Development of Learning Models for Programming Algorithms and Structure of Data I for E-Learning Assistance

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***Abstract*—This research aims to develop a learning model of Programming Algorithms and the Data I Structure of e-learning assistance. Research and development of this model will produce products in the form of print modules, learning designs and e-learning assisted media for Algorithms and Data I Structure courses. Development of learning models for Programming Algorithms and Structure of Data I for e-learning assistance using the Dick and Carey model design modified with the Trollip and Alessi models. The steps taken in the development of this model are preliminary research, planning and model development, validation, evaluation and revision of the model, and implementation of the model. Validation results from experts consisting of 93% learning design experts, 95% material experts, and 87% of media experts recommend that this development model is used in learning Programming Algorithms and Structure of Data I. As for the implementation of individual trials are achieved 95% achievement, a small group trials reaching 95%, and a field test achieved 96% success. The conclusion of the expert validation process and the results of trials, that the development of learning models of Programming Algorithms and Structure of Data I for e-learning assistance is feasible to be used in learning.**

Keywords—learning models, algorithm, e-learning.

I. INTRODUCTION

In this learning process we need media or tools that support the achievement of learning objectives. Harold says that learning is a change in behavior that results from the learner's interaction with the environment (experience.). Herein lies the importance of the use of information and communication technology in education. Various ICT software such as Microsoft office makes it easy for students / students to complete and present their assignments. In addition, the learning process can use technology that involves text, images, sounds, and videos. The use of this technology makes the presentation of learning materials more interesting, not monotonous and easy to digest. Students can hear, see, and read material delivered in the form of text, images and videos.

Other information and communication technologies that can be used in education are the internet. Using the internet can help students get learning materials in the form of modules, power points, and learning videos and learn them independently. In addition, the use of e-learning can overcome the limitations of time in the learning hours that have occurred. This time limitation makes it difficult for students to explore learning material, especially for students who have low abilities. E-learning can be defined as the technology used to enhance or facilitate the learning process through interaction with digital services, help or content (Riad, et all, 2009).

E-learning helps learners to take responsibility of their learning, becomes autonomous and selfconfident. It enables introvert students to interact more freely, provides diversification of activities, fosters their intrinsic motivation and permits the acquisition of valuable study and time management skills (Gambari, et all. 2017). The greatest impact on learning comes from good instructional design paired with high rates of meaningful active student responding (Twyman & Heward, 2016). The use and implementation of E-learning is broad and complex; Details are given as follows: (Alharbi and Lally 2017).

With e-learning assisted learning, students who have low abilities can catch up with repeating the material provided. While students who are left behind learning materials can learn independently through e-learning media. The other students who are not left behind the learning material can use e-learning as an alternative way to explore the learning material provided by the lecturer.

II. METHOD

The general objective of this research is to develop a learning model of Programming and Data Structure Algorithm assisted by e-learning so that later it can facilitate students in implementing practical and effective learning. The research method used is a method of research and development in the field of education, better known as Research and Development.

According to Silalahi (2017), the term development research is difficult to distinguish from research and development because these two terms refer to the same thing, namely both contributing from a theoretical perspective and also contributing to product improvement (practical contribution). According to Tim Puslitjaknov, the definition of development research in the field of education consists of: Development Model Components, Development Procedure Components, and finally the Model Test Components or Development Product Components.

Borg & Gall (2003), says that the definition of research and development is an industry-based development model whose research findings are used to design new products and procedures and then apply the research method to field trials, evaluate and refine products and procedures to meet the criteria of effective, quality and have good standard. Research and development in the field of education is applied research that is directed at developing effective products for the needs of education managers. Furthermore Borg and Gall says that Educational Research and Development is a process used to develop and validate educational product (1983). Development of learning models for Programming and Data Structure Algorithm assisted by e-learning, using the Dick and Carey Model design modified with the Trollip and Alessi models. The model is equipped with an evaluation phase that can help in determining if something is wrong and how to improve and improve it (Dick & Carey, 2009:3).

III. RESULT AND DISCUSSION

Development of learning materials is made in 3 draft models, namely:

A. Model Draft I

Development of draft 1 is based on the results of identification of objectives and analysis of learning objectives. Identification and analysis of this need is done after analyzing the results of preliminary research that has been done before. Draft 1 was made after determining General Instructional Objectives, analyzing learning, identifying behaviors and initial characteristics, Special Instructional Objectives, reference assessment and learning strategies. Furthermore, a design expert and material expert is tested. This draft eventually becomes a book or learning module, in addition to the learning material also contains examples of questions whose contents have all been validated and revised according to expert advice. Making a draft written about the results of the mapping that already exists in the learning objectives. The existing mapping is planned to pour in the form of menus found in e-learning developed. Draft 1 contains the design of learning materials used by students. The order of material from learning materials Programming and Data Structure Algorithms I are composed of material that is easy to complex. This is done so that students can easily understand the contents of the material developed. The sequence of draft learning modules in learning The Programming and Data Structure Algorithm I in draft 1 are as follows:

KATA PENGANTAR

MODUL I KONSEP DASAR ALGORITMA
Pendahuluan
Tujuan Instruksional Khusus
Apa itu Algoritma
Program
Memperkenalkan Algorima melalui soal-soal praktis
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL II PROGRAM C/C++
Pendahuluan
Tujuan Instruksional Khusus
Bahasa Pemrograman C
Struktur Bahasa C
Cara Penulisan Program dalam Bahasa C
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL III FLOWCHART DAN PSEUDOCODE
Pendahuluan
Tujuan Instruksional Khusus
Konsep Dasar Flowchart
Flowchart Program
Pengambilan Keputusan dalam Flowchart
Pengulangan Proses
Konsep Dasar Pseudocode
Struktur Algoritma
Input dan Output
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL IV TIPE DATA DAN OPERATOR
Pendahuluan
Tujuan Instruksional Khusus
Tipe Data Dasar
Variabel
Konstanta
Operator
Urutan Operasi
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL V RUNTUNAN DAN PERCABANGAN
Pendahuluan
Tujuan Instruksional Khusus
Runtunan
Seleksi atau Percabangan
Bentuk Umum *IF* dan Variasinya
Terapan Bentuk-bentuk *IF*
Bentuk Umum *CASE* dan Variasinya
Terapan Bentuk-bentuk *CASE*
Konversi Struktur *IF* dan *CASE* ke Bahasa C
Rangkuman
Kuis benar salah

Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL VI PENGULANGAN
Pendahuluan
Tujuan Instruksional Khusus
Konsep Pengulangan
Sintaks WHILE
Sintaks DO … WHILE
Sintaks FOR
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL VII PENGULANGAN LANJUT
Pendahuluan
Tujuan Instruksional Khusus
Konsep Pengulangan Tersarang
Struktur Perulangan *While-Do* Tersarang
Struktur Perulangan *FOR* Tersarang
Struktur Perulangan *Do While* Tersarang
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL VIII PEMROGRAMAN MODULAR
Pendahuluan
Tujuan Instruksional Khusus
Definisi Pemrograman Modular
Variabel Lokal dan Variabel Global
Variabel Lokal
Variabel Global
Fungsi
Prosedur
Fungsi dan Prosedur Yang Telah Terdefinisi
Fungsi Rekursif
Unit
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL IX *ARRAY* DIMENSI 1
Pendahuluan
Tujuan Instruksional Khusus
Definisi *Array*
Menyiapkan *Array* Satu Dimensi
Mengisi *Array* I Dimensi Dengan Nilai *Konstanta*
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL X *ARRAY* DIMENSI 1 LANJUT
Pendahuluan
Tujuan Instruksional Khusus
Mengisi *Array* I Dimensi Dengan Nilai Yang Diketik Melalui Keyboard
Mencetak Isi *Array* Satu Dimensi
Menyalin Isi *Array* ke *Array* Yang Lain
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL XI *ARRAY* DUA DIMENSI
Pendahuluan
Tujuan Instruksional Khusus
Pengertian *Array* Dua Dimensi
Menyiapkan *Array* Dua Dimensi
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL XII MESIN KARAKTER
Pendahuluan
Tujuan Instruksional Khusus
Mesin
Penggunaan Mesin
Rangkuman
Kuis benar salah
Kunci jawaban test formatif
Daftar pustaka

MODUL XIII Pencarian
Pendahuluan
Tujuan Instruksional Khusus
Konsep Pencarian
Pencarian *Sekuensial*
Pencarian *Biner*
Pencarian Lain
Rangkuman
Kuis benar salah
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

MODUL XIV PENGURUTAN (*SORTING*)
Pendahuluan
Tujuan Instruksional Khusus
Pengertian *Sort*
Bubble *Sort*
Selection *Sort*
Insertion *Sort*
Rangkuman
Pilihan ganda
Kunci jawaban test formatif
Daftar pustaka

B. Model Draft 2

Draft 2 is an explanation of the components, sub-components which are input to the final draft. Draft 2 relates to the media used in the learning process, which is e-learning assisted learning.

C. Model Draf Final

The final draft is a merger of draft 1 and draft 2. The procedures for using e-learning are as follows:

1. Start Learning

E-learning assisted learning can be run using the Explorer internet browser, Mozilla Firefox or Chrome by typing *http://www.zatranssmarttech.com/edukasi*.

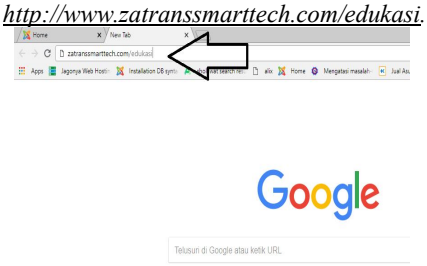

Figure 1. Display of typing e-learning web address

After clicking on the address above, there will be an initial display of learning I Programming and Data Structure Algorithms assisted by e-learning as follows:

Figure 2. The initial appearance of Learning I Programming and Data Structure Algorithms assisted by e-learning

The above display is the initial appearance of learning I Programming and Data Structure Algorithms assisted by e-learning. At least 1 (one) menu is displayed at the beginning, namely:

a. Login

To register a new user or fill in new student data and login to enter the next stage.

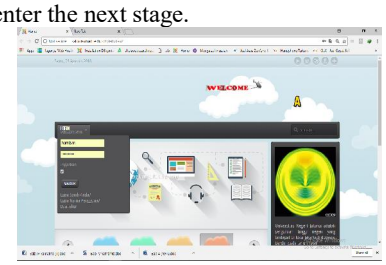

Figure 3. Display of User / Student Login on Learning I Programming and Data Structure Algorithms assisted by e-learning

Students are welcome to click LOGIN in the upper left corner, to access the facilities available in learning the Programming and Data Structure Algorithm I, the user must fill in the user name and password for those who have registered. While those who have not registered, please contract the course and the admin will make or add to the list of courses. Following is the login menu display:

Type the user and password in the place that has been given, type the caphcha and then click the send form menu. Whereas students who have not registered mean that the relevant person has not registered or has not contracted the course and the admin will make or add to the list of courses by opening the created account menu, with the following display.

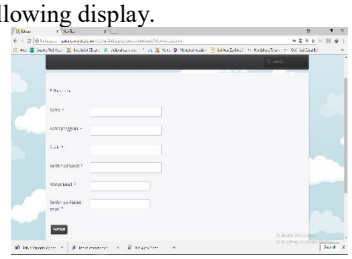

Figure 4. Display Admin Login to Add Students

Fill in user data by:

- Name (fill in the full name of the student / user who contracted the course).
- Username (contains a short name / student / user call).
- Password (filled in at USER's request and filled in by admin).
- Email address (containing student email address)..

b. Menu utama

The main menu of learning I Programming and Data Structure Algorithms is assisted by e-learning as shown below:

Figure 5. Learning Main Menu I Programming and Data Structure Algorithms assisted by e-learning

The menu consists of:

1) *Home*

Is a domain name or website to enter access to learning Algorithm and Data Structure I courses, namely www.zatranssmarttech.com/edukasi.

2) *Profile*

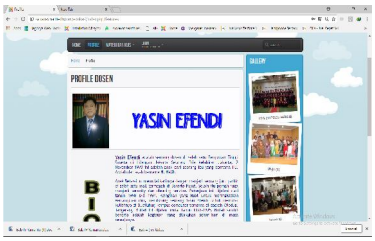

Figure 6. Lecturer Profile Menu which contains a biography of lecturer lecturers in e-learning assisted Programming and Data Structure Algorithms

In the upper left corner after home, the lecturer profile menu will appear, which contains the biography of the lecturer.

3) Material and Quiz

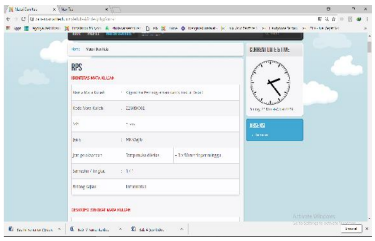

Figure 7. Semester Learning Plan (RPS) Learning I Programming and Data Structure Algorithms assisted by e-learning

On the top left page after the profile, there is a material menu and quiz provides information on Semester Learning Plans (RPS). In the material menu and lectures there are several sub-menus including 4 sub-menus, namely pre-test, material, post-test, and forum. If the pre-test click, the continue button will appear and when clicked, you will see several sets of questions, where students before going to the material must work on the pre-test problem with the aim of knowing the ability of students before learning.

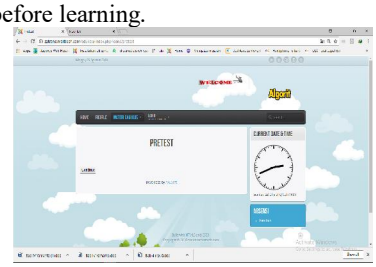

Figure 8. Preliminary display of learning Pre-test learning Programming and Data Structure Algorithms assisted by e-learning

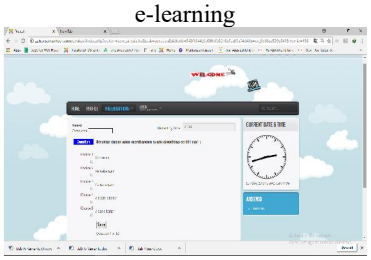

Figure 9. Display of questions l Pre-test Learning I Programming and Data Structure Algorithms are assisted by e-learning

Picture as above, if you click save then it will continue to the next question until the number of questions that are determined by the lecturer and after the finish will show the percentage of success of the student after working on it. After completing this problem, students can enter the next stage into the next sub menu, namely material. If students click on the material sub-menu, several sets of material will emerge which are mandatory for students to learn starting from the 1st meeting to the 14th meeting where 3 buttons and learning videos have been inserted.

Figure 10. Display Sub Menu Learning Materials Programming and Data Structure Algorithms I

1. *Button meeting module*

If the meeting module button is clicked the meeting material will appear.

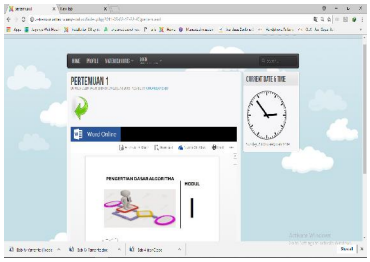

Figure 11. Display of Meeting Modules in the form of Word Online Learning Programming and Data Structure Algorithms I

1. *Button presentation module*

If the presentation module button is clicked, it will download the presentation module in the form of power point (ppt). For menu display, same as display image 10..

2. *Button* quiz

If the button quiz is clicked it will display several sets of questions.

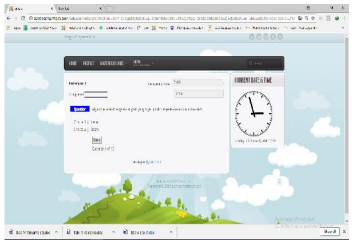

Figure 12. Display of Sub Menu Exercises in the form of type true or false and multiple choice Learning Programming and Data Structure Algorithms I

After the material menu stage has been run according to the student procedure, it is mandatory to proceed to the next step to the post-test sub menu. If students click on the student sub-test sub-menu will be directed to the continue button, after clicking the continue button students will be faced with a number of questions. This post-test aims to determine the ability of students after getting the material.

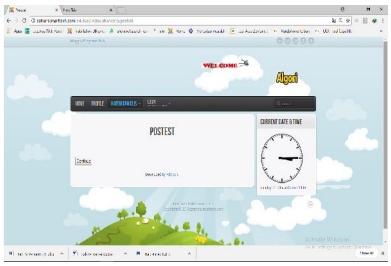

Figure 13. Initial appearance of post-test Learning Programming and Data Structure Algorithms I

Figure 14. Display of Post-test questions Learning Programming and Data Structure Algorithms I

In the picture above, if it is clicked save, it will continue to the next question until it is finished and after completion the percentage of student success will be seen after working on it.

Moving on to the following sub menu, namely forum, if the forum sub menu is clicked, an info, input, comment or suggestion will appear as a place for brainstorming or sharing about e-learning learning. Students can also discuss online and be active with both fellow students and lecturers because lecturers are directly involved from the beginning of the lecture to the end like face-to-face lectures.

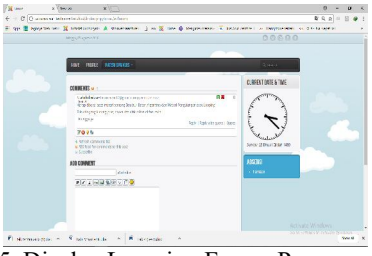

Figure 15. Display Learning Forum Programming and Data Structure Algorithms I

On the discussion menu students can discuss online and be active both with fellow students and with lecturers because lecturers are directly involved from the beginning of the lecture to the end like face-to-face lectures.

3. Logout

In the upper right corner there is a login / logout option, whose function is to enter e-learning or close e-learning. If students want to close the lecture, students can click on the login and then opt out.

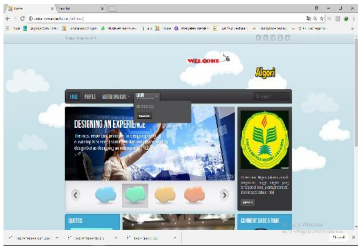

Figure 16 Display of Logout Programming and Data Structure Algorithms I

D. Disscussion

Robin & Judge (2013:23) says that a model is an abstraction of reality; a simplified representation of some real-world phenomenon. Similar things conveyed by Gustafon 7 Branch, a simple representation of more complex forms, processes and function of physical phenomena or ideas (Gustafson & Branch, 2002:1). According to Heinich et all (2005) this model consists of six steps of activities.

The Instructional Development Model consists of a series of activities which include design, development, and evaluation, after several revisions with field tests this learning model can be effective, efficient and interesting (Napitupulu, 2018).

The development of the learning model of the e-learning-assisted Programming and Data Structure I Algorithm was compiled based on the needs analysis carried out in the learning of the Programming and Data Structure Algorithms. The validation process by several experts was carried out repeatedly. Inputs, suggestions, and evaluations from experts were used to perfect the model developed. Furthermore, it was tested in stages to several students to find out that this development model is feasible to use. The effectiveness of the development of learning models of e-learning aided Programming and Data Structure I Algorithm can be known by the analysis of the results of learning achieved in the field trials. There was an increase in achievement of learning outcomes after this development model was implemented.

Learning is not a purely individually constructed process and social constructivists view individual learning as being mediated by the environment (Hean et al, 2009:7). Learning Theories describe the ways that theorists believe people learn new ideas and concepts (Schneider, 2014:155). Zschocke (2002:95) says that modeling is an important aspect of analyzing or developing a system. Models help to decompose a complex system using abstraction, i.e. concentrating on relevant details while ignoring others. Learning as an effort to make behavioral changes must be able to optimize all potential. As stated by Kusumandari & Istyarini, Learning is defined as a deliberate effort by educators to support student learning activities (Kusumandari & Istyarini, 2015). The e-learning module is an innovative use of the information and communication technology to enhance student engagement and learning outcomes in a local context Kowitlawakul, et all. 2017).

IV. CONCLUSION

Based on the formulation of the problem, the results of the research and discussion in the research development of the learning model of Programming and Data Structure Algorithm assisted by e-learning, obtained several conclusions as follows: (1) Development of the learning model of Programming and Data Structure Algorithm assisted by e-learning is an effort to meet the needs of improving the quality of learning in the I Programming and Data Structure Algorithms in the Informatics Engineering and Information Systems study program at the NIIT College of Information Technology, (2) Development of learning models for Programming and Data Structure Algorithms assisted by e-learning gives students convenience in participating in learning so that they achieve optimal results, and (3) The procedure for developing the learning model of the I-e-learning Programming and Data Structure Algorithm has 4 steps in sequence, namely: preliminary research, planning and model development, followed by validation, evaluation, and model revision, ending with the implementation of the model.

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