A Framework for Open Assurance of Learning

Gokul Bhandari
Odette School of Business
University of Windsor
401 Sunset Avenue ON Canada
+1-519-253-3000 x3150
gokul@uwindsor.ca

Maureen Gowing
AOL Coordinator
Odette School of Business
401 Sunset Avenue ON Canada
+1-519-253-3000 x4252
mgowing@uwindsor.ca

ABSTRACT
Assurance of Learning (AOL) refers to the outcomes assessment process which involves the systematic collection, review, and use of information about educational programs undertaken for the purpose of improving student learning and development [8]. While emerging trends such as open education, open learning, learning analytics, academic analytics, and big data in education have recently become mainstream, studies regarding the design and development of open source analytics applications for AOL are non-existent. In this paper, we describe an application called *AOL Analyzer* that we developed for our business school last year to assist in the analysis of AOL results reported by faculty. To the best of our knowledge, this is a first paper to bridge the existing gap in AOL analytics research.

Categories and Subject Descriptors
K.3.1 [Computers and Education]: Computer Uses in Education

General Terms
Learning Analytics; Open Assurance; Accreditation

Keywords
Assurance of Learning; AACSB; Analytics; Open Framework; R; Shiny

1. OVERVIEW OF AOL
AOL involves a cycle of continuous improvement of curricula, with schools regularly assessing and improving their programs to ensure that students possess essential competencies upon their graduation [9]. The focus of AOL is on outcomes of the school's programs (cognitive, affective, and performative) rather than inputs (faculty qualifications and course content). The systematic assessment of student learning outcomes is important for institutions of higher education, and particularly for schools of business [5].

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The *Association to Advance Collegiate Schools of Business International* (AACSB) has been instrumental in the movement to student learning assessment in management education. AACSB's Standards 8-12 relate to the Standards for Business Accreditation and comprise the following elements: Curricula management and assurance of learning; Curriculum content; Student-faculty interactions; Degree program educational level, structure, and equivalence; and Teaching effectiveness [3]. There are four overarching intents of AOL: *Demonstration* of students' achievement of program learning goals; Systematic collection of reliable *evidence* to inform program improvements; *Evaluation* of evidence regarding the effectiveness of the program; and *Accountability* to funding and accreditation agencies. Table 1 outlines AOL goals for our three business degree programs.

According to AACSB [3], the outcomes assessment process should include the following: Definition of student learning goals and objectives; Alignment of curricula with the adopted program goals; Identification of instruments and measures to assess learning; Collection, analysis, and dissemination of assessment information; Use of assessment information for continuous improvement including documentation that the assessment process is being carried out in a systematic ongoing basis.

Another form of the above steps can be stated as:
1. What will our students learn in our program? What are our expectations?
2. How will they learn it?
3. How will we know they have learned it or not?
4. What will we do if they have not learned it?

Table 1. AOL Goals for Business Degree programs

Bachelor of Commerce (BComm)	Master of Business Administration (MBA)	Master of Management (MoM)
Business Acumen	Dynamic Management	International Business Knowledge
Critical Thinking	Decision Making & Problem solving	Decision Making & Problem solving
Data Analytics	Interpersonal Capacity	Interpersonal Capacity
Business Communication	Social Responsibility	Social Responsibility
Leadership/ Teamwork/Ethics		

2. OVERVIEW OF AOL ANALYZER
Our business school is a medium-sized school located in Canada which offers three business degrees: Bachelor of Commerce, Master of Business Administration, and Master of Management. After going through several years of rigorous process management, quality control and documentation as necessitated by the ACCSB, the school was successful in getting accreditation

in 2015. A critical part of the accreditation process was to be able to document and demonstrate the students' learning process as they progressed to their higher study levels. In order to facilitate this process, a web-based application called *AOL Analyzer* was developed in early 2015, which is described in the next section.

2.1 A Framework for Open AOL

The Open Definition 2.0 defines "open" with respect to knowledge, developing a strong commons in which participation and interoperability is maximized [7]. Siemens et al. [10] underscore the following aspects of openness in developing learning analytics: (i) openness of process, algorithms, and technologies; (ii) seamless integration with modular tools for adaptation, learning, interventions, and dashboards; and (iii) minimization of fragmentation/discontinuance through the adoption of open technology for data mining, analytics, and content development. Based on these notion of openness, we describe the design and development of Open AOL.

To achieve openness in technology, we decided to develop this application using R which is a programming language and environment for statistical computing and graphics. R is open source and is available as Free Software under the terms of the Free Software Foundation's GNU General Public License in source code form. To deploy it on the web, we used R Studio's Shiny server accessible through Shiny and shinyapps package within the integrated development environment of R Studio (https://www.rstudio.com/). Shiny is a complete web framework that does not require the knowledge of HTML, CSS or JavaScript to develop interactive web-based applications. Figure 1 shows the schematic diagram of the Open AOL framework. In order to make the application truly open, AOL Analyzer is accessible to anyone and does not require any username/password to download the documents and view the learning outcomes for each course across three terms (Fall, Winter, and Summer).

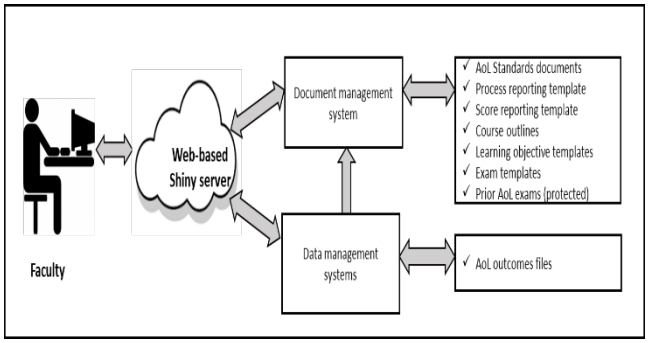

Figure 1. A Schematic Diagram of AOL Analyzer

As shown is Figure 1, AOL Analyzer has two systems: Document Management System, and Data Management System.

Document Management System assists in managing the following documents in Word, pdf, and Excel format: AOL Standards Documents (Published by AACSB periodically); Process Reporting Document (Internal document developed by the school to keep track of the AOL reporting process); Score Reporting Template (a CSV file to be used by faculty for reporting their AOL scores); Course outlines (Word/pdf files with embedded table outlining course learning goals, learning objectives, and corresponding test instruments); Learning Objective Templates (a detailed rubric that divides each learning goal into several sub-goals and recommends different competency levels as *Benchmark*, *Milestone 2*, *Milestone 3*, and *Capstone 4*); Exam templates (rubric for developing various formats of AOL tests); and Prior AOL Exams (accessible to faculty only). Figure 2 depicts a screen-shot from AOL Analyzer's Document Management System displaying the intent of AOL.

Data Management System primarily deals with the management of AOL scores data for all courses and terms. The scores are reported in Excel files with the following attributes: CourseID, SectionID, TermID, StudentID, Faculty Name, Learning Objective, Test Type, Link to Actual Test File (protected), Test Date, Student Score, Maximum Possible Score, and Benchmark Score (Desired Outscore Level). The current benchmark adopted by the school for its BComm undergraduate program is that 70% of the students should be able to obtain 70% or higher in the AOL tests. Figure 3 depicts a screenshot from AOL Analyzer. Currently, the application allows the program level analysis of AOL data. Scores from individual learning objective can also be combined and displayed as "Aggregate Scores". The "Objectives" tab displays all Learning Objectives that were tested in a particular course. The "Scores by Objectives" tab displays the AOL result for each learning objective separately.

Tools and features of Learning Management Systems (LMS) can be broadly divided into five categories: (a) course management tool for posting syllabus and announcements, recording grades and monitoring student performance, (b) communication tool for chat and collaboration, (c) presentation tool for learning content, (d) collaborative workspaces such as discussion boards, wikis, and blogs, and (e) assessment tools including assignment submission, quizzes, exams, and surveys [4]. While Blackboard is one of the most popular learning management systems [6], it is primarily designed to assist faculty in tasks such as posting lecture notes, administering online exams, grading assignments and providing statistical feedback to students [2].

2.2 Adoption Challenges

Initially, the faculty resisted the adoption of AOL Analyzer due to the perceived complexity of following the AOL data reporting template along with the "stringent" documentation requirement. This is not surprising because faculty buy-in, a crucial feature of the assurance of learning process, is reported as the number one challenge confronting accredited programs [5]. After attending a few tutorial sessions and becoming familiar with the application and data reporting structures, the faculty gained confidence and successfully used this application. During the first term of their adoption, faculty were assisted by teaching assistants for data formatting and reporting. In subsequent terms the faculty no longer required assistance for data entry. Currently, all faculty may access past results from any AOL test in any semester.

In addition to informing faculty on the actual percentage of students who obtained 70% or more on the AOL test, the AOL Analyzer also informs faculty about the score achieved by 70% or more students. Should students tested for a learning outcome fail to achieve the threshold, the AOL Analyzer informs faculty what percentage achievement level 70% of students actually achieved. This information supports discussion on the identification and implementation of program improvements to assure learning achievement improves. Throughout the discussion of results the focus is on how the program can be improved rather than on the individual course level of analysis.

In order to formally assess the adoption of AOL by our faculty (around 60), we are currently developing a questionnaire based on the Technology Acceptance Model extended with constructs such as digital inclusion, perceived attention, and perceived enjoyment.

Similar approach had been taken in a recent LMS adoption study [1].

2.3 Limitations and Future Extensions

AOL Analyzer is being used by faculty for only about a year and as such it is difficult to assess its impact on student learning and development which is the primary object of AOL. However, as a data collection and visualization tool, AOL Analyzer seems to be useful based on informal and anecdotal evidence. A formal analysis based on faculty adoption data will be necessary to judge the tool's perceived usefulness, perceived ease of use, perceived attention and digital inclusion.

The current study can be extended by examining whether and how the tools like AOL Analyzer facilitate students' learning by identifying their difficulty in grasping specific learning objectives. The real impact and contribution of AOL Analyzer would be to pinpoint the pedagogical issues at the learning objectives level and identify the corresponding assessment rubrics in need of improvement. In future, AOL Analyzer should be able to handle and analyze learning related big data to meet the ever growing challenges in AOL.

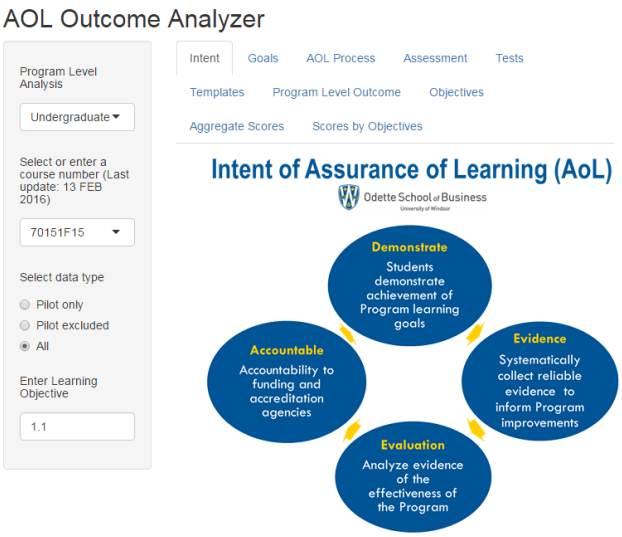

Figure 2. A screen-shot from AOL Analyzer's Document Management System showing the intent of AOL

3. CONCLUSION

Currently, all faculty are now in a position to use this application without the need for any external assistance. Several of them have expressed their satisfaction with the simplicity and effectiveness of AOL Analyzer. Some of the positive attributes of AOL Analyzer are as follows:

i. Ability to upload the AOL data from anywhere (currently protected)

ii. Ability to see the AOL scores for all courses and terms (benchmarks and histograms) thereby fostering transparency and openness. For graphical outputs, we have used googleVis package which serves as an R interface to Google Charts API and allows users to create interactive charts based on data frames which are displayed locally via the R HTTP help server. The data remains local and is not uploaded to Google.

iii. Ability to understand how the AOL tests were developed and administered thereby ensuring the content validity of the instruments

Given the success of the current version of AOL Analyzer, we are planning to introduce several new features in the summer of 2016 such as the ability to track the performance trend of individual student throughout their academic career. This feature enables earlier identification of at-risk students across the program who will receive additional teaching and learning support. Student cohort analysis can trigger follow-up focus groups and interviews with students to evaluate how the program may be improved. In order to manage the interface complexity of this application as more and more new features will be introduced in future, we are revamping the whole application using shinydashboard package from R to convert it into a dashboard driven application.

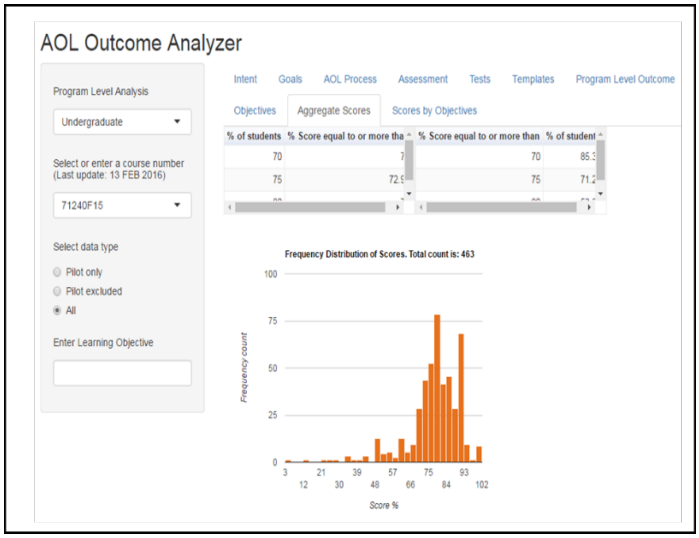

Figure 3. A screen-shot from AOL Analyzer's Data Management System showing score distribution

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