



# Constructing an Open Learning Analytics Architecture for an Open University

Jun Xiao<sup>1</sup>(✉), Tore Hoel<sup>2</sup>, and XueJiao Li<sup>3</sup>

<sup>1</sup> Shanghai Open University, 288 Guoshun Road, Shanghai, China  
xiao.j@sou.edu.cn

<sup>2</sup> Oslo Metropolitan University, Pilestredet 46, 0167 Oslo, Norway  
tore.hoel@oslomet.no

<sup>3</sup> East China University of Science and Technology, 130 Meilong Road,  
Shanghai, China  
lixuejiao9405@163.com

**Abstract.** Open learning analytics (OLA) aims to meet diversified needs for insights into different stakeholders' efforts to improve learning and learning contexts integrating heterogeneous learning analytics techniques. From an abstract point of view, OLA aligns well with the ideas of open and distance education institutions, of which Shanghai Open University (SOU) is a learning Chinese representative. The paper reports on the design of an OLA framework for SOU, based on different users' service demands and the diverse sources of data and multiple platforms in use at the university. The proposed architecture is based on a discussion of the general characteristics of OLA architecture. The final model is achieved through an iterative development method.

**Keywords:** Online learning · Open Learning Analytics · Open University

## 1 Introduction

Application of learning analytics can help learners achieve better learning results and improve the quality of online education. However, open universities face a complex environment with a wide range of data collected from different learning environments, heterogeneous learning contexts, as well as diverse needs and analytical objectives from stakeholders. The technical infrastructure (learning analytics platforms, etc.) should ideally accommodate a number of learning analytics methods [1]. These diverse elements lead to a new concept of learning analytics [3], open learning analytics (OLA). It deals with learning data collected from multiple environments and contexts, analyzed with a wide range of analytics methods to address the requirements of different stakeholders [3]. As the guiding framework of open learning analysis, there are many typical architectures in the world (eg. Integrated learning analytics system/Open Learning Analytics Diamond/Open learning analytics architecture) [1, 2, 4]. The paper has carried out an extensive literature review, and extract the following characteristics from the literature review of international open LA architectures: (1) the architecture should be goal oriented; (2) based on open standards; (3) consist of modules that can be interchanged.

SOU has used learning analytics to provide personalized learning services for learners by monitoring their learning process. However, SOU faces the same challenges as other open universities that is to integrate multi-platform learning data and better understand the learning status of learners. In order to solve the challenge faced by SOU, this paper based on the analysis of the general characteristics of open learning architecture and the requirements of SOU, an iterative approach is used to propose an Open Learning Analytics Architecture for SOU (SOU\_OA4LA).

## 2 Methodology

This research studied SOU\_OA4LA with research methodology of iterative design science and interview. In the design of open learning analytics framework, initially evaluates SOU\_OA4LA1 Open Learning Analytics architecture's three aspects, including the intelligibility, integrity and openness. The survey is in the form of questionnaire and interviews, which contains 11 questions, including 10 multiple choice questions, with answer range from 0 to 5 grades; and 1 open question which allows the subjects to give their own suggestions on this open learning analytics architecture. The subjects of the survey are teachers, managers and technical personnel, such as data base administrator, architecture engineer, software engineer and project manager. According to the survey results of this questionnaire, this study improved SOU\_OA4LA1 Open Learning Analytics architecture and obtained SOU\_OA4LA2 Open Learning Analytics architecture. Focus group interviews are a method for collecting qualitative data. Then, experts are invited again to evaluate the architecture through focus group interviews, and we updated the SOU\_OA4LA2 based on the results of the interview and finally gained SOU\_OA4LA3-the final version.

## 3 Results

### 3.1 Process of SOU\_OA4LA Formation

SOU\_OA4LA1 (Fig. 1) is the first generation of open learning analytics architecture we designed. The statistical results from 27 valid responses to the questionnaire showed that SOU\_OA4LA1 architecture scores below 4.2 on average in terms of completeness and clarity, and the evaluation results in the target module (only 21 people think that the architecture reflects the openness of the target), the analysis module (mean = 4.148) and the visualization part (mean = 4.037) are not ideal.

So the research improved the architecture and got SOU\_OA4LA2 (Fig. 2): (1) learning system is added to access data; (2) stakeholders are added to the architecture; (3) learning models are added to the module section; (4) open services replace analysis output. 'Service-orientation architecture' from Information Technology domain is introduced to the SOU\_OA4LA2.

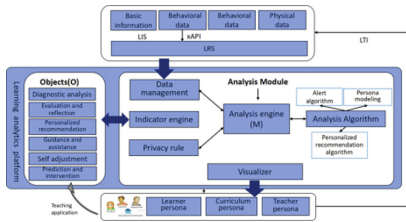


Fig. 1. SOU\_OA4LA1

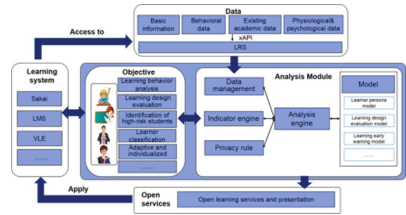


Fig. 2. SOU\_OA4LA2

To polish the architecture, experts of educational technology are interviewed to evaluate for SOU\_OA4LA2. They are approval of the overall structure design of architecture, which assist with teaching and learning activities. More importantly, experts also pointed out a problem that part of the four types of data does not belong to the same dimension. And, the architecture did not reflect the “ecological” well.

### 3.2 The Description of SOU\_OA4LA3

According to the evaluation results, the revision is made again and the latest version of architecture SOU\_OA4LA3 is shown in the Fig. 3. This architecture is an objective-oriented ecological system, accessible to different learning system. More importantly, its analysis result output is also available to different learning system. The procedure of analysis and format of analysis output are both determined by the analysis objectives. Therefore, the final application performance should be evaluated by whether achieve a preset analysis objective. This architecture consists of four modules, which are objective, data, analysis, as well as open service.

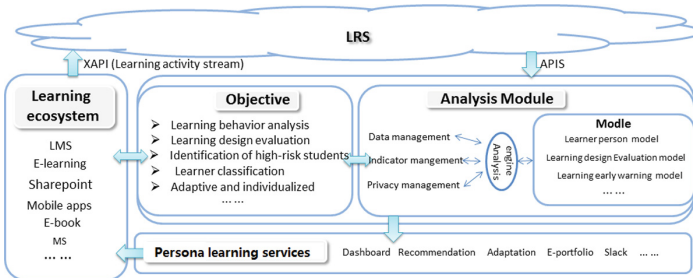


Fig. 3. SOU\_OA4LA3

**Objective Module:** Objective is determined by the demands from different stakeholders, eg teachers, students, researchers, management personnel.

**Data Module:** There three categories of data access to the learning platform of open learning analytics. They are knowledge, behaviour and attitude. These data are the fundamental components of analysis, in xAPI format storage within LRS.

**Analysis Module:** Privacy management provides open learning analytics platform with privacy protection, managing privacy rules storage. Analysis module runs in a precondition of guaranteeing stakeholders' privacy. Data management is managing data processed into xAPI format. The indicators are acquired from data polymerization, providing the basis for model construction. Indicator management is to form indicators according to analysis objectives, then undertake management, for instance, indicator storage management. Model management is to preset corresponding model or to add new models according to analysis objectives, for example, alert model. Analysis engine takes advantage of the other four parts, adopting certain of data analysis methods, and algorithm, receives the analysis result relating to analysis objectives.

**Open Service Module:** Open service is the output of analysis procedure. It could be demonstrated as a teaching service accessible to learning system, also could be a visualized report. For example, an alerting service based on alert objective, is an open learning service applied to learning system, an evaluation report generated according to 'Learning Design Evaluation' objectives is one form of visualization.

## 4 Conclusion and Future Work

In conclusion, SOU\_OA4LA can help stakeholders to conduct better open learning analytics, moreover, has great potential to be expanded to a wider environment. This architecture is highly feasible on various platforms, learning objectives and data flows. The SOU\_OA4LA compensates for the lack of operational open learning analytics architecture, and integrates the existing open learning analytics architecture type, which is conceptual. It is also developable and can serve technicians for different purposes. More case study are needed to feedback the application effect in the future to evaluate the effectiveness of SOU\_OA4LA.

**Acknowledgements.** This paper is supported by China's National General Project granted by China National Office for Education Sciences Planning (Grant No. BCA160053). The Construction and Application of Online Learners' Persona based on Big Data Analysis.

## References

1. Chatti, M.A., Muslim, A., Schroeder, U.: Toward an open learning analytics ecosystem. In: Kei Daniel, B. (ed.) *Big Data and Learning Analytics in Higher Education*, pp. 195–219. Springer, Cham (2017). [https://doi.org/10.1007/978-3-319-06520-5\\_12](https://doi.org/10.1007/978-3-319-06520-5_12)
2. Greller, W., Drachler, H.: *Translating learning into numbers: a generic framework for learning analytics* (2012)
3. Muslim, A., Chatti, M.A., Bashir, M.B., Varela, O.E.B., Schroeder, U.: A modular and extensible framework for open learning analytics. *J. Learn. Anal.* **5**(1), 92–100 (2018)
4. Siemens, G., et al.: *Open learning analytics: an integrated & modularized platform*, Doctoral dissertation, Open University Press (2011)