Digital learning model based on intelligent tutoring system in 3DMUVLE

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Abstract. Information and Communication Technology (ICT) has been used in broad education both for pre-learning, in-learning, and post-learning. But its use often generalizes learning material for all students even though each student has different characters and abilities. Intelligent Tutoring System (ITS) is able to provide learning materials according to students’ models. This study aims to model ITS-based digital learning. This model consists of four parts, namely: domain knowledge, pedagogy, students’ model, and interface. Domain knowledge produces learning materials that are suitable for each student model and pedagogy while virtual learning environment is a learning interface for students. This interface integrates MOODLE, SLOODLE and OPENSIM. The student’s model used is Myer Briggs Type Indicator (MBTI). The results of this study are 16 types of students and 16 types of learning material. The implication of this research is a comprehensive model that integrates ITS and VLE.

1. Introduction
21st century learning emphasizes the use of ICT and student-centered learning [1]. One of the benefits of ICT-based learning is the framework 5R [2], namely: right location, using the right device, at the right time, by the right learner, and having the right contents. This framework leads to personal learning. Personal learning treats each student differently according to their needs. In personal learning, the learning material presented must be adapted to the students’ model.

Talk about personal learning based on ICT cannot be released from ITS. ITS is an AI application for education [3] which has components, namely: domain knowledge, pedagogy, and students’ model whereas [4] add interfaces as part of ITS. Determination of student's model becomes a very important part, because it can determine the other parts. [5] uses a fine grain skill model to find out students' models. [6] use ITS with the Problem Solving learning model. But making learner happy can be done by keeping him in the Zone of Proximal Development (ZPD) and challenge or anxiety (VLE). A personal learning in this study focused on integrating ITS with VLE as interfaces integrating MOODLE and OpenSim through SLOODLE.

Determination of learning materials cannot be separated from the student model and the learning style of the students. Learning styles that are often used are Kolb, Honey, Keefe, Felder and Silvermans and MBTI [7]. The MBTI model pays attention to the character of students as human beings based on their preferences in interpreting and interacting with the world [8]. In terms of learning, the MBTI model divides learning styles into 4, namely: rational type (NT), idealistic type (NF), artisan type (SP), and
Guardian type [9]. The purpose of this study is to build ITS-based digital learning models, especially domain knowledge and students' models in a virtual environment.

2. Methods
This research was completed with several stages, as shown in Figure 1. The first stage is to determine the problem of research, in this case is the use of virtual / digital learning supported by technology to achieve personal learning. The next stage is data collection, in this case is collecting the data needed related to learning materials and learning technology. Literature study was conducted to deepen understanding of personal learning, virtual learning, and intelligent tutoring system. Problem analysis phase to determine learning topics and education units. This is closely related to the determination of the curriculum structure that will be used. From the data and problem analysis, an appropriate model for ITS-based digital learning is compiled. The final step is the implementation of a model in the form of a prototype in a software that is ready for use in learning.

3. Results and Discussion
In personal learning, the teacher must know the character of each student, this is important to deliver appropriate learning materials. In this study the characteristics of students were viewed from four dimensions in accordance with the MBTI model [10], namely: Introvert/Extrovert, Sense/iNtuitive, Feeling/Thinking, and Perceive/Judging. Of the four dimensions, a combination is made to form 16 characters as shown in Table 1.

| MBTI model | ISTJ | ISFJ | INFJ | INTJ |
| --- | --- | --- | --- | --- |
| ISTP | ISFP | INFP | INTP |
| ESTP | ESFP | ENFP | ENTP |
| ESTJ | ESFJ | ENFJ | ENTJ |

Determination of student character is done before learning using questionnaires. The questions and calculations refer to [11] with 70 questions. The composition of the questions is as follows: 10 questions for determining Introvert / Extrovert, 20 questions for determining Sense / iNtuitive, 20 questions for determining Feeling / Thinking, and 20 questions for determining Perceive / Judging.
As shown in Figure 2, each question corresponds to the MBTI dimension. Each question has two possible answers, namely A and B which correspond to the character of the student. The calculation is done by adding up the answers for each dimension. As the case study in Figure 2 is a comparison of the sum of answers for E / I dimensions is 6: 4, so the properties for this dimension are "E", the comparison of the sum of answers for S / N dimensions is 11: 9 so the properties for this dimension are "S", the comparison of the sum of answers for the T / F dimension is 11: 9, so the properties for this dimension are "T", the comparison of the sum of answers for the J / P dimension is 8: 12, so the properties for this dimension are "P". So the final student character is ESTP.

3.1. Digital Learning Model

The learning model proposed in this study can be seen in Figure 3. The model consists of 4 parts, namely domain knowledge, pedagogy, student’s model, and interface. The domain of knowledge contains the development of a curriculum used by the teacher to determine the curriculum for selected topics and education units. This curriculum structure is carried out for Tyler's model [12]: determining learning objectives, material organization, and assessment. The results of curriculum development are a collection of learning materials for 16 types of MBTI and a list of questions for learning evaluation.

Pedagogy and Student's model in this study were put together using the MBTI model as learning style and at the same time student's model. This section contains the determination of student models through questionnaires and conducts learning by providing learning material that fits the student's model. The interface consists of 3 components, namely: MOODLE, OPENSIM and SLOODLE. MOODLE is used to enter learning material, questions for evaluation, and to register students in a virtual class. Whereas OPENSIM is used to interface with students through OPENSIM VIEWER. And SLOODLE is used as a middleware that bridges between MOODLE and OPENSIM.
3.2. Determine Learning Material
Each student character has their own student learning style. At the end of each learning style must be supported by appropriate learning materials, eg learning materials for learning style discovery will be different from learning materials for learning style problem solving. This study matches the character of students and customized learning materials, as shown in table 2.

Table 2. Correlation of students’ Model with Learning Material.

| No | Students’ Model | Type of Leaching Material                          |
|----|----------------|--------------------------------------------------|
| 1  | ISTJ           | Tutorial                                         |
| 2  | ISTP           | Problem solving                                  |
| 3  | ESTJ           | Project based                                    |
| 4  | ESTP           | Contextual                                       |
| 5  | ISFJ           | Tutorial+ Exercises                              |
| 6  | ISFP           | Contextual and packed in games                   |
| 7  | ESFP           | Discovery Learning                               |
| 8  | ESFJ           | Material for discussion                          |
| 9  | INFJ           | Conceptual and theoretical                       |
| 10 | INFP           | Problem solving with added supporting reading material |
| 11 | ENFP           | Discovery + Material for discussion              |
| 12 | ENFJ           | Tutorial + Material for discussion               |
| 13 | INTJ           | Problem analysis + concept maps                  |
| 14 | INTP           | Conceptual + Problem Solving                     |
| 15 | ENTP           | Problem solving + Problem analysis               |
| 16 | ENTJ           | Tutorial + Conceptual + problem solving          |

3.3. Implementation
The implementation of learning in a 3D virtual environment in this study integrates MOODLE, and OpenSimulator through SLOODLE. Figure 4 is a model system using a use case diagram. In this model there are two actors, namely teacher and learner. Teacher can prepare material learning and evaluation while the learner conducts learning starting from the pre-test, questionnaire to determine student's model, learning, and post-test. The questionnaire was answered by answering 70 questions to determine...
their character. To avoid boredom, this system divides 70 questions into 7 stages, each stage is placed in a separate room and building. In the last stage, after the student completes the questionnaire, the type / character of the student is directly displayed.

The learning process is carried out by presenting learning materials in accordance with student's models in a room. The final step is a post-test to measure the performance of the learning. However, if students want to see the value of each student in the class, this system also displays the recapitulation of the overall grades of students which are sorted from the largest value to the smallest value.

Figure 4. System Model. [13]

4. Conclusion
This learning model is an integration of learning preparation in the form of curriculum development and a personal learning process using the concept of ITS in a virtual environment. Both of these parts cannot be separated because they influence each other. in this study only implemented some components of ITS. The next research is to integrate all components so that ITS-based Digital Learning is obtained comprehensively.

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