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Design of E-Learning Structure Model based on Artificial Intelligence for Constructivism Learning Theory

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***Abstract*—The constructivism learning model can be used to form students' critical thinking skills through knowledge formation with the guidance of a mentor. The Industrial Revolution 4.0 presents challenges to constructivism learning models to be able to apply e-learning. The e-learning process through information technology must have artificial intelligence as a major part of the e-learning application structure used by mentors. The e-learning application based on artificial intelligence is able to detect students' knowledge through the input of sentences provided and compare them with the knowledge possessed by mentors. The purpose of the comparison is to enable the application to provide some information to the mentors regarding the students' progress. With the addition of decision support system features, e-learning applications are able to provide informed decisions in the form of advice to mentors to take action on students who have knowledge below the standards set by the mentor.**

Keywords—Constructivism, E-Learning, Artificial Intelligence

I. INTRODUCTION

Steffe and Gale (1995) in Kroll [1] state that constructivism learning models show various ways to think about the learning process, development and effects that arise due to the teaching process. Tam [2] further points out that constructivism learning models are able to identify problems and constraints on social learning processes such as constructivist theory social of Vygotsky and individually such as Piaget's theory of constructivism. This constructivism model is a student-centered model for determining learning needs, setting one's own goals, monitoring one's own progress and ways of achieving learning outcomes [3]. Thus Badie [4] argues that students strive to learn in the form of constructivists to form, carry out transformation and reform a concept. It even manages the concept into a personal concept as the most valuable product of constructivist interaction [5] [6]. The most significant goal of constructivism is the construction of personal knowledge, development and understanding in the process of interaction with meaningful motivation in its own way based on development [5] [7]. Quoted from the originator of constructivism, Jean Piaget [8] argues that all learning is constructed by schemata gradually so that it becomes more conceptual. This is because schemata are procedural rules that connect a category with impressions that provide references to intuition in a manner similar to empirical concepts. Schemata have 3 development concepts, namely:

1. Empirical concept which describes the rules according to the imagination that is not closed and unlimited generated based on experience.
2. Pure mathematical concepts which construct geometric images, numbers, algebra and arithmetic.
3. The concept of pure understanding which focuses on the characteristics, predicates, quality attributes or properties of objects in general or in detail.

Georgieva & et al (2003) in Somaye Shahtalebi et all [9] reveal that the change to online technology in education has a perspective to overcome limitations on traditional education, has equal opportunities for education wherever it is and a quality of teaching materials as well as freedom using various resources.

Brooks and Brooks (1993) in Tam [2] state that constructive teachers will do the following:

- Motivate and accept ideas from students;
- Use a variety of data sources and interactive media to increase students' interest;
- Give questions to students regarding initial understanding of the material to be provided;
- Increase the motivation of students to ask the teacher and ask each other questions and responses;

- Involve students to form experiences based on initial experience and form an atmosphere of discussion;
- Provide time for students to build relationships and harmonize thoughts;
- Assess students' understanding through applications and structured assignments.

The approach done by Farshad Badie et al [6] links between linguistic expressions and mental images that originates in the minds of students as shown in Figure 1.

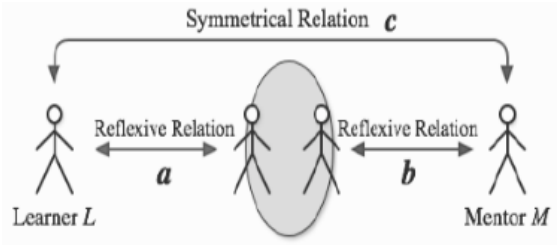

Fig.1 Conceptual Mirror

There is a symmetrical relationship between learners (L) and mentor (M) represented by c which describe as a product that reflects the combination of the two relations. Learner sees the concepts that exist in him and gets a reflection of concepts that come from his mentor. Mentor is also able to observe the concept reflections of the students he accompanies. Students see the reflection of the mentor in themselves and the mentor sees the reflection of the mentor in the students. A series of reflexive relationships b is formed to produce symmetrical relationships C. Farshad Badie [10] designed a semantic network related to logical description to see conceptual and logical relationships so as to be able to support the development of learning concepts and to support students' reasoning processes, curriculum design, and educational psychology to find unseen facts.

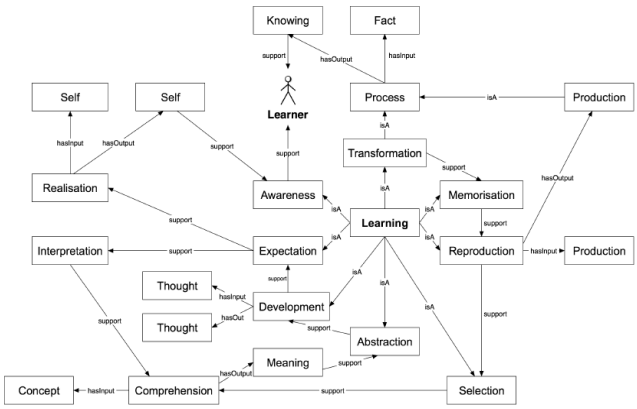

Fig 2. A Semantic Representation of Learners Developing Conceptions of Learning

The existence of concepts, ideas and hypotheses combined with the concept of machine learning is able to provide a strong background to improve the quality of the transformation of knowledge from human to machine and human reflection on machines to form epistemological conceptual relationships between human learning and machine learning, namely:

- Transforming knowledge and knowing what people have into machines.
- Transforming experimental and empirical experiences that humans have into machines.
- Transforming the real problem that humans have, the real task to solve a problem and the real performance into the machine.
- Reflections on the acquisition of knowledge and human learning into a machine that is equivalent to the transformation of a change in the image of learning and knowledge acquisition.
- Reflection of concepts that humans have into hypotheses because they relate to human mental states and linguistic expressions mapped as ideas into hypotheses that exist in machines because they relate to important features to express the use of reasons and languages.
- Conceptual reflection that humans have in the form of hypotheses and hypothesis hierarchies in basic machine knowledge.

Tatiana Markova et al. [11] said that online learning is increasing very quickly in universities. In a virtual learning environment, communication and interaction is more centered on students. Furthermore, there is no intimidation and it supports the formation of more interactions than in the conventional classroom. Based on research conducted for the online learning process, 37% strongly agreed and 26.8% agreed, due to the flexibility formed through the online learning process and also because the participants positively valued the resources owned by technology and the ability of students to use technology.

II. IDENTIFICATION

Based on the description above, several things can be identified, as follows:

- Interaction of mentors with students;
- Transfer of knowledge from mentors to students through reflection of students 'initial knowledge, reflection of knowledge possessed by the mentor so that the process of observing the development of the reflection of students' knowledge by the mentor;
- Knowledge transfer is carried out through discussion;
- Knowledge transfer is carried out to harmonize thinking;
- The process of knowledge transfer is done through interactive data sources and media;

Based on the above identification, this research formulates how to design e-learning application structures that can help the process of knowledge transfer in constructivist learning models.

Thus, the sequence of actions formed in the constructivist learning process is:

- Mentors provide or display material to be discussed.

- Mentors measure students' initial knowledge through students' responses to the material that will be given.
- Initial measurements are carried out by asking questions about the material that has been shown.
- Mentors provide instruction on the material discussed.
- Mentors again ask questions to students about the material that has been taught.
- Mentors make final measurements of students' knowledge through responses to questions that are given.

In the process of transfer of knowledge from mentors to students that occur in real terms, there are conditions as follows:

- The use of language which is a series of words to provide an explanation of scientific material and provide answers between mentors and students.
- The formation of measurements of knowledge of initial knowledge and final knowledge gained after the learning process in students themselves.
- The formation of measurement of knowledge by comparing the knowledge of mentors with the knowledge of students.
- The use of documents, pictures, videos and audio by mentors to students.

If translated into a flowchart diagram, it will be generated as shown in Figure 3.

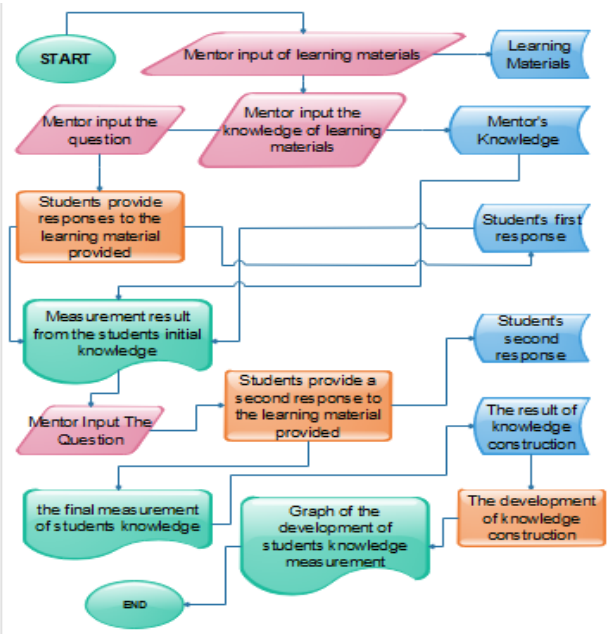

Fig 3. Flowchart Diagram of the Process of Knowledge Constructive Development

To form the transfer of knowledge, the authors see that artificial intelligence is needed in e-learning systems that are able to:

- Measure the comparison of mentor and student knowledge to the teaching material provided.
- Detect students' critical thinking skills through writing that is entered into the e-learning system.

In the learning process, the mentor will provide learning materials through the e-learning application shown in the following diagram:

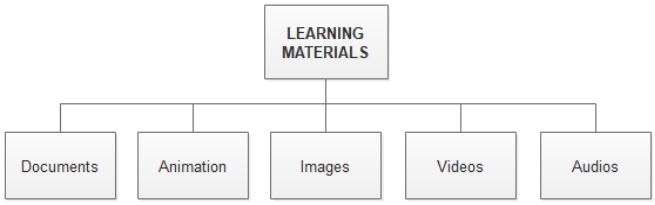

Fig 4. Learning Materials Diagram

The development of the knowledge process through e-learning media has difficulties that attract the attention of the writer. Based on the 5 learning materials in figure 4, there are differences in the process of increasing knowledge for each given learning material, namely:

- Images. Students are able to provide answers based on characters, shapes, colors, circumstances and other information in the image.
- Videos. Students are able to provide answers based on the story line, characters, events, area of events, and other information contained in the video material.
- Audios. Students are able to provide information about the audio content that is heard.
- Animation. Students are able to provide information on the type of animation and characters, story line, events, and event areas if the animation is made in the form of stories.
- Docs. Students are able to provide information about the material in the document.

Based on the information obtained, we are able to see that the components needed to build an e-learning system structure that is able to support the constructivism learning model consists of:

- User Management to manage the addition of users, reduce users, manage access rights.

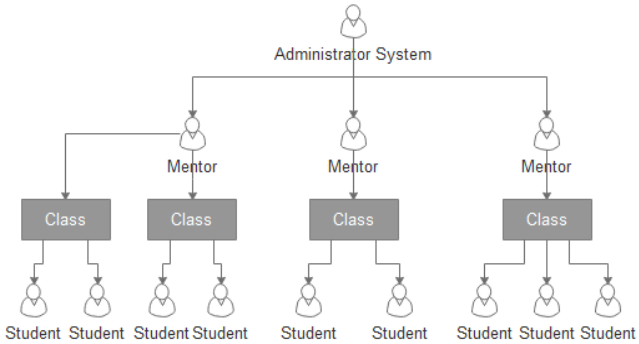

Figure 5. Management User Example

- Learning Data Management consists of User Data, Mentor Knowledge, Student Knowledge, and
- Learning Materials consist of document, image, animation, voice, movie and movie.

- Artificial Intelligence uses Natural Language Processing which is used to detect word input made by students into the system. The input of these words is knowledge that comes from students to the learning material taught by the mentor. Then it detects the similarity of knowledge owned by students to the knowledge possessed by mentors. The e-learning system then calculates the percentage of learners' knowledge by guiding the mentor's knowledge.
- Measurement Module has a function to compare the measurement of knowledge that will gather data on the measurement of students 'initial knowledge, measurement of students' final knowledge, knowledge of mentors and the results of the development of student knowledge.

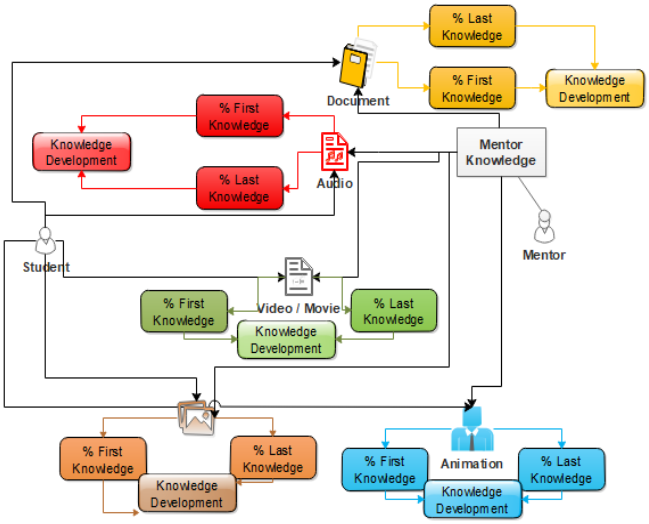

Fig 6. Measurement Scheme for Each Learning Material

- Decision Support will provide recommendations to tutors about the decision whether the students pass or not in a learning process.

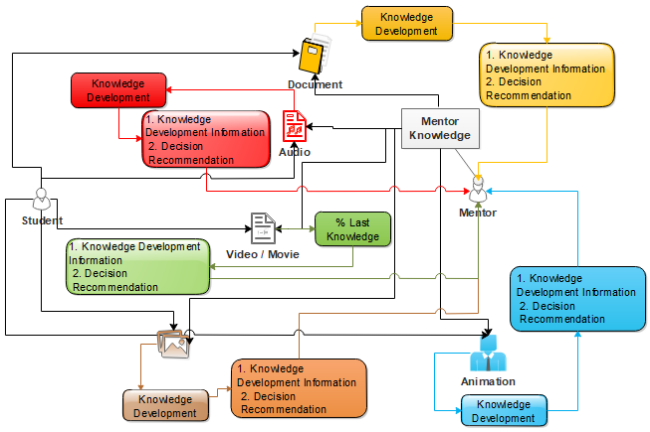

Fig 7. Decision Recommendation Scheme for Each Learning Material

The 5 components can be seen in figure 8 below:

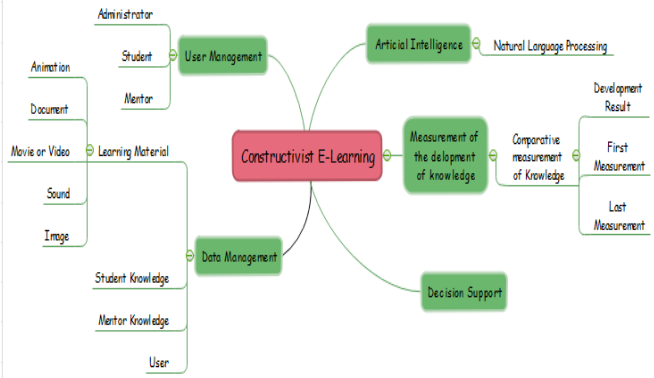

Fig 8. Constructivist E-Learning Structure

III. CONCLUSION

The integration of e-learning applications with artificial intelligence is a very interesting topic to discuss because it has different levels of difficulty with a quite large impact if successfully applied to every learning process at the school and university level. E-learning application is an application that facilitates the distance learning process so that mentors and students do not have to be in the same room when the learning process takes place. E-learning applications that are complemented with artificial intelligence greatly help mentors to apply learning models to mentor learning classes.

During the learning process using e-learning, interactions that occur between mentors and students can be in the form of voice and written input that make up sentences. Therefore, e-learning applications must be equipped with artificial intelligence to detect the sentence structure of mentors and students as representatives of their knowledge.

In constructivist, mentors have a great opportunity to continue to improve the ability of students to increase their knowledge. Using e-learning application complemented with artificial intelligence can detect the knowledge of the mentor, the initial knowledge and the final knowledge of the students and the development of their knowledge aiming at helping the mentor to know the success of the students in increasing their own knowledge. The e-learning application is also equipped with features to do mathematical calculations to show the mentor regarding the progress of students' knowledge in the form of numbers and graphs. If equipped with decision support features, the mentor can easily determine his decision in helping students increase their knowledge.

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