 30 students. Each subject of CAI judged by a small group of about 10 people. In this small group testing, the instrument used is not different from the instruments used in the experiment one to one.

Overall mean of CAI 4.7 has to be in very good criteria. However, if viewed every component, the presentation component of practice questions and tests on CAI EMO-EM and EMO-PLC and motivation at CAI EMO-EM is below the average of 4.5. Therefore these components still require minor revisions so that the evaluation results can be obtained by mean of the maximum. Revision results from the pilot phase a small group, mainly used for the next learning aspects of field trials (expanded).

Summary of evaluation results for the small group looks mean component of text legibility, image quality and resolution with a 4.6 each criterion very well. Harmony of color components and each transition is the criterion very well, although with a mean that is the lower limit of this criterion, namely 4.5. While the quality of the audio, animation, simulation, and each button is located on the criteria very well with the average of 4.7. better layout with an excellent average of 4.8 criteria and display games according to student assessment is still in good condition with a mean of 4.2 tests the same as one to one. CAI program overall has been on very good condition with a mean score of 4.6.

As well as on the results of individual trials (one to one), results of the assessment on the subject try this small test group discussed with the expert that has been involved from the beginning of the development of the CAI. Test results are still focused on small groups about the dish, and games and animation.

After revisions are made obtainable prototype CAI is ready to be tested in the field. For this field trial, the subjects try extended (enlarged) by taking three VHS with each subject try 30 people.

Expanded Trial

This trial is testing the students' actual field and the output of this field trial is a prototype that is ready for use in bulk.

Summary results of the evaluation trials found extended student responses to the four aspects assessed in the category: for the learning aspect is very good, very suitable material aspects, aspect of the display is very attractive and very good with the programming aspect of the overall average of 4.7.

To determine differences in each aspect of training the eye, followed by analysis using the Kruskall Wallis nonparametric statistical. Chisquare value ($\chi 2$) showed EMO-EM was 2.757, with Asymp-Sig = 0.431 is greater than the alpha of 0.05, indicating there were no differences in students' responses to the four aspects of the CAI program. Training for EMO-EL found chisquare value ($\chi 2$) = 1.849 with Asymp-Sig = 0.604. This value is also well above 0.05, so the training for EMO-EL is also no difference in the responses of students to aspects of CAI. Meanwhile EMO-PLC, was found chisquare value ($\chi 2$) = 3.369 with Asymp-Sig = 0.338, which is above 0.05 indicates no difference to the four aspects of student assessment in the development of CAI. Thus the four aspects in the development of CAI are met evenly and consistently.

Consistency test assessment results with the presence or absence of differences in the results of the assessment (bias rating). Therefore, to test the consistency of the results between the three sources of assessment used analysis of variance (Kruskall Wallis) to test for differences in mean outcome of those assessments.

Thus there is consistency between the three groups of subjects appraiser is EMO-EM. This gives the conclusion that CAI subjects EMO-EM is effective. The second test is the assessment group EMO-EL, t value of chi-square (X2) = 1.426, with df = 2, and Asymp-Sig = 0.490 is well above 0.05 indicate that the assessment results between the groups in CAI subjects evaluator EMO-EL not reveal any differences. Thus there is consistency between the three groups of subjects appraiser is EMO-EL. This gives the conclusion that CAI subjects EMO-EL is consistent. Meanwhile, for the CAI subjects EMO-PLC was found chisquare ($\chi 2$) 0.429,

with df = 2, and Asymp-Sig = 0.807 is well above 0.05 indicate that the assessment results between the groups in CAI subjects evaluator EMO-PLC did not reveal any difference. Thus there is consistency between the three groups of subjects appraiser is EMO-PLC. This gives the conclusion that CAI subjects EMO-EL is consistent with the two other subjects.

5.1.6. Integration of Learning Methods

Integration of learning methods implemented concurrently with the development of computer-assisted learning model above. Learning methods lectures, demonstrations, explanations, simulations still be used as a complementary method in the development of computer-assisted learning model is to form a unified model of learning not only obtainable of learning software that has been developed but collaborated with other methods.

Integration of real learning method outlined in the syllabus-CAI, where each subject or sub-subject using different learning methods. This integration involves learning models that exist in the CAI, the tutorial, drill and practice, problem solving, simulation, games, and testing.

The sixth component of learning methods are summarized in CAI, described by the topic on the syllabus CAI. On the syllabus CAI apparent method or strategy used for each topic EMO-EM, EMO-EL, and EMO-PLC subjects.

5.1.7. Integration of learning theory Constructivism

Constructivist teaching strategies often called student-centered or student centered instruction. Therefore, the development process CAI, are concerned interactivity program, because in the end the students will use, and can repeat what is in the CAI. Constructivist integration in the development process is mainly done by considering every strategy and interactivity material featured in CAI program. Starting from the early stages of development have noted how users can use their own suite of programs produced without the need for additional clarification from the instructor. To keep this in the process of development has been carried out additions information about the program to be run.

Constructivist integration process has been considered while making the design flow charts and storyboards, to the writing-program implementation using macromedia flash applications, swishmax, macromedia fireworks, macromedia freehand, macromedia director and other application programs.

5.1.8. End product studies on the CAI Vocational School

The end product of this CAI-CDI development form consisting of three subjects namely Operate production machines with electromechanical control (EMO-EM), Operate Mechanical Production with Electronic Control (EMO-EL), Operate Machines with Full Production Programmable Logic Control (EMO - PLC). Three subjects were integrated into a single package Computer Assisted Instruction Program in a Compact Disc Interactive (CAI-CDI) or can be stored in other storage media.

In addition to CAI-CDI product, the final product of this research package resulted with an evaluation instrument for the development of CAI, CAI Syllabus, RP-CAI, Flowchart CAI, and CAI storyboard. Sixth devices such learning is an integral part of this development. But for the needs of students, CAI-CDI program package can be used independently.

Can run this program for CAI-CDI, the minimum hardware requirements refer to the minimum requirements required to be able to run the program Macromedia Director MX2004 and can run programs such as the support of third-party simulators. Regarding the minimum hardware requirement is now no longer a problem, because the computer has been progressing hardware and software extraordinary rapid. To be able to run the CAI well, it takes the form of a minimum of: (1) Processor Intel Pentium IV 1.6 GHz, (2) Memory 512 MB, (3) 32 MB VGA card, (4) 300 MB Hard Disk free space: (5) at least 256 Color Monitor, with resolution of 800x600dpi; (6) Operating System Windows 9X, 2000 or XP; (7) CD ROM Drive; (8) Speaker.

VI. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

Based on the research that has been discussed in the previous chapter can be summarized as follows: (a) step-by-step systematic development of computer-assisted learning model in vocational preceded by a preliminary study of a needs analysis performed on the client, the next stage of learning system design and lesson plans, develop the material after it is done. In the development stage of prepared material around the device that will be used in the writing program. Writing programs produce initial prototype validated to media

expert and an expert on materials, repairs made after input from experts. Subsequently tested on subjects try with three stages namely the individual, small group, and the group expanded. At the end of each trial was subject to revision in accordance try appraisal; (b) The development of CAI resulting from this include: Model Development CAI; competences tables; CAI Syllabus; subjects Module; CAI Flowchart; storyboards, and CAI prototype software products (c) Integration of learning methods in the development model of CAI in VHS done through existing strategies on the CAI tutorial, drill & Practice, games, Problem Solving, Simulation, and Testing, (3) Integrating constructivism learning theory into a model of CAI in VHS done through interactivity program that was developed and EAPs can be packaged and distributed through storage media such as flash, external disk, or CD/DVD, (4) user response to aspects of the display, programming, learning aspects, and aspects of the content is very good with above average percentage 90%, (5) learning model has been developed to meet CAI validity, practicalities and consistency.

6.2. Recommendations

Based on the study findings, presented some suggestions as follows: (a) development of learning programs for other subjects especially productive on VHS can be done by following these steps systematically found from the results of this research and development, (b) At VHS, especially the technology , can use the results and the development of its products as a learning tool in schools is concerned; (c) it is recommended to use a whole strategy/method in the CAI, so that teaching and learning process can take place as expected; (d) Digging further theory constructivism; (e) for developers learning, computer-assisted learning in particular, the need for needs analysis, to determine the requirements needed by potential users of the software to be developed; (f) In any software development learning Noteworthy aspects of the aspects related learning, aspects of appearance, content and programming aspects; (g) at VHS, expected to be used in teaching and learning in the classroom, in an effort to bring the learners into the real world through the help of computers; (h) is recommended for the next researcher to further research on the application of test / dissemination for one or two semesters, to see the effectiveness of the developed model.

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