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Introduction

The landscape of technology in education has changed over the last two decades. Online learning has become prevalent. In Fall 2012, there were 6.7 million students taking online courses in higher education (Allen and Seaman, 2013) and 1.8 million in K-12 setting (iNacol, 2012) in the United States. Constant monitoring and analysis of information through learner-centered instruction and assessment are two essential conditions required for the success of today's online courses. In this study, we examine online learner-centered assessment and how it helps with online teaching and learning to measure the students' progress, and take corrective measures if necessary, through the lens of learning analytics. Learning analytics focuses on the transformation of education, by changing the very nature of teaching, learning, and assessment (Siemens and Long, 2011). Learning analytics is defined by the Society for Learning Analytics Research (SOLAR) as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" (SOLAR, p.1). In the next section, we review different types of assessments in online learning and the use of learning analytics in assessments. The term assessment is used to capture both formative assessment (activity) and summative assessments.

Learner-centered assessments shift the move from grades, marks and credits to learning, outcomes, and graduating with the skills needed as a professional. Researchers have studied assessment in online learning for a number of years (Rovai, 2000; Kim, Smith, and Maeng, 2008). In the previous years, practitioners and researchers were primarily using tests, projects as assessments, and rubrics to grade students' performance. Recently, researchers have begun promoting and advocating the use of learning analytics which is "interpretation of a wide range of data produced by and gathered on behalf of students in order to assess academic progress, predict future performance, and spot potential issues" (Johnson et al., 2011, p.28). Macfadyen and Dawson (2010) mined data from the Learning Management System (LMS) and studied the relationship between student LMS use (e.g., posting discussion messages, completing quizzes) and academic achievement. They also stated that "pedagogically meaningful information can be extracted from LMS-generated student tracking" (p.1). Fritz (2011) used the "check-my-activity" tool to study the relationship between student performance and activity in the LMS. They found that students earning a D or F used the LMS 39% less than students earning a grade of C or higher. Arnold and Pistilli (2012) used an application called signals which was developed to provide instructors the opportunity to use the power of learner analytics to intervene and provide feedback to students who were not doing well in their courses. In the next section, we review different types of assessments in online learning, and differentiate formative and summative assessments.

Learning Analytics and Assessment

Gordon Commission (2013) recommends "separate responsibility for the use of data drawn from rich descriptions of these transactions for administrative and for student development purposes. Teachers would be enabled to interpret these data diagnostically and prescriptively" (p.15). Gordon commission went further to differentiate between assessment "of" educational outcomes and assessment "for" teaching and learning. Assessment of educational outcomes, is described as the "use of assessment for accountability and evaluation" (p.xvi), and assessment for teaching and learning is described in "its use for diagnosis and intervention" (p.163) thus focusing more on its formative functions and nature. McManus (2008) from North Department of Public Instruction defined Formative assessment as "a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes" (McManus, 2008, p.3). As opposed to summative assessment,

this definition of formative assessment emphasizes the terms as a process during ongoing instruction, where both teachers and students use evidence of current learning to improve subsequent learning.

Summative assessment on the other hand focuses on assessing learning at the end of instructional unit, and comparing and benchmarking it with predefined standards. The main purpose of summative assessment is to evaluate learners' achievements with respect to previously defined expected competencies. Therefore summative assessment is used more from an evaluative purpose rather than a diagnostic one which is the domain of formative assessment. While formative assessment can be used to take corrective measures and monitor progress when learning is still happening, summative assessment is used to determine effectiveness of a program, students' achievements etc. after learning has been completed. For that purpose summative assessment places more emphasis on accountability with the assignment of a grade. In other words it "summarizes … learning for the purpose of accountability, taking a snapshot in time of their performance" (Earle, 2014, p.218). This explains why it is also referred as assessment of learning as opposed to formative assessment which is referred to as assessment for learning.

These two forms of assessment are not mutually-exclusive (Emanuel, Robinson, & Korczak, 2013). While learning analytics can play major roles in summative and formative assessments, research exploring its usage, especially for formative assessment purposes, is limited. Zupanc, Urank, & Bren, (2009) described a process where learning analytics is used for both summative and formative purposes to "disseminate … effective tools for assessing the quality of educational establishments as feedback on improvement" (p.92). The authors advocated the combination of summative and formative assessments through a balance between assessment for learning and assessment of learning.

Romero-Zaldivar, Pardo, Burgos, & Delgado Kloos, (2012) on the other hand seem to focus more on the formative assessment aspect and define learning analytics as the use of "data and any other additional observations that can be obtained, and use it to directly impact the students, the instructors and the details of the learning process" (p.1059). Referring to previous work from scholars (Maki, 2002; Banta, Jones & Black, 2009; Kirkpatrick & Kirkpatrick, 2013), the authors suggested the following process shown in Figure 1. Figure 1 depicts the process of collecting and analyzing formative and summative assessment data.

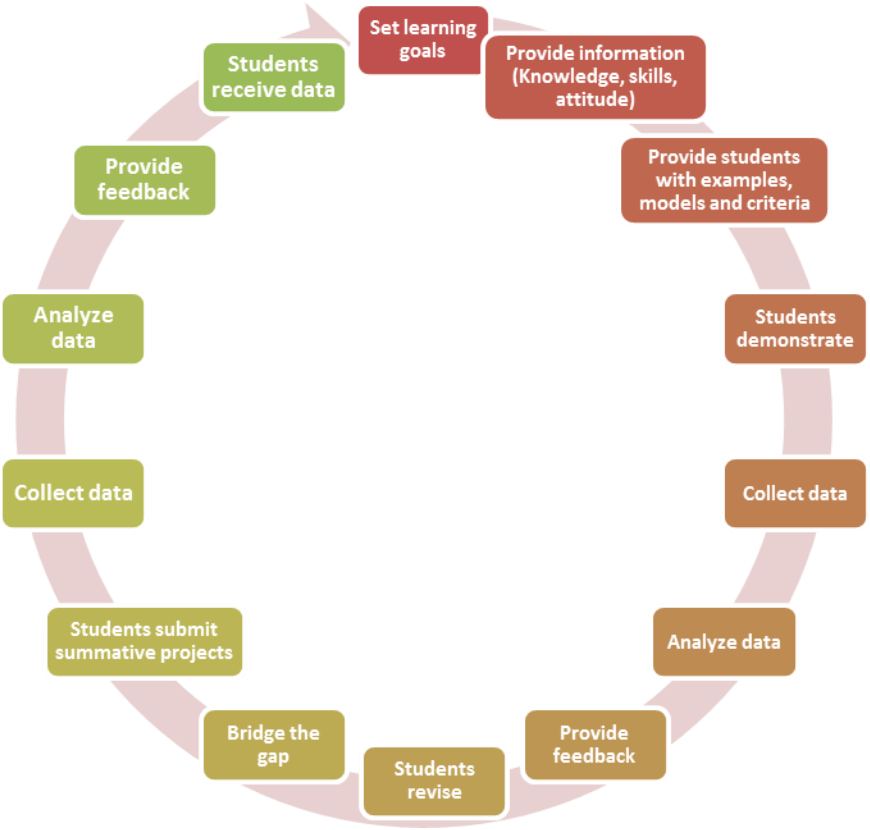

Figure 1. Steps in Formative and Summative Assessment

Assessments and Activities in Online Learning

The development of online learning in higher education requires schools and teachers to shift their thinking and practices in terms of learning effectiveness (Gikandi, Morrow, & Davis, 2011; Prineas & Cini, 2011). The asynchronously online learning courses provide opportunities for a student centered approach to learning and assessment. In fact, the online learning environment provides a platform for more performance based assessment through immediate feedback, opportunities for individual practice and guidance (Reeves, 2000). These opportunities provided by the online learning environment place educators in the ideal and most desired position of not only monitoring learning events as they happen but also the possibility to take corrective measures and adjust teaching to improve student learning (Romero-Zaldivar, Pardo, Burgos, & Delgado Kloos, 2012). Other benefits that the online learning platform provides with respect to assessment include better monitoring opportunities for student learning and immediate feedback (Buckingham & Ferguson, 2012 ; Benson, 2003 ; Romero-Zaldivar, Pardo, Burgos, & Delgado Kloos, 2012), and individual practice opportunities (Shuey 2002 ; Orme, 2004). Scholars (Blummer, 2007; Orme, 2004)) have studied assessment practices and techniques that could foster learning effectiveness and continuous improvement in an online learning environment.

Four types of online learning assessment techniques are commonly used. They include: Comprehensive-type, discussion board, reflective-focused, and project-based assessments. These assessments can be used both as a formative assessment (activity) or summative assessment.

Comprehension-type assessment: These are selected response type of assessment. In this type of assessment, students are usually given choices to select one or more answers from many. Comprehension type assessments aim for students to understand remember and/or memorize concepts and ideas (Van den Broek et al., 2005). They are mostly meant for formative type assessment as they are quicker tools to gather information that can be used to monitor student learning and make necessary adjustments (Cornelius, 2013; Wormeli, 2007 ; Tomlinson, 1999). These include assessment such as multiple-choice, true false, matching ranging etc.

Discussion board: Discussion boards are well-suited for promoting collaboration and interaction among online learners. According to Shuey, (2002), these can be used to assess skills such as reasoning, collaboration, negotiation, argumentation, and debating (clark, Sampson, Weinberger, & Erkens, 2007) and teamwork etc. This method of assessment promotes active learning and also allows student to support each other in the form of a learning community and therefore assists developing multiple perspectives (Gikandi et al., 2011; Mackey & Evans, 2014)

Reflection-focused assessments: These assessments focus not only on the correct answers of a given problem, but they emphasize the thought processes that lead to that answer (Frederick, 2002). These are assessments for which students are expected to articulate more elaborate responses to questions related to skills and knowledge learned in the course. These assessments allow students to formulate their responses using theoretical and practical knowledge. Examples of these assessments include short answers, essays, minute papers, research papers, reflection papers etc. Cumulative assessments such as eportfolios can also promote students reflective skills in addition to helping them connect different learning events and opportunities that happen during a course.

Project-based assessment: Project-based learning (PBL) organizes learning around a project and involves answering authentic, real-life challenging questions involving students in constructive investigation (Thomas, 2000). Assessing project-based learning is referred to as project-based assessment. These assessments include presentations and products. These types of products require manual grading based on rubrics. Examples of such skills include the ones requiring students to integrate different skills to create a product (a business plan, or lesson plan) or related to oral communication (i.e interacting with audience, keeping eye contact, tone of voice etc…) which cannot be assessed from written work since they require live or recorded demonstration. Projects based assessment provides an opportunity for students to work in groups or individually, and the interaction among group members can be analyzed as part of this assessment. Examples of project-based assessment in this sample course included, using livebinder to compile a list of 20 websites that they can use in their future classroom, using smore to create a flyer on computer security for the students and parents etc.

Different type of Assessments and type of Learning Analytics techniques.

The different types of assessment (comprehensive type assessment, discussion board, reflection focused and project based assessment) and the learning analytics techniques and data measures are depicted in table 1. These are some techniques that can be used but this is not an exhaustive list of all the techniques. Due to time and space constraints we provide below some example techniques.

Table 1. Different types of Assessments and Learning Analytics

Types of Assessment	Learning Analytics Techniques	Data Measures
Comprehension type assessment	Quantitative Analysis • Descriptive Statistics • Item analysis	• Current Score • Time Spent • Frequency of access
Discussion board	Social Network Analysis • Interactions between student and facilitator • Interaction among students	Interaction measures • Frequency of Posts • Length of Posts • Themes
	Qualitative Analysis • Discourse Analysis • Conversation Analysis	Quality of Posts • Use of concept and theories • Common patterns • Repeating events • Key phrases
Reflection focused assessments	Qualitative Analysis • Content Analysis, • Concept Mapping • Document Analysis	Quality of Reflection • Rationale • Multiple Perspective • Supporting theories or frameworks • Common patterns • Repeating events • Key phrases • Writing Skills • Grammatical Errors • Typos • Coherence of Ideas Quality of Evidence • Analysis of Artifacts • Type of Artifacts • Justification of Artifacts
Project based assessment	Quantitative Analysis Observation	• Current Score • Time Spent • Frequency of access

Providing Feedback in Assessments and Learning Analytics

Referring to SOLAR definition provided on the first page of this article, learning analytics seems to place a great deal of importance on feedback for teaching and learning effectiveness. The

purposes of "understanding and optimizing learning and the environment in which it occurs", as reflected in that definition, will depend mostly on providing information in the form of feedback to teachers about their teaching effectiveness and to students regarding their learning achievements. Providing feedback is very critical in any assessment and feedback provided should influence the quality of student work. ‘

Feedback is defined as “information about the gap between the actual level and the reference level of a system parameter which is used to alter the gap in some way” (Ramaprasad 1983, p. 4). Feedback has been studied for decades and several principles on feedback have been identified to facilitate learning. Nicole and Macfarlane-Dick (2004) list the following as some of the principles of feedback.

> “Feedback is used to encourage teacher and peer dialogue around learning; help clarify good performance; provide opportunities to close the gap between current and desired performance; deliver high quality information to students about their learning; and also provide information that teachers can use to help shape their teaching.” (p.3)

This paper supports the feedback model proposed by Boud and Molloy (2013) where teachers are the drivers of feedback. In online courses, there is a lot of rich data that is being captured by the learning management system. Several researchers (Price, Handley, Millar, & O'Donovan, 2010; Carless, Salter, Yang, & Lam, 2011) have developed interventions with new assessment activities to provide feedback. Learning analytics techniques encourages the use of data to make decisions that will assist student learning by bridging any gap that exists between the actual level and the reference level.

Purpose of this Study

The purpose of this study was to identify learning analytics techniques and data measures for different assessment types in online courses. Using a set of structured and non-structured data the study suggests different techniques and analysis that can be used to provide feedback that could enhance both online teaching and learning.

Method

Data Measures

Sample assessment data measures (as referenced in Table 1) were collected from a preservice instructional technology course taught at a southeastern university in the United States. The course was taught in a 15 week time period and had 7 modules. Each module included a variety of instructional components including an elearning module, a quiz, and hands on projects. There were 18 students in this online course and Table 2 below provides the names of the different modules in this course and the different assessments that were used.

Table 2. Modules in the Instructional Technology Course

Module	Module Name	Assessment
1	Technology Integration	20 websites on LiveBinder Quiz 1
2	Computer Networks, Security and Ethics	Brochure on Smore Quiz 2
3	Productivity Applications	Multimedia Program using

		PowerPoint Quiz 3
4	Hardware for Educators	Budget on Word Quiz 4
5	Curriculum Integration	Smartboard lesson using Smartnotebook Quiz 5
7	Online Teaching	Online Lesson on Edmodo Quiz 6
8	Eportfolio Technologies	Eportfolio on Weebly Quiz 7

The types of assessment provided in Table 1 could generate quantitative or qualitative data depending on their nature and set up. In this section, different techniques will be presented for both types of data.

Tableau© for Quantitative Data Analysis and Visualization

The data was imported into a data visualization tool, Tableau©. Different visualization techniques were applied. Below is a screenshot of the tableau© software. The analysis techniques shown in this article aim to provide instructors with an opportunity to connect different pieces of information that can support and inform their decision making in their efforts to formatively evaluate teaching and learning and provide feedback to students for more effective teaching and learning. Figure 2 is a screenshot of the data analysis tool tableau© which was used to conduct quantitative learning analytics.

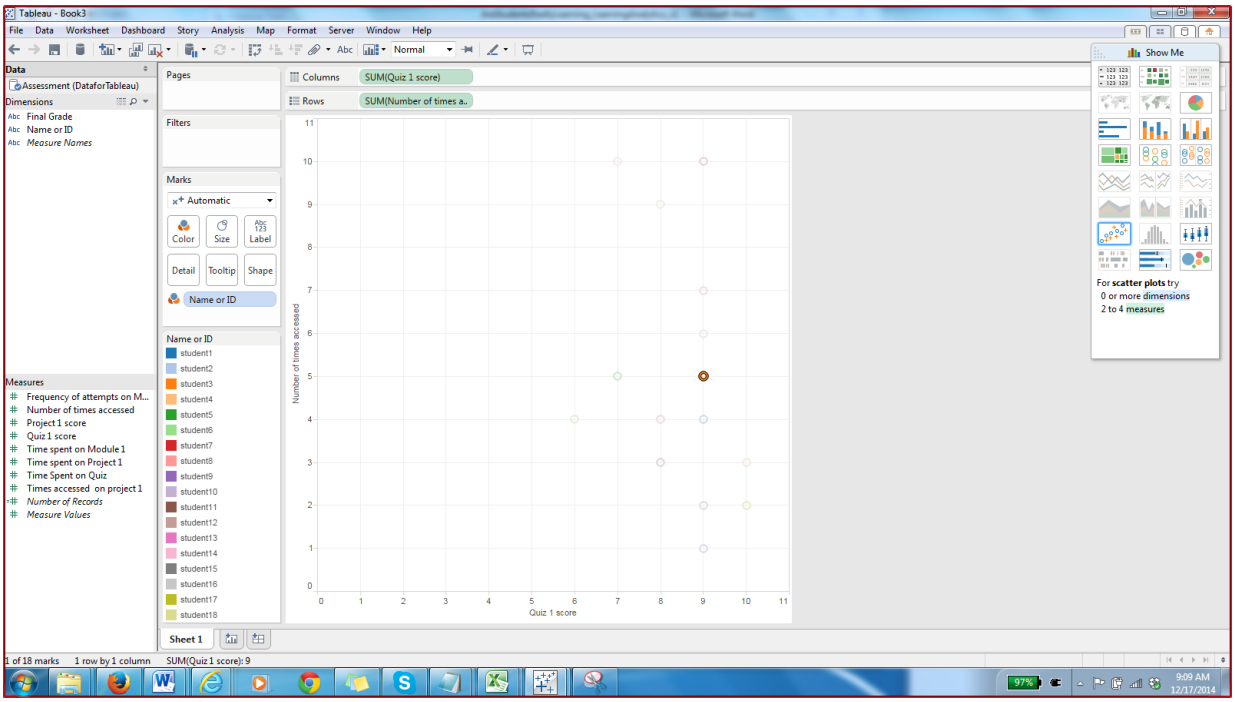

Figure 2. The Tableau© Screen

ManyEyes© for Qualitative Data Analysis Visualization

Qualitative data were imported into IBM's ManyEyes© to run different visualization techniques. Below is a screenshot (Figure 3) of the Manyeyes Visualization tool.

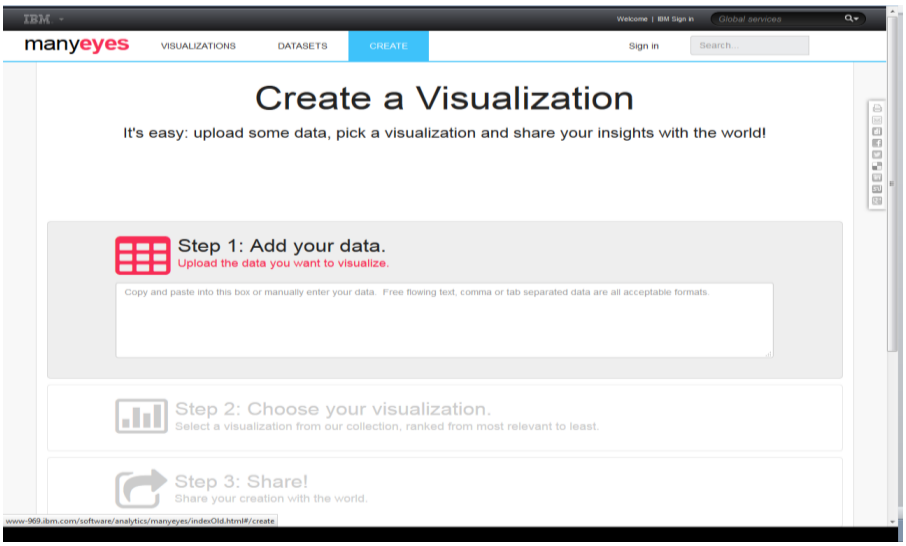

Figure 3. Screenshot of Many Eyes©

Results

Comprehension-Type Assessment

Two different example analyses are presented for comprehension type assessment. Time spent 1 on quiz 1, quiz1 score and frequency (number of times) of access were tabulated and a whisker plot was drawn (see Figure 4). The maximum score that a student could earn in quiz 1 was 10 points. The quiz included 10 multiple choice items with four item responses. Since this course was offered 100% online, the students had the option to take this quiz open book. There was no time limit set for them to complete the quiz. The whisker plot provided representation of variables by providing the median values for each one of them. In this visual below, the median time spent on the quiz is between 0.03 and 0.35 (hours), and the median quiz 1 score is between 8 and 9 points, and the median for the number of times accessed was 4. Analysis like this can provide instructors with useful information on students' behavior. For example if you look at the element "number of times accessed" the figure shows that he lower quartile is 3 times and the upper quartile is 6 times meaning half of the students (50%) accessed the quiz between 3 to 6 times. The average score is 8.44 with the minimum score being 6 and the maximum score being 10. Such information could be useful and meaningful for instructors, as it could be used to benchmark students 'scores and practices (i.e. time spent on a quiz) to analyze and understand students' performance in a course. In each of the three areas (time spent on quiz, Quiz 1 score, and number of times accessed), the dots outside the box represent outliers.

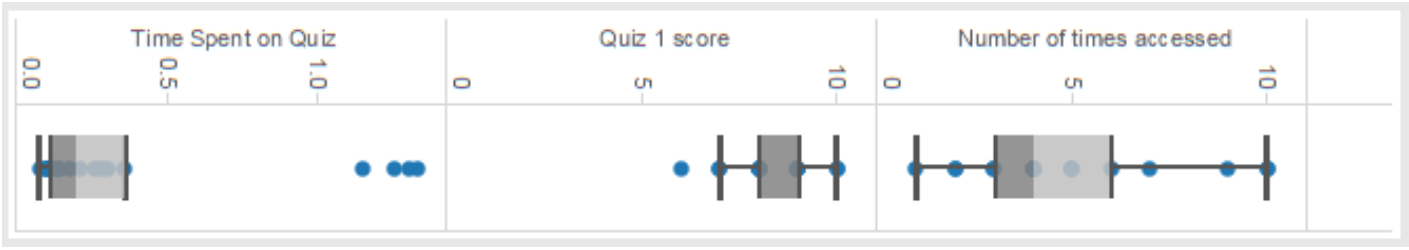

Figure 4. Box and Whisker Plot depicting time spent on Quiz 1, Quiz 1 score and Frequency (number of times) of Access of Quiz 1

Following this preliminary analysis, we looked at the possible relationship between the number of times the quiz was accessed and the quiz score (see Figure 5). The goal of this analysis is to identify the type of information that might be useful to an instructor. For example the visual shows that, the student who scored 6 points on the quiz, accessed it four times, and another student who scored the highest accessed it between two or three times. From examining the visual, an instructor might be able to relate pieces of information such as how many times a student accessed an assignment with their final score on that assignment in an attempt to understand factors that might influence a student's performance. This scatter plot can benefit an instructor as it can be used to relate or explain student performance with respect to all these behaviors, therefore help provide students with targeted feedback they can use to improve their learning performance. Different variables can be entered in the rows and columns of tableau© and different representations can be drawn. For example, figure 5 tells us how many times a student accessed the quiz but does not tell us how long they stayed.

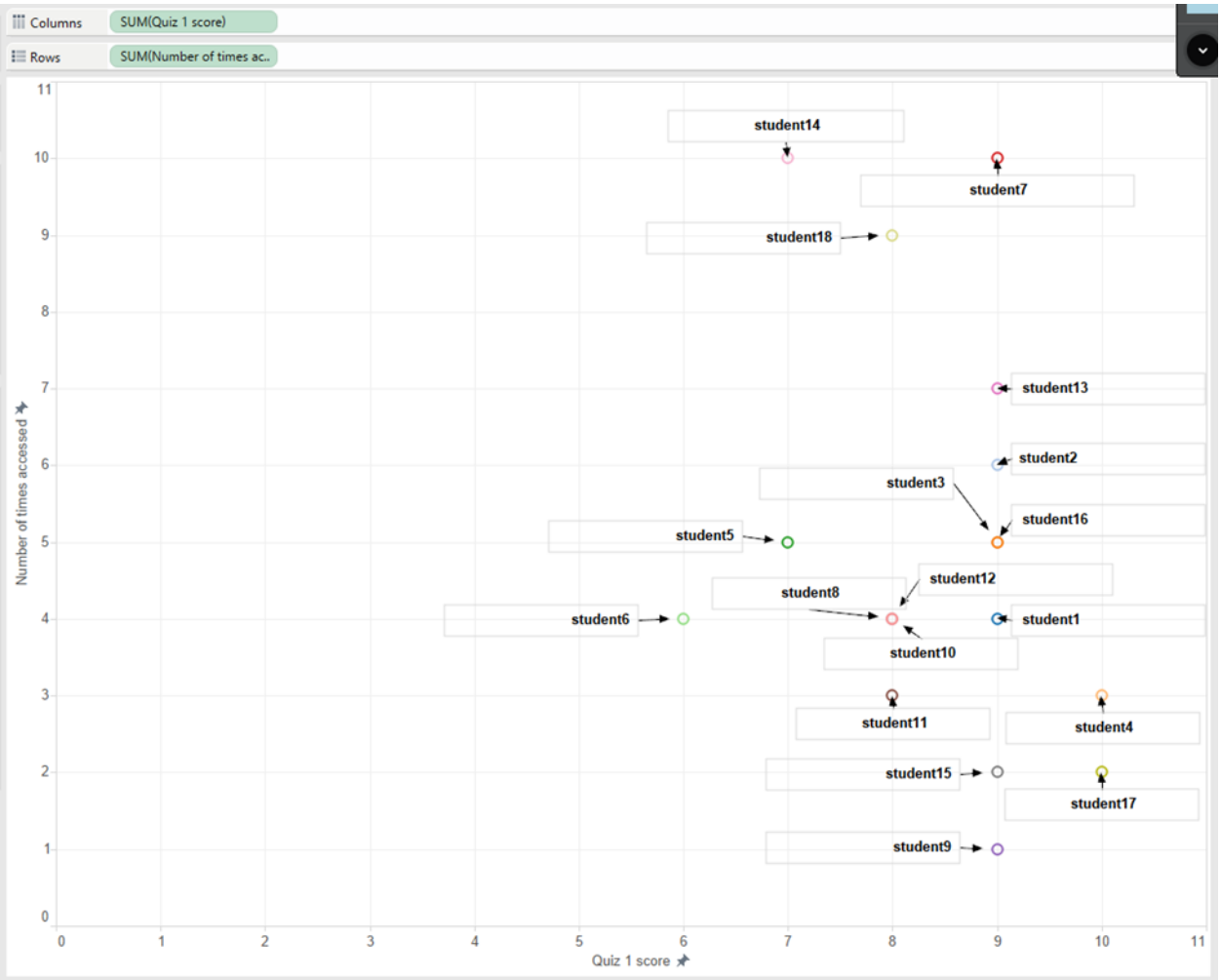

Figure 5. Scatter Plot depicting Quiz 1 score and number of times accessed

Further analysis was conducted by relating quiz 1 score and time spent (figure 6 below). With such analysis an instructor could follow individual students to detect patterns. For example students 5 and 6 who got one of the lowest scores on figure 5, accessed the quiz 4 times and 5 times respectively but did both only spent less than 0.2 hours, and their scores of respectively 6 and 7 are both below the median quiz 1 score which is between 8 and 9 points reported earlier in figure 4, and also below the average score of 8.44.

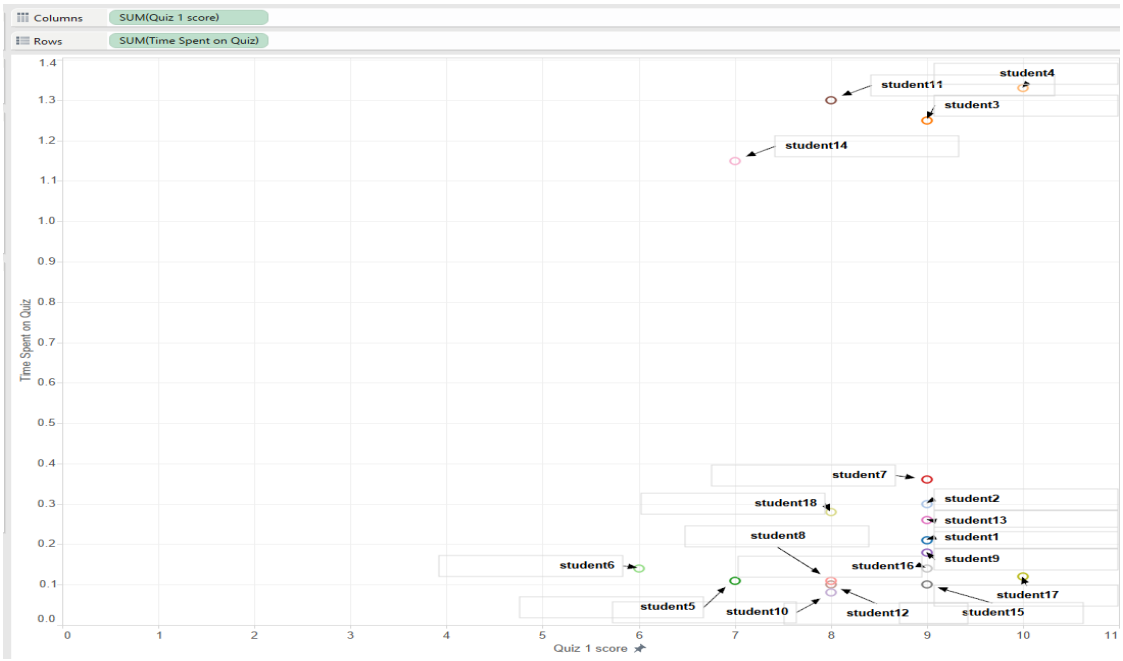

Figure 6. Scatter Plot depicting Quiz 1 score and time spent

Figure 7. Bullet graph depicting frequency of access of Module 1. Higher the frequency of access, bigger the bullet size

This could indicate that these students though accessing the quiz are not spending enough time on it. Therefore feedback for these students could be modeled around taking enough time to complete the quizzes. Student 14 who also has one of the lowest scores (7) which is below the average score of 8.44 and accessed the quiz 10 times (figure 5), spent more than 1 hour. This also could indicate that this student though coming in frequently did not spend enough time every time she or he accessed the quiz. Student 4 on the other hand who has one of the highest scores accessed the quiz about 3 times and spent a little bit more than 1.3 hours. Students 17, 15 and 9 on the other hand show a different pattern as they accessed the quiz fewer times (no more than twice), spent no more than 0.2 hours and ended up with some of the highest scores. An instructor could use all of this information to develop more targeted support, feedback and instruction if needed. For example feedback for student 6 might be focusing on spent ding more time and figuring out the reasons why she or he did not spend enough time. Information collected through this feedback process and dialogue could be used to adapt instructions and teaching for these students if needed.

Project-Based Assessment

Time spent on project 4 and Project 4 score was tabulated and side by side bar analysis was performed. The grades that the students earned were distributed between 11 and 15. There was one student who received no points. The average score was 13.16 with the minimum score being 11 if we exclude the student with a 0 and the maximum score being 15. With the information such as the one represented in Figure 6, an instructor can analyze students' score with respect to how much time they spent on this assignment to see if there might be any emerging patterns, as well as feedback for him or herself and the students. Moreover an instructor could use this information to answer questions such as whether time spent affect a student's score or what seems to be the optimal time spent for a student to achieve a high score?

A bullet graph (see Figure 7) is another way to provide an instructor with a quick glance at the frequency of access to show who accessed it the most and who accessed it the least based on the size of the bullet. From the above visual, student 18 had accessed module 1 the most number of times, whereas student 5 and 9 had accessed it the least number of times. This information could be useful for an instructor who would like to detect any patterns of continued and sustained efforts in learning. Information provided in Figure 7 could be related to other students' behavior or performance. For example an instructor could use this information not only to give students' feedback on their performance but also on their efforts and participation. Additionally similar analysis as the ones conducted for quiz 1 was also performed.

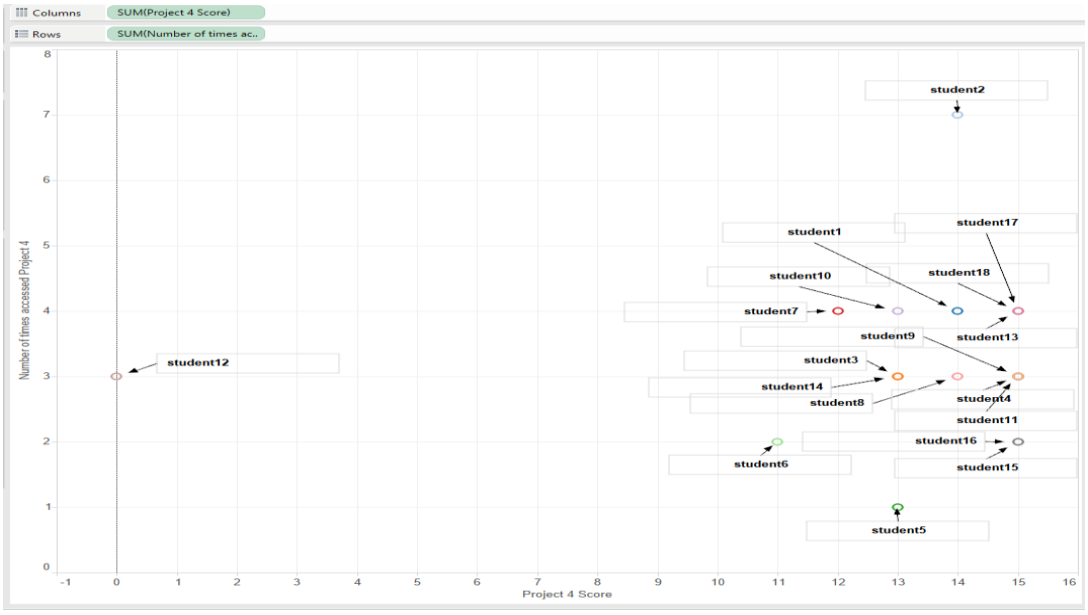

Figure 8. Scatter Plot depicting Project 4 score and number of times accessed

Using information reported on figure 9, an instructor could see results indicating that student 6 is again the one with the lowest score and also among the ones who access the project 4 the least (2 times). Further that same student 6 only spent 2.5 hours on the project (see figure 10 below). Student 4 accessed the project 3 times and spent 3.5 hours and consequently earned one of the highest scores.

Student 14, who had one of the highest accesses on the quiz and the lowest scores as well, shows a different pattern for the project which he or she accessed only 3 times (figure 9) and got a score of 13 out 15 slightly below the average of 13.16. Comparing the results on figure 9 and figure 10, it appears that most of the students who got the highest scores (students 11, 18, 17, 4 and 15) spent at least 3.5 hours on the project which they accessed at least twice. Students 16 and 13, on the other hand spent less than 1 hour even though they earned some of the highest scores. A quick glance at figure 9 also revealed that those are among the students with the highest frequency of access of module 1 which was the content related to the project. Moreover a comparison between figures 5 and 8 show that students 7 and 18 shows a pattern of high frequency of access for both the quiz and project. Student 15 on the other hand seems to show a pattern in low frequency of access for both the quiz and the project.

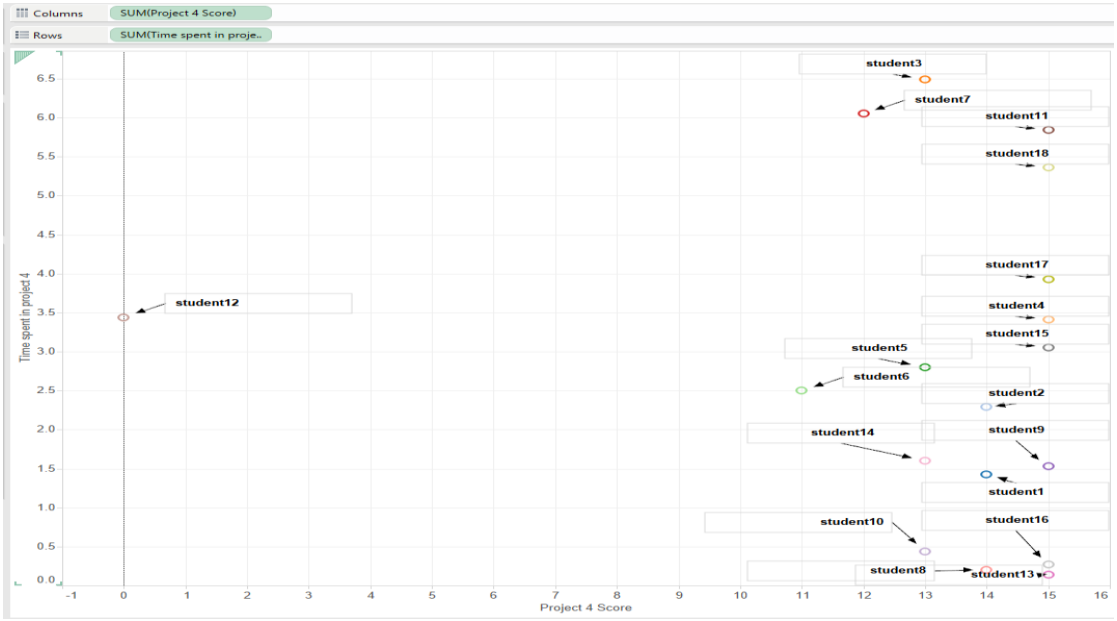

Figure 9. Scatter Plot depicting Project 4 score and time spent

Reflection-Focused Assessment

Assessment for reflection-based assignments can focus students' use of key phrases as indicated in Table 1. In this case students' reflections were collected from their e-portfolio and entered in Many Eyes©. Figure 10 below shows the main key words and concepts most used by students. The bigger the font size of the words, the more frequent its use by students. It shows the words *students, children, educator and standards* were the most represented ones in the reflections. This analysis could be used by instructors especially if they want to see students' usage of certain key words and concepts. For example in this case, the higher frequency of words such as children, educator and standards, could be due to the fact that students in this case were teacher candidates, as these are very important concepts in the teaching profession. The same analysis could have revealed other words or concepts in different fields.

Results can be sorted in different ways, such as order of appearance, by frequency, alphabetically etc. Results displayed are also interactive and it is possible to eliminate some of the least represented keywords from the analysis. Similar analyses can be conducted using other software such as Excel Textalics which can perform topics extraction to see which topics are the most common, text classification etc.

Figure 10. Word Cloud visualization of key words used by students in their eportfolio reflections.

Discussion Board Assessment

Similar analysis can be conducted with discussion topics. Analysis can reveal most common words, types and categories of words used. For the introductory discussion, students were asked to introduce themselves using the discussion board. Along with introducing themselves, they were also asked to share what they hope to learn from the course, and share something or someone special to them. In the example below, students introductory statements from an online class were entered into many eyes©. From the Figure 12 below, it appears that students in this class refer to family or other words related to family such as sisters a lot in their introductions to other classmates in response to something or someone special. This type of information can be very useful for instructor to have a better understanding of the types of students they have as well as background information and other factors that may affect learning in the classroom. For example results from the Figure 11 below might suggest that students in this class place a lot of emphasis on family.

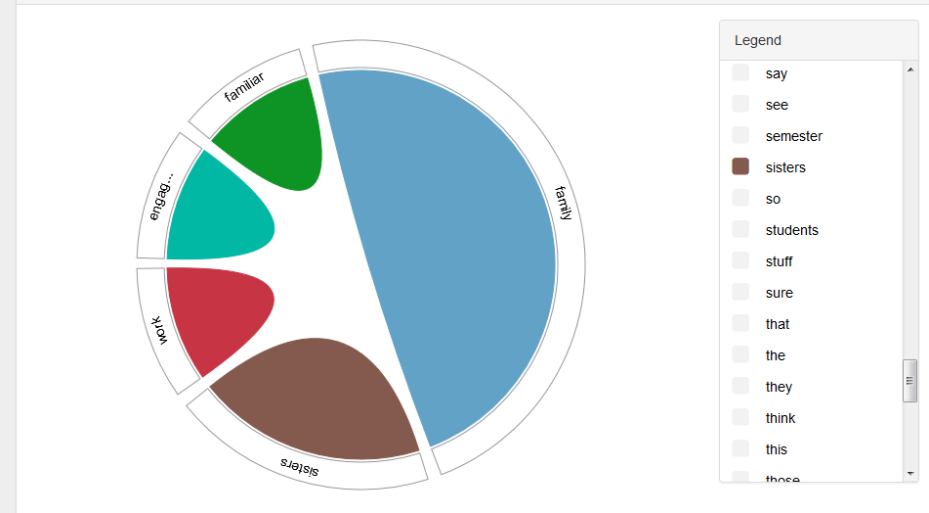

Figure 11. Chord Chart Visualization of Introduction discussion posts

Discussion

This article provides guidelines and suggestions for the necessary shifts in how instructors, especially those involved in online learning, need to approach student learning using all available and meaningful data at their disposal. The main characteristics of such shifts are to promote simultaneous and instant use of data for feedback to students as well as effective decision making during learning as opposed to using such data only after the learning event. With learning analytics techniques, such as the ones displayed here, the instructor no longer need to wait for the end of the course to download and analyze the data. The instructor also does not have to wait for another employee to run these analyses. The instructor can download the data, analyze it, draw conclusions, and act on it immediately as learning is happening. This possibility to act on instantaneous data places the instructor at an ideal position in the quest to improve student learning (Arnold & Pistilli, 2012; Becker, 2013). Further this type of information can help online instructors predict and identify at risk students and therefore develop strategies to remedy the situation.

Data displayed in the figures above can help instructors gather longitudinal data in order to observe trends and follow each student, especially in small groups. For example follow student 6 online behaviors and practices could be traced through the quiz and the project to detect patterns.

Based on the examples, analyses and tools shown above, learning analytics could have multiple benefits for online course instructors as well as students. Online course instructors can use multiple assessment techniques through the lens of learning analytics to support student learning through data driven decision making model. According to Dietz-Uhler and Hurn (2013), learning analytics can be used to monitor student behaviors and promote their success in online learning. This is very important in online learning format given the fact that the instructor might not have the time to meet with students as regularly as one would in a face to face course. Therefore the instructor would need to have access to meaningful information that would allow quick reaction. For example from the figures above, an instructor could have an array of information available to see if there are any patterns or useful information such as how much time students spent or how

many times they access the quiz and their final score. Information of this type can help an instructor to find trends and decide what types of actions need to be taken to address shortcomings or build on potential benefits. For example, using the information provided in figure5 and 9, an instructor could detect pattern that student 6 not only had the lowest score on quiz 1 but is one of the student also who accessed the quiz the fewest. With such information, an instructor could reach out to that student via email, phone call, or even a skype meeting to help identify barriers and issues preventing access as well as expected performance. Instructors could even suggest a face to face meeting with such a student if it is convenient for both of them, regardless of the course being online. However, with such a small sample in this case study inferential claims cannot be made. If teaching large class sizes and if vast volumes of data are available these types of inferences can be made.

Similarly instructors of online courses can gather information from students' introductions to see what type of students are enrolled in the class, what things do they seem to value, and what factors might interfere with their learning. All this information once gathered from analysis like the Chord Chart in Figure 10, can be used by online instructors to better understand students' background that otherwise would have been difficult to have access to without a face to face meeting with students. Using this type of information online course instructors can help students develop more personalized learning based on their background and circumstances to improve learning (Shum & Ferguson, 2012; Zupanc et al., 2009). Gathering and acting on information obtained from students 'interactions can be related to what Shum and Ferguson, (2012) refer to as social learning analytics. According to the authors social learning analytics could be understood as type of analytics "that draws on the substantial body of work demonstrating that new skills and ideas are not solely individual achievements, but are developed, carried forward, and passed on through interaction and collaboration" (p.5).
The instant and immediate feedback that could be derived from learning analytics techniques and tools such as the ones shown above could be very beneficial to students and instructors. One of the major benefits is that these learning analytics provide students with the availability of immediate and instant feedback they can use while still working on their assignments or projects. In that sense instructors will become more proactive in terms of identifying factors that can influence learning and acting on them for the benefit of the students.

While learning analytics in general can be very helpful to an instructor in supporting student learning, practitioners need to be aware that it does have some limitations in terms of observing or monitoring what happens outside the learning management system. This might be the reason why there seems to be no clear patterns at times between scores and time spent or number of times accessed. For example time students spend reading textbooks, or other materials to help them complete a project are is an important aspect of motivation and a factor that contributes to learning but yet cannot be captured with learning analytics in its current form. Similarly students' abilities to engage in reflective activities, to regulate their own learning through goal setting, to monitor and evaluate the quality of their work are also important factors of learning that are not captured in learning analytics (Winne, 2010). Students This It is to address these limitations that scholars (Winne & Peery, 2000) suggested to consider learning as an event and that processes that happened during such event can assessed through students' self-report and recounting of them. This is one of the reasons, the researchers suggested individual one on one meeting with student 6 as one of the ways to account for such factors.

Implications and Future Directions

The goal of this article is to report the results of a small case study of 18 students in an online environment. Some of the data available from the 18 students' use of the online learning platform are exported and quantitative and qualitative visualizations of learning analytics data are presented. Furthermore, the information and feedback provided through the use of learning Analytics data for assessment in online and blended learning could be of great importance to all stakeholders.

As an instructor, taking the time to review the learning analytics data on student activity and assessment was meaningful though the class size was small. It helped identify the students who were very active in the online class and were spending a lot more time in the Learning Management System. It also helped identify students who were not as active and who I needed to reach out to both in terms of performance and engagement. Analyzing the data helped with the implementation of similar courses and in designing the assessments in a way that is more beneficial to the students. As an instructor, if I noticed that there was a student who was struggling with a particular module, I reached out to the student to provide additional support. I was also able to reach out to inactive students early on, rather than waiting until the end of the semester to provide support and develop remediation strategies.

While instructors may use such information for effective online teaching, students can also use it to enhance their learning. Instructional designers may use this information to recommend best practices in online course design. Administrators may use this information to design successful online programs. Educational researchers may use this framework to analyze data from the various online assessments within the learning analytics framework. Bringing together these points of view will help improve online teaching and learning.

Future directions for this study will be to conduct research on the effectiveness of these tools. The authors also plan to implement the various data analyses techniques in large enrollment classes in the future.

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