Embedded Selforganizing Systems

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Categorization of Learning Analytics Models: Brief Literature Review

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Abstract-- Learning analytics is one of the technological tools aiming to investigate educational database collected during the learning delivery process for further purpose of use in decision making or process update. Various types of methods on learning analytics are originated by scholars with their own ambition to contribute the field study. It is emerging study field since 2010s. This paper review literature papers which focused on categorization of learning analytics models with focus of its' criteria. The papers are chosen from open scholar databases. The selected papers reviewed learning analytics model related studies to bring up their suggested categorization. The category based on the learning analytics models' main objective as well as used approach. It is observed that prediction of student achievement or success is significant method among learning analytics models.

Keywords -- Learning analytics, Learning analytics model, categorization of learning analytics model

I. INTRODUCTION

Educational lifecycle has main purpose of continues improvement on learner's achievement. Learning analytics (LA) is one of the technological tools aiming to reach above goal. It collaborates with process of educational data collection, analysis, and processing [1] [2] which produces input to stakeholders' further decisions and actions. LA is a similar form of traditional education's evaluation process, utilizes advantages of technology. For the educational data analysis, learning analytics is mostly suggested as specific methodology, proper way of process defined as model. Under LA concept, various types of models originated by scholars contributing to this emerging study field. While LA is a bit new research area of existing fields such as educational data mining [1], the LA model gains its recent form starting from 2010s [3]. Existing scholars raise various questions to review existing LA related studies with their specific focus. In this study, we compared literature reviews on learning analytics models. In each review, 10 to 101 papers considered to find their research questions and tried to categorize by defined criteria. This paper summarizes LA model categorization and its criteria from those selected literature reviews. Thus, we stated the research question as below:

Research question: How the learning analytics models categorized in?

II. METHODS: RELATED LITERATURE REVIEWS ON LEARNING ANALYTIC (LA) MODELS

Using keyword of 'Learning analytics', 'model(s)', 'categorization', and 'educational data', the main search conducted on free academic databases including Google scholar, ScienceDirect, and Web of Science. By first stage of search, we have collected 42 articles which are includes at least on of keywords. Considering its' title meaning and availability of free download, 22 published articles were selected from the pool. When we have the resulted documents, we had additional criteria including if study focused educational data, learning analytics models and categorization. Finally, we stayed with 7 papers to review briefly.

All the search based on electronic database. Through a systematic review, Ifenthaler et al. [4] found that considerable number of LA methods utilizing efficient approaches to support study success and students. Gedrimiene et al. [5] conducted qualitative analysis on 60 articles to see what educational level mostly tested and discussed on LA studies with main focus of vocational education level. Namoun A. and Alshanti A. are [6] investigated LA research to understand how the prediction model associated with machine learning algorithms to define student learning outcome. Since then, major amount of LA models initiated and experimented by scholars in academic context to achieve narrow goals. For example, in literature review of [3] the number of LA model articles is boosted from 1 to 21 accordingly between 2011 and 2019 showing increasing trend. Each LA model has specific objective to reach, element(s) to process and algorithm to implement itself. Since LA is data-oriented, the model collects raw inputs from learning systems: centralized educational systems and distributed learning environment [1].

Students, educators, institutions, and researchers are participant of LA process with respected purposes and level of attendance. LA studies try to find answer on multiple

questions, while major number of them focuses on student learning achievement or process by developing required models. By seeking possible improvement from learning data of Moodle logs, Zang et al. [7] aim to reduce number of underperforming students. Sowmiya et al. [8] try to predict students' performance in college level domain system adapting in Exam metrics. Beth et al. [9] study learning analytics in usage of manage and prediction of student performance in university level. With the intense development of LA models, this study checks briefly on how the models classified as the field study developed.

III. RESULTS

Using keywords, searching done from scholars' open database to collect related papers. Couple of studies made its classification on LA models based on its features including overall goal, objective, method used and component. See Table 1. Shows number of papers reviewed by the literature reviews.

Quadir et al. [3] reviewed in total 101 LA models and classify them based on their foci, and components. In this study LA models categorized in five types: data model, performance model, meta-cognitive model, interactivity model and communication model. Also, they defined components corresponding to each model where the popular ones are analytics, visualization, feedback, performance, behavior, goal, environment etc. Quadi et al. [3] suggest the LA model categorization to contribute to the field study conceptualized.

Chatti et al. [1] categorized LA studies based on their suggested four-dimensional reference model. In this study LA models classified separately based on the objectives as well as used methods. As objectives, LA is classified into eleven types including monitoring, analysis, prediction, intervention, tutoring/mentoring, assessment, feedback, adaptation, personalization, recommendation, and reflection, while four definitions stated as used method: statistics, information visualization, data mining and social network analysis.

Fiaidhi J. [10] creates LA architecture classifying it through goals: prediction, reflection and summarization; and methods: machine learning, statistical analysis, empirical rules, data mining, tagging, logfile analysis, searching engine and NLP pipeline.

Ranjeeth et al. [2] checked predictive LA models by defining its used rules and its factors, adapted data set of related 10 studies published within 5 years. Also, Namoun A. and Alshanti A. [6] chose predictive model to review with purpose of how they utilized machine learning approaches. Table 2. Shows summary of categorization for the LA models.

TABLE 1. NUMBER OF PAPERS REVIEWED BY THE SELECTED LITERATURE REVIEWS

Literature review	No. of papers
Quadir et al. [3]	101
Chatti et al. [1]	56
Fiaidhi J. [10]	13
Ranjeeth et al. [2]	10
Namoun A. and Alshanti A. [6]	62
Gedrimiene et al. [5]	60
Ifenthaler D. et al. [4]	46

TABLE 2. CATEGORIZATION OF LEARNING ANALYTICS MODELS

Categorization based on Objective
Quadir et al. [3]:   1. Data   2. Performance   3. Meta-cognitive   4. Interactivity   5. Communication   Chatti et al. [1]   6. Monitoring,   7. Analysis,   8. Prediction,   9. Intervention,   10. Tutoring/mentoring,   11. Assessment,   12. Feedback,   13. Adaptation,   14. Personalization,   15. Recommendation,   16. Reflection   Fiaidhi J. [10] :   17. Prediction,   18. Reflection   19. Summarization
Categorization based on Methods
Chatti et al. [1]:   1. Statistics,   2. Information visualization,   3. Data mining,   4. Social network analysis   Fiaidhi J. [10] :   1. machine learning,   2. statistical analysis,   3. empirical rules,   4. data mining,   5. tagging,   6. logfile analysis,   7. searching engine,   8. NLP pipeline   Ifenthaler D. et al. [4]   1. Descriptive,   2. Predictive,   3. Prescriptive
Single model as categorized
Ranjeeth et al. [2]:   1. Predictive model   Namoun A. and Alshanti A. [6]:   1. Predictive model   Gedrimiene et al. [5]   1. Predictive model

IV. DISCUSSION

With aim of further intensive study on the field, this basic study focused on how the field scholars categorized the learning analytics models. At the same time, it aims to gain overall picture of current studies' main focuses, trending on learning analytics discipline.

Scholars suggest variety of own methods on analyses of learning activity using its existing or collected data. Almost each method can be called as model since it has own architecture as well as way of data collection, database structure, objective, evaluation method etc. There are also researchers who summarizes the LA studies and focuses to define the state of the art as well as trending. With majority of

learners' prediction, LA models have been broadened through assessment, monitoring, reflection etc. in context of educational process.

From this brief summary, it is seen that the objective or used method among LA models is almost mandatory criteria to categorize them.

V. REFERENCES

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