Learning Analytics Dashboard Widgets to Author Teaching-Learning Cases for Evidence-based Education

Rwitajit Majumdar[1], Arzu Akçapınar[1], Gökhan Akçapınar[1,2], Brendan Flanagan[1], Hiroaki Ogata[1]
Kyoto University[1], Hacettepe University[2]
{majumdar.rwitajit.4a, ogata.hiroaki.3e} @kyoto-u.ac.jp

ABSTRACT: In this paper, we introduce the components of LAView, a learning dashboard that assists teachers to author criteria for different teaching-learning cases. We define indicators as the basic unit to define the status of a situation and visualise that on the dashboard. This paper describes the technology design and workflow of the teacher as the user of the dashboard from setting indicator criteria to recording reflection of their results. We conclude with the utility of such a technology support in the context of evidence-based education.

Keywords: BookRoll, LAViEW, Visual Analytics, Criteria setting, Evidence-based Education

1 LEARNING EVIDENCE ANALYTICS FRAMEWORK (LEAF)

Evidence-based education seeks to establish evidence in the context of teaching-learning practices (Davies, P.,1999; Ferguson, R., & Clow, D., 2017). While it is primarily done as a meta-analysis of the published literature, we attempt to extract evidence from practice. Our novelty lies in the approach to conceptualize evidence in practice by utilizing educational big data. We base our work on the Learning Evidence Analytics Framework (LEAF) (Ogata H., et.al. 2018). The components of LEAF are based on the LA platform proposed by Flanagan and Ogata (2017). It extends the infrastructure to include specific functionalities in the LA Dashboard and an Evidence Portal (see Figure 1).

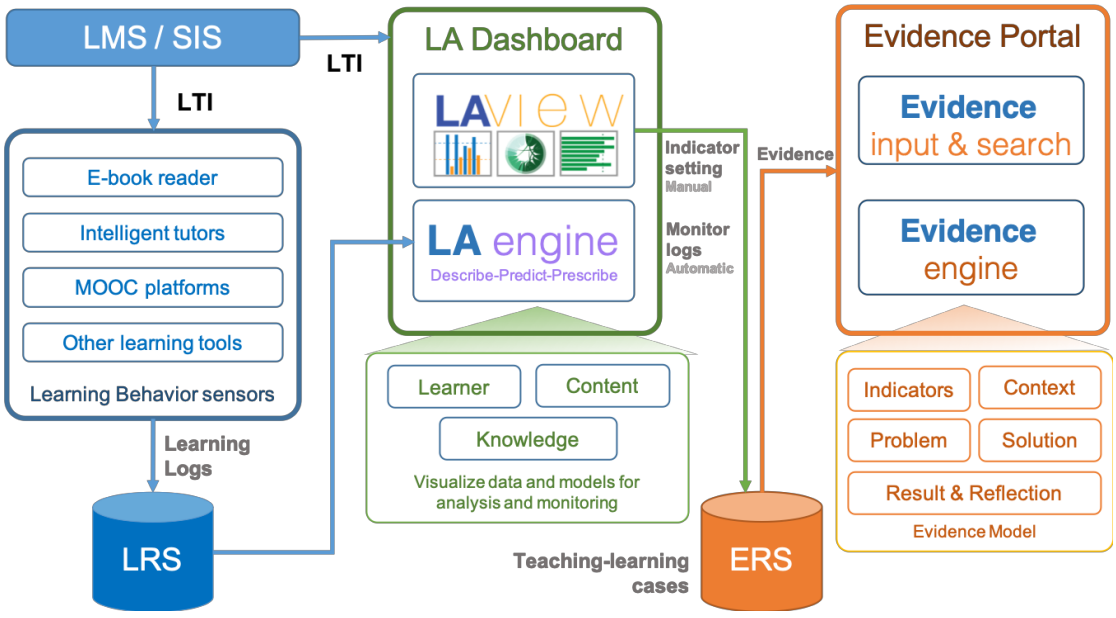

Figure 1: Components of the LEAF framework.

Using the LA platform helps to collect anonymous learning logs of students. For example, teachers can use a Learning Management System (LMS) to coordinate a course and upload reading content in an eBook reader linked to that LMS. BookRoll, the eBook system in our context assists instructors to support students' in-class and out-of-class learning activities. It has features to highlight important and difficult to understand text. Students can add memos or bookmark important pages. While students use BookRoll for browsing course material, their reading behaviors can be anonymously logged. Learning Logs of BookRoll reading is recorded in Learning Record Store (LRS) as an Experience API (xAPI) statements. We consider any similar tool which can log learner behavior as Learning Behavior Sensor (LBS). The LA dashboard has a backend LA engine and web-based front-end LAViEW. The LA engine helps to analyze the log data and extract features and recording in database. This processed information and models regarding the learners, the content and their knowledge data is visualized in LAViEW. The framework applies a two-way anonymization to the student data and supports all these processes in real-time. In the logs, students are represented by UUID to ensure their privacy. However, when user logins to the system via LTI s/he can see the converted student ids based on their roles. Thus, the framework is also very flexible to connect to any other behavior sensors which has LTI. While the users interact in the dashboard to monitor and analyse the state of teaching and learning, the evidence portal gathers their interactions.

In this paper in the context of LAViEW, we define the user workflow to gather evidence from practice and the corresponding features in the dashboard.

2 SUPPORTING ACTIONABLE ANALYTICS WITH LAVIEW

Our approach to designing technology-enhanced and evidence-based practice in education starts with systematically defining indicators of teaching-learning experiences in a specific scenario. These indicators are measurable attributes of the individual users or their interactions within the learning system. Our dashboard, LAViEW, plays a central role to assist analysis of the visualized indicators to identify problems by teachers. Based on the problem that the teacher identifies, (s)he can think of possible solutions to mitigate it and then monitor its effectiveness. We are designing technology that can help to capture this process and reflect on the effectiveness of the practice as evidence. Conceptualizing such an evidence analytics system in education would push the boundaries of existing learning analytics infrastructures. We define the workflow for the teachers first.

2.1 Teachers Workflow Design

The teacher workflow is based on the DAPER model (see figure 2). The data collection is supported directly by the LA infrastructure. The indicators are either collected directly from data log or computed from the log. Typically, we envision that the learning analytics system developer would visualize various indicators based on the data that a particular system gathers and the features that are extracted from them. It is then visualized in dashboard to assist easier and useful interpretation by different stakeholders. For analysis phase, the teacher needs to specify the criteria to determining status of students based on those indicators. Based on the analysis, the teacher can implement certain intervention plan to mitigate the problem. Post-intervention the teacher can monitor the indicators while the system computes the change in the indicator values and stores it as results for the teachers to reflect on it. In the dashboard we want to assist the users monitor indicators, analyze and annotate status of problem based on those indicators and implement certain

solution interventions (for e.g. email based interventions as demonstrated in Majumdar 2019). This set of indicator-problem-solution-result-reflection is saved as a teaching-learning case in the evidence record store for further analysis.

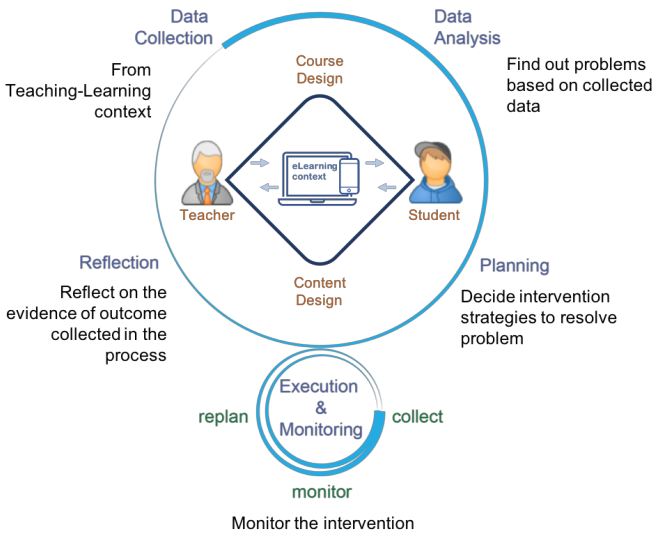

Figure 2: DAPER model-based workflow for intervention and evidence collection.

2.2 LAViEW to support the teacher through DAPER workflow

We are designing LAViEW dashboard as the unified tool that would assist instructors with the functionalities in the DAPER model. The collection phase is coordinated automatically by logging data from the ebook reader and Moodle. For analysis, teachers can first use the setting panel to set the criteria of each indicator based on which they get notification of the problem state. An example UI mock up is shown in Figure 3. Criteria can simple indicate desirable (green), ok (yellow), critical (red) zones based on the indicator value.

Figure 3: Criteria setting panel for indicators

In Figure 3, the indicators are in the context of BookRoll reading behaviors. The Markers and Memos are in terms of counts. Considering the act of annotating as active reading behavior, markers and memo count can indicate the level of active reading the learners are involved in. Similarly, reading completion and engagement are in terms of percentage and they can highlight the status of student's engagement. While setting the criteria if the teacher sets reading completion lower than 40% as low engagement, then dashboard can be used to notify both the teacher and the students respectively (see Figure 4a and 4b) for monitoring.

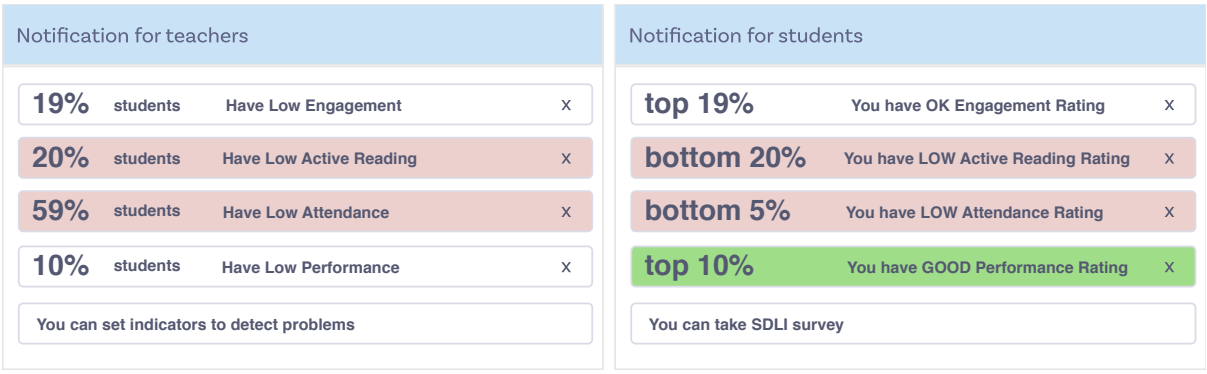

Figure 4: Notification panel for monitoring. Left – Teachers view , Right – Students view

2.3 Extracting evidence from teaching-learning practice

Figure 5: Sample information presented in LAView.

The dashboard contained various panels of visualized indicators for monitoring (see Figure 5). To assist users, we even add an overlay panel to every graph which gives explanation about each graph to the users. The ERS records all the information that is part of the earlier discussed workflow. It records the criteria set for each indicator, details of the context regarding which course and content,

the solution plan of intervention in case there is a problem identified and the result of the solution. These actions of analysis, planning and monitoring by the teachers are saved in as xAPI statements in the Evidence Record Store (ERS). Context anonymized dataset in the LRS can be used to retrieve the whole case details during evidence search. Each of these records are saved in the ERS as a teaching-learning case which can then be analysed for extracting evidence.

Figure 6 illustrates an example of an overall workflow. The teacher sets the criteria value for indicators which is saved in the system. Based on that criteria the system puts notification on the instructor's dashboard. The instructor can select to email the cohort of students in a particular criteria zone (red, yellow or green) by selecting a predefined editable message. Once the message is sent the indicator criteria, problem identified based on cohort definition, and intervention (email message) is saved in the teaching-learning case. After a period of designated time period the result of the intervention is also added to the case. Such a record captures the cycle of DAPER model and we plan to use the case for extracting evidence.

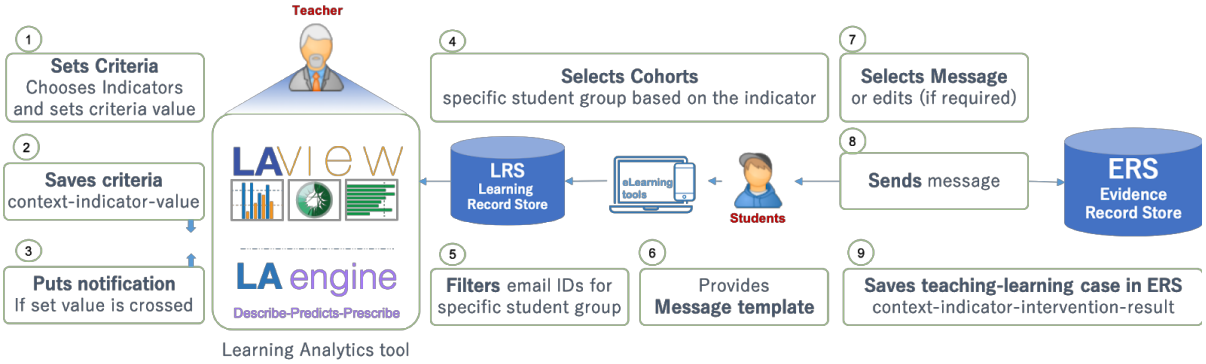

Figure 6: Example of an overall workflow with LAViEW

An example of record of the TLC is presented in table 1 based on the previous example workflow.

Table 1: Description of the parameters captured in a Teaching-Learning Case (TLC)

Sl.	Parameter	Description	Example
A	**Context**	Details of course-student-content.	
1	*Institutional profile*	Details of the institute.	
1.1	Country	Name of the country.	Taiwan
1.2	Institution type	University/School/Corporate training.	University
2	*Course profile*	Details of the specific course.	
2.1	Field or Subject	Name of the course or subject.	Introduction to programming
2.2	Mode of instruction	How is the course offered, for example face-to-face, eLearning, MOOCs.	Face-to-face

2.3	Language	Language of instruction.	English
2.4	Time	The date and duration of the course.	Fall 2018, semester long
2.5	Units	Number of units.	14
2.6	Pre-requisite	Pre-requisites required for the course.	none
2.9	Class size	Number of registered students.	122
3	*Learner profile*	Details of the cohort of learners.	
3.1	Demographics	Distribution of learners.	Undergraduate first year
4	*Content profile*	Details of content.	
4.1	Learning content	Course content and its link.	<BookRoll link of content>
B	**Indicators**	Measurable parameters defining the problem and highlight results.	
5	Indicator definition	The definition of the data or its computed feature and description	Percentage completion
C	**Problem**	Problem identified through analysis	
6	Problem definition	Describes the problem and how to identify them from the indicators	Low engagement if percentage completion is less than 40%
D	**Solution**	Solution to mitigate the problem	
7	Plan definition	Description of the plan and associated content for it.	Email sent to low engagement students: <body message>
8	Review period	Period to review the indicators after the plan is implemented.	1 week
E	**Results**	Results of the implemented plan	
7	Dataset	The indicator values in the context across time.	<link to dataset 1 week before and after the intervention>
8	Reflection	Reflection of the teacher or student	*The tone of the message in the email seems critical for the motivating the low-engagement students.*
F	**Metadata**	The data related to the case	
9	Timestamp	The time the record was updated	ISODate("2018-12-03T20:48:08.099Z")
10	Rating	The rating of the case for the evidence.	4

3 PLANS FOR TESTING AND VALIDATION

The current system is under active development and we propose to open it up to teachers, such that they can use the various components in actual practice. We would follow a co-design paradigm by observing log data and getting feedback from the teachers who use the system.

3.1 Sample

To conduct such a research, we selected teachers who were already trained for offering course by using some LMS. We invited the teachers who successfully completed a MOOC based faculty development course on Educational Technology. Total 533 participants completed this course. Participants were from across 16 different states in India. These instructors were across 15 disciplines including Engineering, Humanities, Language, Science, Law, Pharmacy and Commerce to name some. Majority of them are from Engineering (377) and in that too in computer science (175). Teachers have diverse teaching experience 1 – 10 plus years.

3.2 Method

We offered the infrastructure associated with LEAF to the interested teachers and such that they can conduct their next semester-long course on the platform. We choose Moodle as the LMS. Teachers shall use BookRoll as the ebook-reader and the LAViEW dashboard with that Moodle. We shall set-up a course on the same moodle and register the teachers there. This course would be used for coordination and training of the various components in the system.

While the teachers conduct their course, we shall log their Dashboard components utilization. We plan to gather an initial dataset of teaching-learning case from this pilot. It shall help us to validate the process and the actual structure of the collected data too.

To initiate this in an immersive and pertinent way (Warriem, 2014), we had a face-to-face workshop with teachers during mid-December 2018 following which we launch the coordination course on the Moodle.

4 CONCLUSION

In this research article we take a position to extend the notion of evidence in the evidence-based education from meta-analysis of published works to educational BIG data gathered from actual teaching-learning scenarios. This complements the existing research-based evidence by finding evidence in practice. Based on LEAF, a framework design which defines and supports gathering all the associated parameter from such an instance of practice, we illustrate a dashboard design to supports it. We give an example of teaching-learning case (TLC) that notes the context, problem, solution and indicators related to a teaching-learning scenario. It gives a micro-view of the evidence. A collection of such TLCs can be aggregated or analyzed based on its parameters to get a macro view of the evidence. We presented the details of the technical components and illustrate how it supports the DAPER workflow model to generate the evidence parameters and store it as xAPI statements. Also, keeping the components in LEAF as standard learning analytics infrastructure and standard data structures making it easier to adopt by interested institutions which has existing resources.

Our approach to commence an evidence-based practice in education supported by technology starts with systematically gathering indicators of learning in a specific scenario and then analyzing visualized indicators in the analytics dashboard to identify problems. Teacher can design intervention to mitigate it and then monitor its effectiveness. We believe technology can help to capture this process and reflect on the effectiveness of the practice as evidence. Conceptualizing such an evidence analytics system in education would push the boundaries of existing learning analytics infrastructures towards a technology-enhanced and evidence-based education and learning.

REFERENCES

Davies, P. (1999). What is evidence ‐ based education? British journal of educational studies, 47(2), 108-121.

Ferguson, R., & Clow, D. (2017). Where is the evidence? : A call to action for learning analytics. In Proceedings of the 7th International Learning Analytics & Knowledge Conference (pp. 56-65). ACM.

Flanagan, B., & Ogata, H. (2017) Integration of Learning Analytics Research and Production Systems While Protecting Privacy. In Proceedings of the 25th ICCE 2017, New Zealand, Nov 2018.

Majumdar R., Yang Y.Y., Li H., Akçapınar G., Flanagan B. and Ogata H. (2018) Supporting Learner's Development of Self-Direction Skills using Health and Learning Data, In Proceedings of 26th ICCE, Manila, Philippines, Nov 2018

Ogata H., Majumdar R., Akçapınar G., Hasnaine N.H, and Flanagan B. (2018) Beyond Learning Analytics: Framework for Technology-Enhanced Evidence-Based Education and Learning, In Proceedings of 26th ICCE, Manila, Philippines, Nov 2018

Warriem J.M., Murthy S., Iyer S., A2I: A Model for Teacher Training in Constructive Alignment for Use of ICT in Engineering Education, In Proceedings of 22nd International Conference on Computers in Education, Nara, Japan, November- December 2014