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The Value and Practice of Learning Analytics in Computer Assisted Language Learning

YU Qinglan[a],*; ZHAO Yushan[a]

[a]Department of English, North China Electric Power University, Beijing, China.
*Corresponding author.

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Abstract
As a significant area of technology-enhanced learning, learning analytics emerged during the last decade and has influential impact on almost all branches of higher education. This article begins with an examination of the social background of learning analytics' emergence in educational settings, and the development of data-driving learning analytics since 20th century, together with introduction to other online learning media. It specifically highlights the value and practice of learning analytics in computer assisted language learning, and also identity a series of future challenges in its application.

Key words: Learning analytics; Value; Practice

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1. LEARNING ANALYTICS AND ITS SOCIAL-ECONOMICAL DRIVERS

1.1 The Origin of Learning Analytics
In the last few decades, the number of people connected online for educational purpose is increasing dramatically, and consequently a huge quantity of data is being generated. These data are mainly "traces" or "digital breadcrumbs" that students leave as they interact with online learning environments. Confident that this data can show us learners' behaviors and also help us enhance learning experience, there has been a growing interest in the automatic analysis of such data. A research referred to as Learning Analytics (LA) is identified. It is considered by many researchers as a strategic trend in education. Nevertheless, LA cannot be considered as a new field, it actually derives from different related fields such as Educational Data Mining, Academic Analytics, Action research, Personalized Adaptive Learning and etc.

As Dr. Diana Oblinger, the President of EDUCAUSE points out in its 2014 annual conference, among the top ten issues of 2014 EDUCAUSE annual list, the No 1 issue is learning analytics (LA), which is fundamentally established on the basis of giant data and complicated data analysis. As a fast-growing area of Technology-Enhanced Learning (TEL), LA has deep strong roots in various areas, including computer intelligence, academic analytics, and educational data mining.

On the 1st International Conference on Learning Analytics and Knowledge (LAK, 2011), people got its current definition, "Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purpose of understanding and optimizing learning and the environments in which it occurs." (Alberta, 2011) As it stands, this definition could be taken to cover the majority of educational research, but it is typically coupled with two assumptions: that LA make use of preexisting, machine-readable data, and that its techniques can be used to handle "big data", large sets of data what would not be practicable to deal with manually. On the Fourth International Conference on Learning Analytics and Knowledge (LAK, 2014) in Indiana, the United States of America, researchers integrate the theory of LA researches with its practice,

in relation to educational psychology, educational management, education, engineering, education data mining, computerized algorithms, data visualization and their intersection.

The overlapping characteristics of LA enable it to be studies from various perspectives, and in turn, its research triggers a series of parallel works to ensure the common goals of a specific learning subject.

And as a cross-discipline subject, its values and implications on various fields are gradually explored and demonstrated, including business, medicine, higher education, and language learning. This paper will specifically focus on the value and practice of LA in computer assisted language learning, together with the background and future challenges.

1.2 The Technological, Pedagogical and Economical Drivers of Learning Analytics' Emergence

LA has been strongly motivated by the development of economy, technology and pedagogy. Firstly, it is faced with the growing challenge posed by "big data". As it commonly acknowledged that "big data are datasets whose size is beyond the ability of typical database software tools to capture, store, manage and analyze"(Manyika, 2011). Businesses make the best use of LA to identify patterns of customer behavior, develop advertising campaign, and also drive recommendation engines. Amazon book shoppers have once posted famous writer's book review to boost the sale, but it did not work well. They changed to recommend relevant choices of other buyers and it is proved very effective. Therefore, with big data, we could know "what to do next" based on "what has happened now", rather than "why it happened". The widespread LMS (learning management systems), such as Blackboard and Moodle, is a typical representation of educational institution's application of large set of data. Each day, LMS would deal with large amount of interaction data, personal data, systems information and academic information. At the same time, learner's tracks, as digital breadcrumbs, are distributed across a variety of different sites at different levels of access. Therefore, big data is the first technical driver that helps researchers to extract value from the big learning-related data sets.

The rise of on line learning offers many benefits associated with problems. What is the students' real feeling since they lack of interaction with teachers and peer learners? Are they disoriented or do they lack of motivation? How can the teacher evaluate student's participation when they lack of visual clues? Are they bored, confused, overwhelmed or simply absent from the class? Teachers may struggle to interpret or evaluate learning and quality of participation of individuals when he/she is buried within hundred of student's contributions to discussions that have lasted several weeks. The second driver of LA, therefore, is the attempt to optimize opportunities for online learning.

In many countries, there is increasing demand for educational institutions to measure, demonstrate and improve performance, with U.S.A as the most articulated, where the national government attempts to increase the overall educational attainment of the population and has been prepared to invest billions of dollars to achieve this goal.

These three drivers get attentions from three interest groups: governments, educational institutions and teachers/learners. Although the interests of all three groups might overlap, they require analytic works on different scale and range. The choice of target audience therefore affects how researchers conceptualize problems, capture data, report findings, act on their findings and refine their models (Ferguson, 2011).

2. LEARNING ANALYTICS AND OTHER ONLINE LEARNING MEDIA

Analytics from Learning Management Systems (LMSs) generally offers one source of data for predicting the success of learners. Through analysis of basic activities related to LMS participation (e.g., content pages viewed, number of posts) and duration of participation (e.g., hours spent viewing discussion pages and content) in LMSs, researchers found significant differences between "withdrawers" and "successful completers," concluding that "time spent on task and frequency of participation are important for successful online learning."(Morris & Finnegan, 2005). LMSs have been adopted as popular LA tools because the data captured is structured and reflects the learners' interaction within a system. But distributed networks and physical world interactions are not covered in LA. For example, most LMS analytics models do not capture activity by online learners outside of an LMS (i.e., in Facebook, Twitter, Blog, Wechat). Similarly, most analytics models do not capture or utilize physical-world data, such as library use, access to learning support, or academic advising. Mobile devices such as smart phones and tablets/iPads offer the prospect of bridging the divide between the physical and digital worlds by capturing location and activity. Similarly, clickers in classrooms can be integrated with data from learners' activity in online environments, providing additional insight into factors that contribute to learners' success.

Massive Open Online Courses (MOOCs), which occur in decentralized, distributed teaching and learning networks, offer another challenge. Online social media monitoring tools (e.g. Radian6) may provide educators with a model for analytics in such networks, in which activity is distributed across multiple sites and multiple identities.

When analytics is applied to curricular resources, the traditional view of courses is revolutionized. The knowledge, attitudes, and skills required in any domain can be rendered as a network of relations (Siemens & Long, 2011). People can sketch knowledge maps, and learner activity can be evaluated in relation to those maps. The traditional concept of "assessment" is also diffused, not an "end of course' activity, but an activity in real time as learners demonstrate mastery of important concepts or ideas (see Figure 1). Learning content is not provided in a traditional packaged textbook but rendered or computed "on the fly", providing each learner with resources relevant to his or her profile, learning goals, and the knowledge domain the learner is attempting to master (Siemens & Long, 2011).

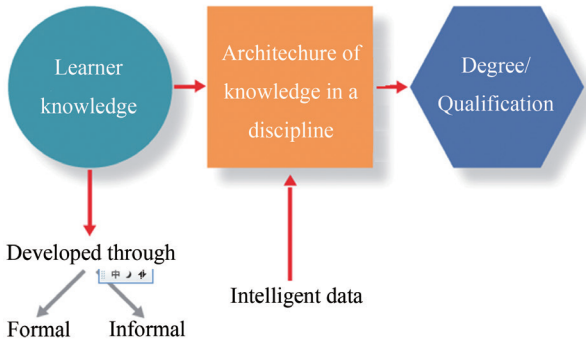

Figure 1
Assessment Throught Analytics

3. THE VALUE AND DEVELOPMENT OF LEARNING ANALYTICS IN HIGHER EDUCATION

LA sweeps around the full scope and range of activity in higher education, affecting administration, research, teaching and learning, and support resources. Universities and higher education institutions thus must become a more intentional, intelligent organization, with data, evidence, and analytics playing the central role in this transition (Siemens & Long, 2011). Its values will reveal gradually around the following issues (Siemens & Long, 2011):

a) They can improve administrative decision-making and organizational resource allocation.
b) They can identify at-risk learners and provide intervention to assist learners in achieving success. By analyzing discussion messages posted, assignments completed, and messages read in Learning Management Systems, such as Moodle and Desire2Learn, educators can identify students who are at risk of dropping out.
c) They can create, through transparent data and analysis, a shared understanding of the institution's successes and challenges.
d) They can innovate and transform the college or university system, as well as academic models and pedagogical approaches.
e) They can assist in making sense of complex topics through the combination of social networks and technical and information networks: that is, algorithms can recognize and provide insight into data and at-risk challenges.
f) They can help leaders transition to holistic decision-making through analyses of what-if scenarios and experimentation to explore how various elements within a complex discipline (e.g., retaining students, reducing costs) connect and to explore the impact of changing core elements.
g) They can increase organizational productivity and effectiveness by providing up-to-date information and allowing rapid response to challenges.
h) They can help institutional leaders determine the hard (e.g., patents, research) and soft (e.g., reputation, profile, quality of teaching) value generated by faculty activity.
i) They can provide learners with insight into their own learning habits and can give recommendations for improvement

EDUCAUSE, an American nonprofit membership association created to support those who lead, manage, and use information technology to benefit higher education, has a lot of promotion papers and reports about learning analytics on its official website. According to EDUCAUSE, the earliest for-profit institutions have been among the early adopters of LA, including University of Phoenix, Capella University, and the American Public University System (APUS). The LA software in APUS could pick up data on a daily basis from a massive data warehouse, compares it by using statistical measures and semantic analysis engines, and could work out a student ranking each week, and indicate the potential successful learners, and possible losers, or to indicate if any changes could be made to the current curriculum or learning materials. And researchers in Rio Salado College found that early grades in coursework were not reliable indicators of student's final grades, therefore, they designed new LA software to record student's log-in frequency, their pace of work, their involvement in discussion forum, and make them more robust indicator. Hyun Jo and his colleagues tries to suggest more meaningful components for LA in order to help learners to improve their learning achievement continuously through an educational technology approach. They apply the seven-predictor model and could account for 99.3% of the variance of the final grade: total login frequency in LMS, regularity of learning interval, and total assignments and assessment composites had a significant correlation

with final grades. However, total studying time in LMS, interactions with content, interactions with peers, and interactions with instructor did not predict final grades. The results provide a rationale for the treatment for student time management effort (Hyun et al., 2015).

There are more researches on educational factors that have driven the need and the development of analytics in education, connections between LA and its most related fields (educational data mining and academic analytics), with the objectives, the stakeholders, the methods and the initial triggers behind the analysis actions. Other potential areas of LA might involve the construction of learner profile, personalized learning model, social network analysis, concept analysis and affect analysis.

A lot of universities or institutions launched their professional researches on this area, some universities even designed academic courses to help lead students' research. For example, in Harvard University, Doctor McLeod Lang has been offering a course, named "Data Science in Education: Big Data, Learning Analytics and the Information Age". In the class description, it says clearly "Data Science in Education provides an overview of the uses of Big Data in education with the aim of developing students' ability to critically evaluate the technologies, analyses and consequences of this emerging field."[1]

In China, people began to put some emphasis on this research area. Ma Xiaoling and his colleagues try to construct an open and comprehensive LA system, to study the interaction between evolution of time, space and data (Ma et al., 2014) More diverse and sophisticated researches on LA comes from the field of instructional technology, where experts like Sang et al. (2014) have originated their study from the history and development of learning science, and they have already carefully explored the complicated relationships between learning science and educational technology.

4. THE VALUE AND PRACTICE OF LEARNING ANALYTICS IN COMPUTER ASSISTED LANGUAGE LEARNING

4.1 The Latest Development of Computer Assisted Language Learning

The field of foreign language education has a relatively late start in big data research, although it has done some work in designing smart teaching or learning assistance platforms. Helene and Elodie (2014) present the outcome of a LA project undertaken in an open and French distance learning institution. They also evaluate the usability of VLE (Visual Learning Environment) learning analytics tools for language course designers, with a particular focus on online revision activities and interactive computer-marked assignments. They also consider how the quantitative data can be related to qualitative notions such as learner behaviors regarding online formative assessment.

In November 2014, on the 4th Conference of China CALL (computer assisted language learning), Gu Yueguo has announced his ambition in establishing a national Big Data research center with the support of National Social Science Research Funding, specializing big data-related research topics in foreign language education, which eventually mark the beginning of big data and LA research.

Innovations and creations are always born with changes to the existing world. Similarly, the massive amount of data and applications replaced every other tool and gives rise to new challenges to all parties of computer assisted language learning (CALL).

Firstly, English teachers and practitioners are no longer knowledge owners or providers, but class organizers and leaders. From "sage on the stage" to "guide on the side", teacher's work load has not been lessened as commonly expected, but even doubled or several times heavier. The space of interaction has been greatly expanded with various learning platforms, such as Moodle or Blackboard, therefore, teachers are facing great challenges in hiding himself from bullets of all directions.

Secondly, learning could be real learner-oriented, for the learner himself could decide what to learn, when to learn, how to learn, where to learn, how much to learn and how fast to learn. In one word, learning could happen anywhere, anytime.

The changes in learning materials could also be huge, with massive digital materials everywhere, written, audio, visual or virtual. The future textbook would be revolutionized with the essential changes in learning media, and complicated word narrations and descriptions would be replaced by videos or movies, and asking for learner's multiple sensory inputs, including that from eyes, ears, mouths at the same time.

Finally, the wall of universities would be pushed down to the floor and be open to learners from all walks of life. Classroom learning would be decreased but online learning would be increased; face-to-face lecture would be rare but on line interaction would be more frequent. A learning community would be made up with members from all around the world and the real globalization would not be a dream.

With all these changes, what are the value and practice of analytics in computer assisted language learning?

4.2 The Value and Practice of Learning Analytics in Computer Assisted Language Learning

As experience and gut feeling are regarded as less reliable compared with decisions made on the basis of massive

[1] McLeod Lang Homepage. (2014). Retrieved from http://www.gse.harvard.edu/course/fall-2014/t510s-data-science-education-big-data-learning-analytics-and-information-age-fall

sets of data, the way of CALL research would experience fundamental changes from the greatest depth. LA would play very important role in various areas.

4.2.1 It Could Improve the Research Process and Help Make More Accurate Judgments

With massive data support from LA, random sampling might gradually be disposed and quantitative analysis could be more accurate since we could get the information of almost all subjects. Cause-and-effect relationships would be preferred than correlation studies since the huge data-sets provide more accurate information to help locate the reason. Shift would be made by digging out "why does it happen" to "what to do next", since learner-centered data trails suggest ways to improve their learning. People would gradually give up the design of large-scale teaching and learning experiment since they could collect massive amount of data on diverse learners, environments, materials, and technologies. Therefore, decision-making could be more accurate since it is not based on quasi-experiment, but real situations.

4.2.2 It Could Optimize Learning Process by Recommending Smart Learning Tasks

With LA, curriculum and syllabus could be made "intelligent" or "smart" to meet the diverse needs of individual learners. As the traditional view of course is disrupted, and knowledge, attitudes, skills are rendered as a network of relations. Smart adaptation could be made at any time since the powerful-enough LA management system could help make smart decisions conveniently. Learning content is not provided in a packaged textbook but is rendered or computed "on the fly", providing each learner with resources relevant to his or her profile, learning goals, and the knowledge domain the learner is attempting to master. Therefore, the learning could be optimized to the greatest extent since both the learning content and form are highly personalized. For example, the learning tasks assigned to an individual learner could be very flexible, based on the datasets that reflect what success he has achieved, what difficulties he has encountered, and the frequency of login in and re-watching. Therefore, the learner could save a lot of time because the smart system would not assign him/her the tasks that he/she already has a very solid grasp. Similarly, the system would recommend him/her more consolidation exercises to help grasp a language point or to help explain specific grammar that he does not know very well. The well-known Khan Academy learning module has achieved great merits, even with their simplistic, master-based approach.

4.2.3 It Could Help Form Formative Evaluation on Learner's Language Competence

The early computer - based tests of foreign language learning involved item types that were easily scored by a computer. Item types included multiple choice, multiple select, drag - and - drop, and short answer response and were presented linearly as they were on their paper - and - pencil counterparts. In the future, with powerful LA tools, test takers wiil be asked to respond to tasks that were more like real - world tasks. In addition, they were asked to produce more open - ended responses. The challenge has been in scoring such items, both in terms of developing the criteria for scoring and in developing programs to help with scoring (Li, 2000). In addition, the field quickly incorporated the adaptive functions of computerized testing. In China, www.pigai.org , managed by National Association of English Writing, has achieved rather great success since it has been widely used by thousands of teachers and students, and they submitted their writing on line and get them improved online.

And the new LA system would experience a giant leap in the depth and width of statistic analysis. With all details of learning activities tracked down, the mean length of learner's utterances/sentences, his/her speaking speed, his grade in every writing submission, how many times he has reviewed his writing, his average score for all five submissions, and etc. With all the help of all this digital records, assessment could be performed in real time as learners demonstrate mastery of important concepts or ideas. The development path of language competence could also be mapped or demonstrated by line graph, with variables like log-in frequency, log-in duration, submission frequency or frequency of attending the discussion forum. At the same time, the evaluation of learner's language competence could be highly objective since there is no possibility for "sympathy score" or "impression score".

4.2.4 It Could Help Establish Learner Portfolio and Provide Diagnosis Suggestions for Individual Learners

The application of portfolio has been widely explored in studies of facilitating learner autonomy. Portfolio tools have long been used to record events after they have occurred, present extant text material in hypermedia format, and create portfolios for students and teachers that automatically incorporate audio, video and other digital evidence of accomplishment. The digital learner portfolio is an innovating methodology from the perspective of LA, in the sense of its innovative procedure, its new structure, and the technological support of a platform of virtual campus. LA holds promises in the context of foreign language learning by offering new methods and tools to diagnose learner needs and provide personalized instructions to better address these needs. With learner portfolio, it will provide constructive diagnosis suggestions to help learners with personalized learning experience, rather than merely clustering people into "behaviorism models" or "communicative model". It will help make wise decisions based on what it finds about learner's learning style: visual learning or audio learning, tactile learning or kinesthetic learning, group learning or individual learning. With valuable diagnosis suggestions,

learners could get find what is his/her biggest problems and challenges in language learning, and get involved into early interventions to make up for his/her weaknesses.

4.2.5 It Could Help Enrich the Resources of Learner Corpus Construction

Despite a mere decade of existence, the field of computer learner corpus (CLC) research has been the focus of much active international work in both Second Language Acquisition (SLA) studies and Foreign Language learning (FLL). The current CLC research mainly focusses on data collection, methodological approaches, learner corpus typology, corpus size and corpus samples, and generate tangible achievements. For example, to study the use of a particular word, researchers could examine a 100,000 words corpus of global computer network, to link expert speakers and learner of a particular language for the purpose of social interaction and academic discussions, over a limited period of time and within an institutionalized setting. With the improved capacity of datasets and computing, the construction of learner corpus could be greatly enhanced. All big data could be the potential resources of the LA learner corpus, with greatly enlarged storage room and highly accelerated computing speed.

4.3 The Constraints of Learning Analytics' Application in Computer Assisted Language Learning

LA does show great room in its potential development of computer assisted language learning, but it is still in the early stages of implementation and experimentation. Numerous questions exist around how analytics relates to existing learning management systems, including privacy, profiling, information sharing, data ownership, and etc..

Firstly, the application of LA requires new higher-order competences to enable fruitful exploitation in learning and teaching. In order to make LA an effective tool for language learning practice, it is important to recognize that LA ends with the presentation of algorithmically attained results that require interpretation. Actually it is not likely that all learners and teachers possess the competence and critical evaluation skills to interpret LA results to determine appropriate actions or interventions.

Interpretation of LA results is often facilitated by visualization tools to serve as a functional aid. One inherent danger that we perceive is that the simplicity and attractive display of data information may delude the data clients, e.g., teachers, away from the full pedagogic reality. This may negatively affect the pedagogic assessment and grading of a student's language competence, which should not be based alone on the visualization of log files from a Learning Management System. Take the example of marking student English writing. An automated spell-check on orthographic mistakes presents itself as a quick and simple tool to interpret the learner's work into numbers. It seems an efficient, cognitively effortless grading mechanism. And people do find that the traditional qualitative assessment of essays gives way to such quick number crunching machines. However, is this superficial digestion of data presentations good enough to reflect the learner's writing ability? Can this lead to the wrong conclusions?

Moreover, it has to be strongly emphasized that data not included in the respective LA approach, is equally important as the dataset that is included. To judge a learner's performance merely on LMS quantitative data is like looking at a single puzzle piece. As learning is more and more happening in a lifelong and diverse ecosystem (such as in library as well as in subway), an exclusive data view on single elements may provide a stimulus for reflection but far from being a sound basis for all-around assessment.

In complement to these human factors that pose obstacles or barriers under the dimension of "internal limitation", we are also facing up to the environmental problems, as the "external constraints". As Dr. Diana Oblinger, the President of EDUCAUSE points out in its 2014 annual conference, BYOD (Bring Your Own Device) is really continue to be the overwhelming trend for the coming years. In universities, people are bringing their own devices and which make it more complicated for teachers and practitioners, especially in foreign language learning settings. And it will bring more security and technology challenges because it is hard to control the device. The wide use of learning Applications (APP) poses as a very convenient tool for smart phone users, however, is it possible to design and apply collaborative APP that is both compatible to Apple operating system and Android operating system and make their data eligible to learners? What should be a typical computer assisted language learning management system display in considering the distinguished features of big data LA principle? The room for further exploration is limitedness.

CONCLUSION

LA is very much at the dawn of its existence and considered by many as one of the technological advances that will bring learning onto a totally new frontier. And its development in CALL, which always highlights the latest technology, would undoubtedly affirm this trend. Language learning could be a very complex process since it involves psychological, physiological and affect processes. LA is essential for penetrating the fog that has settled around language learning, and make things simpler for language learners, practitioners and organizations. For teachers, they could predict who could be the "winner" and who could be the "loser", and to provide earlier interventions. For language learners, the accurate digital analysis could help them to understand their own performance in relation to their peers or to their progress in relation to their personal goals.

While we join in with this positive expectation, we are also aware that LA shows a double nature: in its most optimistic outlook, learners will be provided with personal information about their current needs, their learning styles, their success and failure in previous learning. Therefore, foreign language learning will be evolved from a "one-size-fits-all" approach into a highly personal competence-driven learning experience. We therefore believe that it will be of critical importance for its acceptance that the development of LA takes a bottom-up approach focused on the interests of the learners as the main driving force.

LA has the potential for new insights into language learning processes by making invisible data patterns visible to researchers and end users, and to enable development of new instruments for language learning practice. However, there are substantial uncertainties about the extent of impact LA will have on language learning in general. With Horizon report's forecast and its claim for a prosperous future of LA (Johnson et al., 2011), we also admit that this development should not happen without a guiding framework, and we should combine use of learning data with the protection of individuals' privacy.

One of the major questions in LA is the relation with theories of learning, teaching, cognition and knowledge. LA may support the evaluation of a certain language learning approach which in turn may provide supportive evidence for particular pedagogic theories of language learning. At the same time, technologies are not pedagogically neutral, hence the evaluation will be influenced by the approach chosen. This debate will continuously go on and will require further research and demonstration of applications and the impact they make on the process of language learning.

It is still too early to base CALL fully on LA approaches, and we expect it will never be possible to do so. However, at the very least, opportunities that this new discipline has to offer are to provide new support for learning activities and stimuli for reflection. It is these opportunities that LA should pursue.

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