Personality Learning Analytics System in Intelligent Virtual Learning Environment

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ABSTRACT
In this paper, the researchers propose a conceptual for system architecture of learning analytics process in the intelligent learning environment. Within this concept, today's competitive business environment need for businesses in order to implement the monitor and analyze the user-generated data on their own and their competitors. The achievement of competitive advantage is often necessary to listen to and understand what customers are saying about competitors' products and services. Not only personality analytics but also the conceptual description can capture an intelligent learning environment, and it is the analytic tools that are used to improve learning and education. The researchers also discuss how learning analytics is developed in different fields. It closely tied to, a series of other fields of study including business intelligence, web analytics, academic analytics, educational data mining, and action analytics. The researchers believe that conceptual of personality analytics in the intelligent learning environment can play an essential role in managing and analyzing personality and contribute to the concept of personality analytics in the intelligent learning environment. The results of this research could be summarized as follows: learning analytics process should be used as measuring and collecting data about learners and learning with the aim of improving teaching and learning practice through analysis of the data. By achieving this process, it should collect data to report or analyze the happening about the learner. Then, instructors monitor learning what is happening now, while as learning analytics should get what is going to happen in the future for learners. Finally, instructors take action to feedback learners.

CCS Concepts
• Applied computing~Interactive learning environments.

Keywords
Learning Analytics; Intelligent Environment; Virtual Learning Environment; System Architecture; Personal Analytics

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1. INTRODUCTION
In recent years, technological developments, especially Information and Communications Technologies (ICT), have made computers dynamic in education by proposing new learning channels, contents and strategies functioned through computers. Accordingly, computer-based technologies are an achievement and growing helpfulness in higher education [1].

Learning analytics is developed in different fields that it connects to educational data mining and other neighboring fields such as the learning sciences and learning at scale. The goal thereof is supporting to learning assessment to improve the understanding of teaching and learning through the collection and analysis of data about learners, i.e., behavior and performance. It is rapidly growing in the implementation of innovative methodologies and applications. [2].

The 2011 Horizon Report referred that learning analytics is a key in future trend for learning and teaching [3]. In this paper, the researchers explore the evolution of learning analytics in recent years and discuss a reference model that enables to classify the literature in learning analytics. This model can also foster a common understanding of key concepts in this emerging field [4].

Although data analytics capabilities have been developing over the last 10-20 years, the researchers have broadly been the disconnect between business intelligence and the use of data for supporting learning-based hypotheses. For example, although data have been collecting in educational databases, the competence and know-how for using it to advance learning and improve the student's experience has barely begun and only rarely been investigated [5, 6].

It used an application which was developed to provide instructors with the opportunity to use the power of learner analytics to intervene and provide feedback to students who were not doing well in their courses. The aims of this research were as followings 1) to design the system architecture of learning analytics process in the intelligent virtual learning environment and 2) to develop a proposed system architecture of learning analytics process in the intelligent virtual learning environment by using the waterfall model. This paper is organized as follows — the reviews whereby the directions are developed. The research scope is presented. The research results are discussed, while the paper concludes with the strengths and limitations of the research.

2. LITERATURE REVIEW
The existing researches were based on the empirical and theoretical research that studied on LA in higher education. Also,

the explicitly aimed to cover LA as a research field in a systematic way. While the papers focused on LA and MOOCs as the context is so different for example time pressure, social context, teacher-students from campus environment moreover; there is already reasonably recently summaries of ongoing research. Some studies with a single emphasis on academic analytics were omitted. These included the field of LA, academic analytics and represented either in the articles' titles, abstracts or keywords. The conference proceedings published as part of the main conference. Workshop paper and posters were excluded.

3. SCOPE OF RESEARCH

This research had the research scopes as followings:

1. The samples were fifteen experts teaching Information Technology, purposively selected from higher education institutes located in Bangkok, Thailand. These experts were with expertise in learning analytics, intelligent learning, and virtual learning environment.

2. The tools used in this research were proposed system architecture and an evaluation form developed with a five-point Likert scale. The respondents were questioned to rate their level of agreement by using a scale ranging from "lowest to "highest."

4. RESEARCH METHODOLOGY

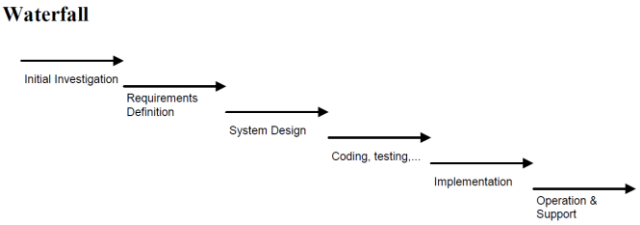

Figure 1. Waterfall Model.

A system architecture of learning analytics process in an intelligent virtual learning environment is a research and development program that consists of six phases, which are in line with the waterfall model [7] as revealed in figure 1. Waterfall model is a multistep, linear process, structured methodically, and the project is divided into sequential phases, with some overlap moreover; splash back acceptable between phases. Then, the emphasis is on planning, time schedules, target dates, budgets and implementation of an entire system at one time. Finally, tight control is maintained over the life of the project through the use of extensive written documentation, also through formal reviews and approval/signoff by the user moreover; information on technology management occurred at the end of furthermost phases before beginning the next phase. Following are the six phases of the waterfall model as following:

4.1 Initial Investigation

During this initial stage, the potential requirements of the application are methodically analyzed moreover; the researchers wrote in the specification document that serves as the basis for future development. Moreover, the result is typically a requirements document that defines what the application should do, but not how it should do it.

4.2 Requirements Definition

During this second stage, the researchers analyzed in order to accurately generate the models by business logic that should be used in the application.

4.3 System Design

This stage mostly covers technical design requirements, such as programming language, data layers, services, and so forth. A designed specification should typically be created that summaries how precisely the business logic covered in the analysis will be technically implemented.

4.4 Coding/Testing

The actual source code should finally write in this fourth stage, implementing such as models, business logic, additionally; service integrations that were specified in the prior stages.

4.5 Implementation

During this stage, QA, beta testers, and all other testers analytically discovered and reported issues within the application that need to be resolved. It is not rare for this phase to cause a "necessary repeat" of the earlier coding phase, in order for exposed bugs to be correctly compressed.

4.6 Operations and Support

Finally, the application should ready for deployment to a live environment. The procedures stage entails not just the deployment of the application, but also subsequent support and maintenance that may be essential to keep it practical and up-to-date.

5. RESEARCH RESULT

5.1 Learning Analytics Process

Figure 2. Learning Analytics Process.

Figure 2 reveals that learning analytics process is a procedure for determining and gathering data about learners and learning with the goal of educating teaching and learning practice through analysis of the data. By achieving this process, it should collect data to report/analyze the happening about the learner. Then, the instructor monitors learning what is happening now, while as learning analytics should get what is going to happen in the future for the learner. Finally, the instructor takes action to feedback a learner. The objective of teaching is to help to learn, and the learning analytics process must lead to the occurrence of learning. As learning needs various conditions, different kinds of teaching events need to be designed. The design of teaching strategy

involves the design of teaching events or activities and the implementation of the method.

5.2 System Architecture of Learning Analytics Process

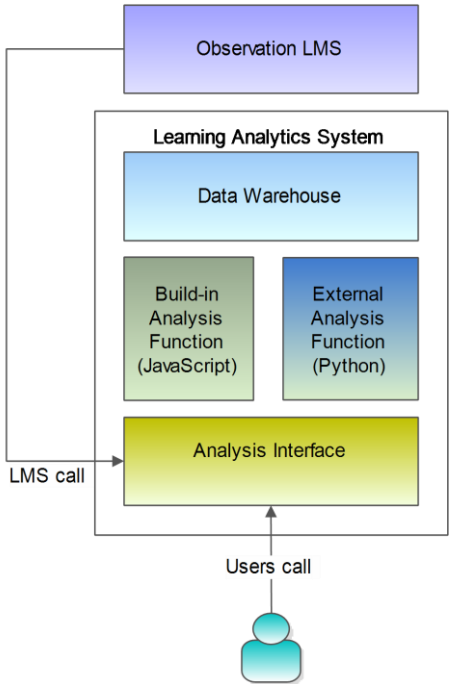

Figure 3. Learning Analytics Module.

It can be comprehended from figure 3 that the data warehouse is used to provide the data for the analysis. For integration purpose, the built-in analysis function is implemented by java language because the Observation LMS is implemented by java language and an open source JavaScript library to decouple the data process. A machine learning library implements the external analysis function with computer languages: Python (based on Java). These can provide most of the statistics, data visualization, and data mining algorithm to expert users for analysis. The top of the learning analytics system is analysis customize interface which is used by users for custom the analysis algorithm and parameters. The LMS also can invoke the analysis customize the interface to provide the adaptive learning function based on the analysis result.

Three types of data are gathered from the LMS:

1. The user profile: the hashed user's ID, the department, the major and the grade. The data except user's ID can be used for comparing purpose by the instructors and managers.

2. The course data: include course necessary information, course content data and learner's assessment data in the course. The course necessary information includes the course's name, number, tutor's number, and the department and significant of giving the course. The course content data includes the learning materials' information, the discussion forum information, the homework, and test information.

The interaction log between the users and LMS: there are 5 types (Openness, Extraversion, Agreeableness, Conscientious, Neuroticism) of the interaction logs between learners and system and 3 types (Interpersonal Content, Interpersonal Structure, Interpersonal Complementarity) between instructors and system is extracted into the data warehouse of the learning analytics system. The log information includes when, where (IP address), who, action type, resource type, resource id, and course id.

From the pedagogical viewpoint, learning analytics as underlying methods should permit organizations in order to support apprentices making progress and to enable rich and personalized learning. The general goal of learning analytics should monitor the learning procedure, and they should use the data analysis to forecast the future performance of students as well as to find their potential problems. It should be possible for instructors to offer useful feedback to learners over virtualized learning dashboards via learning analytics. It should help to have an overall view of the apprentices' activity and permit associated with their peers or other players in the learning experience through visualizations for learners and teachers [8].

5.3 Intelligent Learning Environments

Skills should reinforce intelligent learning environments should not only enable apprentices to digital resources and interact with the learning structures in any place and at any time, but also actively offers them with the necessary learning direction, supportive tools or learning suggestions in the right place, at the accurate time, and in the right form [9]. There are many diverse types of technologies used to support and enhance learning, which includes both hardware and software. Hardware includes those tangible objects such as interactive whiteboard, intelligent table, e-bag, mobile phone, wearable device, intelligent device, sensors which using ubiquitous computing, cloud computing, ambient intelligence, IoT technology, and so forth., intelligent learning environments can provide accurate and rich learning services by learning analytics. So, based on intelligent education demand, the researchers propose ten crucial features of intelligent learning environments.

Table 1. The suitability evaluation of the design of intelligent virtual learning environment under ten evaluation components

Evaluated Components	Evaluation outcome		Suitability level
	$\bar{x}$	S.D.	
Location-Aware	4.20	0.83	High
Context-Aware	4.27	0.44	High
Socially Aware	4.67	0.47	Highest
Interoperability	4.07	0.85	High
Seamless Connection	3.93	0.85	High
Adaptability	4.73	0.44	Highest
Ubiquitous	4.00	0.82	High
Whole Record	4.60	0.49	Highest
Natural Interaction	4.47	0.62	High
High Engagement	4.20	0.98	High
Overall Suitability	**4.31**	**0.76**	**High**

It can be seen from table 1, the researchers interviewed fifteen experts to acquire the most critical elements that should be in the system architecture process of learning analytics in intelligent virtual learning environment, and the result shows that this system should be in the virtual learning environment, with adaptability, the average mean was 4.73 and S.D. was 0.44, respectively. The average mean for social aware was 4.67 and S.D. was 0.47,

respectively. The average mean for the whole record was 4.60 and S.D. was 0.49, respectively. The suitability evaluation of the design of system architecture of learning analytics in an intelligent virtual learning environment is under ten evaluation components. Overall suitability was rated at the high level ($\bar{x}$=4.31, S.D.= 0.76).

6. CONCLUSION

As stated, intelligent education is a new paradigm in global education. The objective of intelligent education is to improve learner's quality of lifelong learning. It was emphases on contextual, personalized and seamless learning to promote learner's intelligent emerging and facilitate their problem-solving ability in an intelligent environment. With the expansion of technologies and within a modern society, intelligent instruction will confront many challenges, such as academic theory, educational technology leadership, teachers' learning leadership, didactic structures, and education ideology.

In the expectation of intelligent education, the intelligent learning environments could decrease learner's cognitive load and thus enable learners to focus on sense-making and simplify ontology structure. Also, students' learning skill could be deepened and extended, and thus help students 'development in an all-round way (effectively, logically, and physically). Pupils can learn flexibly and work collaboratively in intelligent learning environments, and thus could foster the expansion of personal and collective intelligence of learner. Besides, better adapt learning support could be provided for students to improve learners ' expectation.

The researchers designed and developed the system architecture of learning analytics in the intelligent virtual learning environment as a tool to support learning in students. Teaching and Learning Analytics technologies have been proposed as the means to support instructor's data-driven reflective practice. Given that these technologies are considered a top priority in educational research and innovation. The conclusion can be made as follows: 1. The system architecture consists of ten main elements, i.e. (1.1) location-aware (1.2) context-aware (1.3) socially aware (1.4) interoperability (1.5) seamless connection (1.6) adaptability (1.7) ubiquitous (1.8) whole record (1.9) natural interaction and (1.10) high engagement. The ten main elements were further discussed in the discussion part. 2. The suitability evaluation of the quality system architecture of learning analytics in intelligent virtual learning environment under ten evaluation components showed that the overall quality of the system architecture was rated at a high level ($\bar{x}$=4.31, S.D.=0.76). As a result, this research can now be applied to the development of personal learning analytics system, knowledge verification from creation and storage as well as an assessment of students' personality application-based machine learning with the use of text mining to apply the developed system in a practical way among Thai university students.

7. DISCUSSION

7.1 Location-Aware

It implies that sense learner's location in real time; includes sensors and methods for perceiving or manipulative the geographical position of a person, a mobile device or other moving objects. As Ge et al. [10] recommended that the most common location-aware technologies are GPS, assisted GPS (A-GPS), Wi-Fi, Enhanced Observed Time Difference (E-OTD) and Enhanced GPS (E-GPS). Mobile users should take their devices with them everywhere and adding location awareness to the app offers users a more contextual experience [11].

7.2 Context-Aware

According to Hofer et al. [12] explored different scenarios and information of activity, they describe the ability of hardware components and IT systems to respond to user requests based on information about their environment or the context of operations.

7.3 Socially Aware

Dinev et Hart [13] suggested that socially aware was a sense of social relationship. The capabilities should be associated with being socially aware are empathy that sympathetic the other person's sentiments, needs, and concerns. Structural awareness is the ability to recognize the policy within an organization and how these affect the people working in them. Service: the ability to comprehend and meet the needs of clients and customers. Awareness of social situations means the researchers carefully consider what people want, and plan to transfer them in a way that is future to meet that need.

7.4 Interoperability

Chen, Doumeingts, and Vernadat [14] implied the set standard between different resource, service, and platform; the researchers describe the extent to which organizations and devices should conversation data, and interpret that shared data. For two organizations to be interoperable, they must be able to exchange data and later present that data such that a user can recognize it.

7.5 Seamless Connection

Tsuda et al. [15] provide continuous service when any device connects. The researchers proposed a seamless communications capability, therefore, aimed to alleviate any disconnection between mobile and stationary networks and services. It allows the company to provide a stable communications environment so that employees, customers and other third-party participants can communicate quickly and efficiently across different media and technologies.

7.6 Adaptability

Lepine, Colquitt, and Erez [16] proposed a push learning resource according to learning access, preference and demand. The researchers implied the skill of an entity or organism to alter itself or its answers to the changed conditions or environment. Adaptability should show the ability to learn from skill and improves the fitness of the learner as a competitor. Ariga et al. [17] suggested that these approaches to flexibility are based on the notion that adaptability is a function of skill – import that through machine learning, we can leverage information to adapt to the differences in learner styles and abilities.

7.7 Ubiquitous

Kim and Chung [18] predicted a learner's demand until express. The researchers provide a visual and transparent way to access learning resource and service to the learner. "Ubiquitous" is generally used for rather that is seemingly present universally and often happened. Ubiquitous computing is a term presented by Mark Weiser [19] in the early nineties to refer to a world where people are enclosed by computing devices and a computing infrastructure that supports us in everything we do.

7.8 Whole Record

Romero and Ventura [20] record learning path data to mine and analyze deeply, then give a reasonable assessment, suggestion and push on-demand service. When the researchers created a website, they need people to be able to find it quickly in order to promote whatever the website contented is to as many people as possible.

7.9 Natural Communication

Cantoni, Cellario and Porta [21] transferred the senses of multimodal interaction including position and facial expression recognition. Ultimately, according to Turk [22] quoted that instead of making computer interfaces for people, it is of more fundamental value to make people edges for computers.

7.10 High Engagement

Greene et al. [23] suggested that the immersing in the multidirectional interaction learning experience in technology-rich by examining the learning characteristics of learners and the features of interactive teaching in distance education. The researchers proposed the curriculum implementation subject of network education, namely objects multi-directional interaction teaching mode, to progress teaching effectiveness and achieve teaching objectives to ensure the quality of teaching, and puts forward some specific implementation measures.

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