Personalized E-learning Model: A Systematic Literature Review

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*Abstract--*The development of electronic learning models, especially in developing countries such as Indonesia has grown well as information technology applications designed for learning purposes. Community colleges and schools seek to complement the traditional teaching system with e-learning systems. However, we found there are differences in individual learning styles in terms of speed and learning styles. Serving or teaching students with one mechanism of the same teaching method will ignore individual rights while reducing the meaning of education broadly from the humanity dimension. Such situations will affect the target of increasing competence, the growth of knowledge and the value expected for some individuals to fail. The electronic learning model then undergoes a shift away from a mere system, now evolving into a personalized learning model, where learning processes are oriented toward the students' abilities. Under these conditions, models and other techniques are needed to help personalized adaptive learning as they need it. The purpose of this study was to identify the general criteria of personalized electronic learning model to meet the needs, interests and objectives of the learner in a more personal sense in a broader sense. This research was conducted through literature study on papers published in the last five years (2012 - 2017). The results show the common components, techniques or tools that are commonly used, as well as the support of the theoretical basis used as the platform for the development of a personalized e-learning model.

Keywords- E-learning; Personalized; Component; Model; Framework; Architecture

I. INTRODUCTION

Trend of learning system is currently undergoing changes in line with the development of information technology and internet. The business process of the educational world has also undergone a change or evolution from traditional learning system to electronic-based system that is e-learning with its advantages and disadvantages, then developed again to personalized e-learning. These advances provide an opportunity for a university, school or other organization to continue to clean up and adjust to take advantage of the rapid advancement of information technology and communications as well as computing power.

Data shows that research in the field of e-learning, especially personalized, between 2016 and 2017 continues to increase. In the context of Indonesia as a developing country the authors are interested in deepening the models and techniques that match the characteristics of students in Indonesia. The results will be compared with the personalized e-learning model in general. To meet the needs of personalization, it is necessary to filter the right information to select the object of learning, while also directing the learning path adapted to the speed and needs of the learner [1]. Although most educational institutions have a positive perception of the use of e-learning systems, there are still a number of problems in terms of presenting learning contents and evaluating learners' performance with the same measure for all. While each learner has differences in learning styles, abilities, learning experiences, and backgrounds [2].

Many attempts are made by researchers to develop models with techniques and tools to improve the quality of e-learning. For example through the proposed intelligent and adaptive learning methods to serve learners fairly, and also appreciate the uniqueness of each individual learner. In addition to the learner or student, in terms of appraisal, there is the role of the instructor involved in the diagnostic module of the electronic

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rating system model. Instructors serve, students are served. The strengths and weaknesses of the learner are assessed, then the instructor makes the best decision in drawing up their learning concepts [3]. Another flexible and innovative concept offers an e-learning model with a social learning approach that creates interaction among learners in a global space. Expected acquisition of knowledge acquisition through extensive interaction [4]. The impact of technological development then changed everything from concept, process and perspective in the field of educational services.

In the context of personalized e-learning, creating an increasingly complex model of personal learning environment. It relates to humans as subjects of learning, thus involving various disciplines. Most researchers have proposed a recommendation system with knowledge management components and expert systems [5], Felder-Silverman model Learning Style Model (FSLSM) and Fuzzy [6], concept mapping and structure [7], psychology and other related techniques with data mining and ontology. Intermediation skills determine the personal interactions associated with learning styles, background knowledge, performance and so on. A portfolio of information is required to recommend appropriate learning paths as per the needs, goals and interests of the learner. However, each proposed model has not demonstrated the need comprehensively. It relies heavily on the goal of model development based on one or more perspectives to be achieved. The challenge of creating a personalized e-learning model is to unite theories, techniques and tools on a single platform.

Considering the various aspects of the learner's personal and technological progress, it is necessary to create a personalized learning environment through a successful e-elarning model. The success of the e-learning model can be generated through the analytical capabilities and completeness of its features. This study aims to identify the general criteria of the model or learning framework of personalized e-learning. To achieve this goal needs to be supported by a valid theoretical basis and supported by techniques or tools as a fast and precise processing tool. Furthermore, in this study there are three main themes that become research questions. First, "what common components to build a personalized e-learning model"? Second, "what tools are generally used to process the interaction between the learner and the content of personalized learning"?. Third, "what is the general approach of learning theory used to build a personalized learning model"?. The techniques or tools used in point two is defined as the use of computational methods or technology as mediation to achieve the goal. This study was conducted through a literature review relating to a personalized e-learning model of a paper published five years ago.

II. METHODOLOGY

The process of literature review conducted in this study consists of several steps. First, establish the source of research articles and search keywords. There are also sources of research articles that are sought is IEEE, Google Scholar, Science Direct, Emerald, Springer and ACM. While the keyword determination is done with a combination of Boolean AND and OR opeartor to find searches relevant to the research question. The AND operator generally sets up different keywords, while OR is often used to ensure the word or terminology of a term. For example (e-learning OR online learning, OR framework model, personalization OR adaptive) [4]. Thus there may be articles that are not reviewed only because of the difference in terminology. Second, candidate papers are selected based on title and abstract searches related to e-learning and its equivalent, model or architecture or framework and personalization. Third, set the selected articles based on background search, then read the content and discussion in detail to understand more deeply. Every component, tools and techniques most commonly used by previous researchers will be done ranking process, to see which is the most widely used or proposed. Based on these findings, the authors will further study and be considered as the basic platform for proposing or developing a new, personalized model of e-learning. Finally, this literary study will be able to answer research questions related to common components, tools and techniques to build a personalized electronic learning (e-learning) framework.

A. Search Process

The search of previous research articles is done on a predefined database source, by entering a keyword in the search box. The source database of selected articles is as follows:

- IEEE Xplore (http://ieeexplore.ieee.org)

- Google Scholar (http://scholar.google.com)

- Science Direct (www.sciencedirect.com)

- Emerald Insight (www.emeraldinsight.com)

- Springer Link (link.springer.com)

- ACM Digital Library (dl.acm.org)

The search process should ensure that keyword usage can be relevant and relevant to the research question. In this research, the article crawl is done by typing the combined keyword operator or boolean symbol with the main logic of the search is (E-learning OR Online Learning) AND Component AND Personalized AND (Model OR Framework OR Architecure). Then the main logic is decapitated over several search steps to adapt to the characteristics of each source database article as follows:

- E-learning AND (Component OR Parameters) AND Personalized AND Model

- Online learning AND Component AND Personalized AND Model

- E-learning AND Component AND Personalized And Architecture

- Online learning AND Component AND Personalized AND Architecture

- E-learning AND Component AND Personalized AND Framework

- Online learning AND Component AND Personalized AND Framework

- E-learning AND Component AND (Personalized OR Adaptive) AND Framework

The mechanism of searching and collecting papers is done through three stages. First, visit one by one source specified database literature and enter a search keyword complete with synonyms. Found papers are entered into the "Studies Found" category. Second, read titles and abstracts to filter information related to research questions. The results are entered into the "Candidate Studies" category. Thirdly, read the introduction and the contents of the whole paper according to the research question. The end result is saved as the category "Selected Studies".

B. Data Extraction

The number of papers reviewed since the first stage is 209 papers. Then in the second stage it is filtered into 83 papers based on title and abstract. Furthermore, at the last stage selected 27 papers that really directly related to the research questions to explore the content and discussion in order to answer research questions. The full results can be seen in Table 1 below.

TABLE I.   DETAIL SELECTED PAPERS

Source Database	Studies Found	Candidate Studies	Selected Studies
IEEE	63	22	9
Google Scholar	56	21	5
Science Direct	61	28	9
Emerald Insight	7	1	1
Springer Link	10	6	2
ACM	12	5	1
Total	209	83	27

III. RESULTS AND DISCUSSIONS

The purpose of conducting a literature study in this study was to identify the general criteria of the model or learning framework of personalized e-learning. First, the criteria you want to know consists of the common components that form the basis for determining the personalization aspect. Second, identify the techniques or tools used to determine the recommended learning path to fit the goals and needs of the learner. Third, the background of learning theory used. The themes presented in this article are (1) the tendency of "Selected Studies" such as the source and year of publication, type (journal / conference), (2) the tendency of the use of components used to determine the personalization of learning, and (3) the techniques used to determine Recommended path. The complete list of selected publication papers is as presented in table 2 below.

TABLE II.   SOURCE OF PUBLICATION

No	Title	Reference	Year	Type
1	A learner oriented...	[1]	2016	J
2	Personalized e-learning ...	[2]	2016	C
3	Personalized Intelligent...	[3]	2014	C
4	The General Components...	[4]	2016	J
5	Management System...	[5]	2012	C
6	Evaluation based on...	[6]	2013	C
7	Science Direct Personalized ...	[7]	2017	C
8	Personalized Learning Course..	[8]	2012	J
9	Personalized Recomm...	[9]	2017	C
10	Personalized Learning...	[10]	2007	C
11	Student-oriented...	[11]	2015	J
12	A recommender system...	[12]	2012	C
13	A proposed paradigm...	[13]	2017	J
14	A Recommender Model...	[14]	2017	J
15	Modeling the Flow ...	[15]	2016	C
16	A new approach...	[16]	2012	J
17	Data mining for...	[17]	2013	J
18	E-Learning personalization...	[18]	2011	J
19	Study of the E-learning...	[19]	2013	C
20	Analysis of data mining...	[20]	2017	J
21	Towards a learning...	[21]	2014	C
22	A review of paradigm...	[22]	2013	C
23	Development of a ...	[23]	2013	C
24	Deeper Knowledge...	[24]	2016	C
25	The Study of Dynamic...	[25]	2013	C
26	On the way ...	[26]	2017	J
27	Automatic web content...	[27]	2016	J

Based on the literature review, the characteristics of the learner are the main components that become the key issues and the goal of creating a personalized learning environment. Meanwhile, each learner is a unique and complex person. Involving psychological and pedagogical disciplines. Many researchers have proposed a personalized learning model. But the challenge faced is to explore the personal aspects of the characteristics of different learners. Some propose the Felder-Silverman Learning Model (FSLM) approach to extract learning styles. Other researchers use Bloom's Taxonomy (BT), etc. Consequently each model uses different parameters, depending on the perspective of the model used. Because of the many elements involved, the personal parameters discussed are grouped into five categories [13]. Furthermore, in this study referred to as components or parameters or general characteristics of e-learning learning are personalized. The number of papers (n) that discusses each component category is the percentage divided by a total of 27 selected papers that is equal to n / 27. The results are as shown in table 3:

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TABLE III.   GENERAL COMPONENTS PERSONALIZATION MODEL

Components	Description	Refferences	%
Personality	Learner's Profile	[5][8][9][11] [12][13][14] [17][21][27]	37%
	Learning Style	[1][2][3][6] [8][9][10][12] [13][15][17] [21][22][24] [25][26]	59%
Knowledge	Background Knowledge	[2][3][5][6] [7][13][15] [16][18][21] [23][24]	44%
Behavioural	Performance	[2][3][6][10] [13][15][16] [17][19][20] [25]	41%
Interests	Attention	[5][6][9][11] [13][14][15] [17][18]	33%
Preferences	Like and dislike	[5][6][9][11] [13][14][15] [16][18][24] [27]	41%

In this study, in addition to recognizing the characteristics or components of personalization, the techniques used also need to be seen in relation to personalized e-learning based components. The components intended here are the characteristics of the learner. The results showed that the techniques used were different. Again depending on the destination and base parameters used. However most use ontology techniques (18%), while others use techniques that vary from the data mining dimension approach. The full results can be seen in Table 4 below.

TABLE IV.   USE OF ALGORITHMS FOR E-LEARNING

No	Tools/Algorithm	Reference
1	Heuristic Algorithm	[1]
2	Collaborative Filtering, Sequential Pattern Mining	[2]
3	E-Assessment	[3]
4	Social Network Analysis	[4]
5	Expert System	[5]
6	Fuzzy model	[6]
7	Map Structure Analysis	[7]
8	ETL Data Mart	[8]
9	Vector Space Model, K-Mean	[9]
10	Decimal-binary Conversion	[10]
11	Planning Algorithm	[11]
12	Clustering Algorithm	[12]
13	Ontology-Semantic Web	[13]
14	K-Nearest Neighbors Algorithm	[14]
15	Machine Learning	[15]
16	Mathematical Consept	[16]
17	Decision Tree Technik, Game	[17]
18	Ontology Model	[18]
19	AprioriAll Algorithm	[19]
20	Ontology	[20]
21	Data Mining Technic	[21]
22	Map GranuleAlgorithm	[22]
23	Bayesian Networks	[23]
24	Text Mining, Ontology	[24]
25	Support Vector Machine, Naive Bayes	[25]
26	Ontology	[26]
27	Reinforcement Learning Algorithm	[27]

Based on the approach of learning theory used, most authors refer to FSLSM learning theory (22%) to construct e-learning model, as has been expressed by 6 (six) papers [3], [6], [9], [12], [22] and [26]. Meanwhile, of all the papers studied, 10 (ten) papers use one or two approaches to the model of learning theory. Others are not explicitly disclosed. The full results can be seen in Table 5 below.

TABLE V.   REFERENCES LEARNING THEORY

Theory	Description	#	References	%
FSLSM	Felder-Silverman Learning Style Model	6	[3][6][9][12] [22][26]	22%
BT	Bloom's Taxonomy	2	[2][3]	7%
FT	Flow Theory	1	[15]	3%
KSTM	Knowledge Space Theory model	1	[16]	3%
KELT	Kolb's Experiential Learning Theory	1	[26]	3%
RCSM	Riding Cognitive Style Model	1	[26]	3%
MBTIT	Myer-Briggs Type Indicator Theory	1	[26]	3%
GMSM	Gregorc's Mind Styles Model	1	[26]	3%

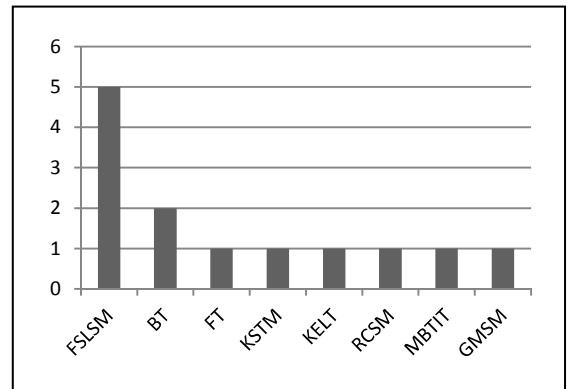The comparison graph of References Learning Theory can be seen in "Fig. 1." below.

Fig. 1.   Comparison of References Learning Theory

When viewed from the involvement of the learning theoretical approach, [26] involves 6 learning theories to encode the personalized e-learning ontology . The full results can be seen in "Fig. 2." below.
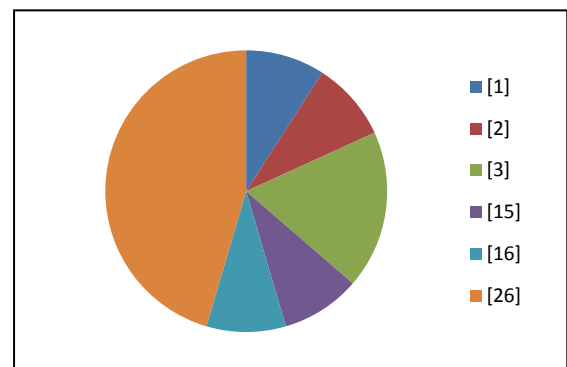

Fig. 2.   Comparison of Use of Learning Theory

According to a study conducted [4] the topic of e-learning involves multiple disciplines, of which the largest portion is computer science. This will be the author's consideration in conducting further studies. Furthermore, in the context of personalized e-learning, the focus of the authors shows that the learning style of the personality dimension reaches the largest portion (59%). Linear with the theory of learning from the third research question, which reached the largest portion (22%). While the techniques or tools used, leading to the ontology approach, although not statistically significant (18%) compared with the type of algorithm from the dimension of data mining. The facts presented provide guidance for authors to serve as the basic platform as a general criterion for the development of learning models from personalized e-learning. For the record, the use of tools to be an interesting fact to be studied comprehensively in conducting research in the future.

IV. IMPLICATION AND CONCLUSION

This study has two implications, namely theory and practice. First, based on the findings obtained, will be used as a reference research e-learning learning that personalized. Second, the findings will generally serve as major platforms such as common components or key characteristics of learners, the use of techniques or tools and what learning theories are used as the main platform to support the development of personalized e-learning models.

In general, this research paper has succeeded in identifying the main criteria according to the research questions which became the foothold in the development of the personalized model of e-learning model subsequently. Based on keyword formula, 27 selected papers have been obtained from 209 reviewed papers. The results show that the personalized e-learning model generally has first, "learning style" which is a sub component of "personality" has a percentage of 59%, while "interests" has the least involvement of 33%. Second, the widely used tools are the learning style theory of "FSLSM" of 22%, followed by "BT" of 7%. While the third, the technique used is a combination of text mining, data mining and ontology. However, other techniques are still studied in depth and tested its validity.

V. LIMITATION AND FUTURE RESEARCH

The personalized e-learning model finds the greatest challenge to fulfill precisely the most unique and complex nature of the learner. Along with technological developments and growing computing speed, a personalized e-learning model that is able to serve intuitively manage the main human factors of various parameters such as learning styles, feelings, cultural and cultural backgrounds to accommodate and promote personalized learning. Based on identified theories, models, and tools, there needs to be considerable consideration and in-depth study of the interaction model of personalized e-learning learning through multi-agent approaches. This approach requires the role of a system that intelligently monitors the development of learners through evaluated behavior online. The next research proposal is to develop a system capable of automatically generating decisions to a group of learners who have certain characteristics of what to do next, through a combination of text mining, data mining and data sets: training, validation and testing in a personalized e-learning model.

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