

Graphical Tool for Formative Assessment with the Moodle Quiz Module

Kahori OGASHIWA ^{a*}, Yoshihiko HAMAMOTO ^b, Yue WANG ^a,
Joji KARIYA ^c & Kakuji OGAWARA ^{a,d}

^a*Media and Information Technology Center, Yamaguchi University, Japan*

^b*Graduate School of Medicine, Yamaguchi University, Japan*

^c*Emeritus Professor at Yamaguchi University, Japan*

^d*Graduate School of Science and Engineering, Yamaguchi University, Japan*

*ogashiwa@yamaguchi-u.ac.jp

Abstract: In this paper, we present a graphical tool that we have developed for the visualization of quiz results in Moodle; it is intended to assist in effective formative assessment. This tool helps to conduct cluster analysis and displays the results in the form of a line graph. In traditional classes, students attempt quizzes, and in each case, the teachers will, using formative assessment, analyze the quiz results and subsequently use the knowledge thus gained to improve their teaching. Although this approach is highly effective, it substantially increases the workload of a teacher. The graphical tool developed on Moodle enables a teacher to form views on a student's comprehension of the material covered, by visualizing the quiz results.

Keywords: E-learning, Learning analytics, Formative assessment, Visualization, Moodle

1. Introduction

Formative assessment is renowned as an effective strategy that helps students achieve high standards (OECD, 2005). Many teachers make practical use of formative assessment; however, there have been only few systematic studies of such work. To realize an educational formative assessment, a tool that visualizes the current system of education is required, and whose usefulness is already known. Many graphical data mining tools that utilize the data of LMSs (learning management systems) have been developed (Dyckhoff, A. L., 2012, Pedraza-Perez, R., 2011, Romero, C., 2008). These tools are very useful to a teacher who specializes in data analysis, and to a teacher who studies a specific educational activity. However, these tools are not easy to use for all teachers. Therefore, we developed a tool that all teachers can use easily.

In the literature, many examples of the practical use of formative assessment with LMSs are available (Olle Bälter, 2013, C. Chen, 2009). That is because a quiz module is included, as a standard, in almost all LMSs, and it can easily be used by teachers; in particular, the grading of most questions can be automated. Nevertheless, gaining satisfactory knowledge of students' understanding requires substantial time and effort. We have developed a graphical tool, based on Moodle as an example LMS, for reducing the time (and effort) involved in carrying out formative assessment. Moodle was adopted owing to its familiarity to the teaching community. The tool also increases the effectiveness of such an assessment.

2. Moodle Quiz Module

The Moodle quiz module has several types of questions, such as multiple-choice questions, true-or-false questions, and description-based questions. With the exception of description-based questions, most questions can be graded automatically, and the results can be made available to the teacher (Figure 1). In the example shown in Figure 1, four questions are solved by each student and graded. The student scores are then averaged.

Attempts: 3

Showing graded and ungraded attempts for each user. The one attempt for each user that is graded is highlighted. The grading method for this quiz is **Highest grade**.

	First name / Surname	Started on	Completed	Time taken	Grade/20	#1	#2	#3	#4
☐	1 Student	16 May 2013, 08:05 PM	16 May 2013, 08:06 PM	1 min 4 secs	17	5/5	3/5	4/5	5/5
☐	2 Student	16 May 2013, 08:07 PM	16 May 2013, 08:07 PM	47 secs	12	3/5	4/5	2/5	3/5
☐	3 Student	16 May 2013, 08:11 PM	16 May 2013, 08:12 PM	45 secs	12	2/5	2/5	3/5	5/5
	Overall average				13.67	3.33/5	3/5	3/5	4.33/5

Figure 1. List of students' scores

3. Formative Assessment using the Developed Graphical Tool

a. Approach (Outline)

The method of formative assessment that we propose consists of three phases: (1) students attempt a quiz in a class; (2) the teacher analyzes the students' results; (3) the results of this analysis are used to improve the next class. The visualization of students' results is included in the second phase, with line graphs as a primary feature.

b. Visualization using Line Graphs

To find students who have made similar mistakes on a quiz, we conducted a cluster analysis. The crucial step in the application of this cluster analysis is the interpretation of the clusters obtained. By visualizing the patterns of similar mistakes as line graphs, one can validate the interpretation drawn from the analysis. Line graphs are used for visualizing the students' results. Each student was given four questions, which were then described as a four-dimensional vector whose components are the students' scores for each question. The X-axis of these graphs indicates the question numbers, the Y-axis shows the students' scores, and a single line graph corresponds to one cluster (Figure 2). In the example in Fig. 2, 20 students were used in the cluster analysis and partitioned into three clusters using the k-means method. Students in the same cluster made similar mistakes. The average student scores in each cluster are displayed by the line graph. The number "9" in Cluster1(9) refers to the number of students classified into Cluster 1. These graphs provide multiple viewpoints that should help a teacher to analyze. For example, a teacher can readily identify patterns in the mistakes made by students in the same cluster.

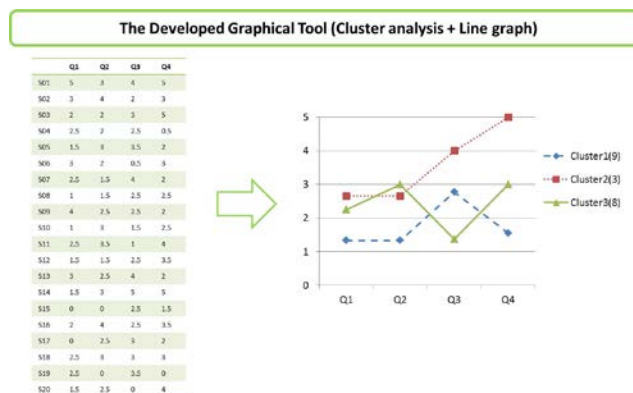


Figure 2. Example of visualization using line graphs

c. Use of the Developed Graphical Tool

A brief explanatory example of the use of the graphical tool has been provided here. The tool alters the existing Moodle quiz module in a way that ensures that the method of using the Moodle quiz module remains unaltered (Jonathan Moore, 2010). As a standard function, the Moodle quiz module provides a

table (Figure 1) for teachers to obtain feedback from the students' results. The graphical tool we have developed includes a line-graph display as an additional function (Figure 3).

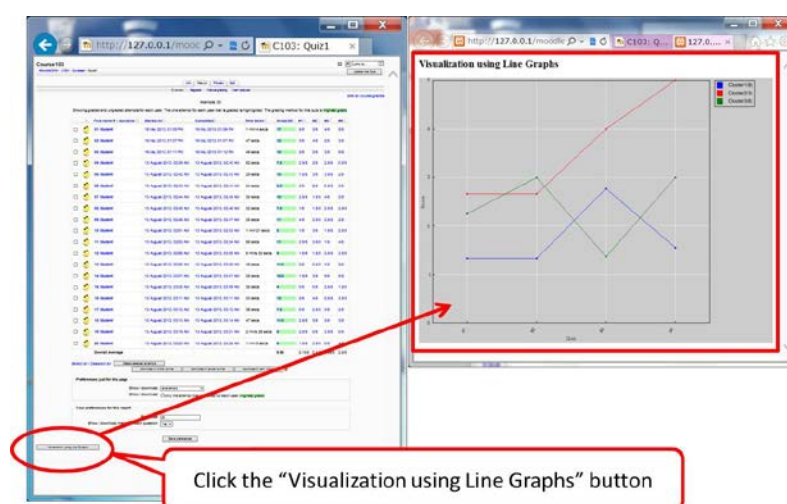


Figure 3. Screenshot of the developed graphical tool

4. Conclusions

In this paper, we presented a graphical tool on Moodle to help teachers perform effective formative assessment. This tool identifies and visualizes patterns in the mistakes that students make. The tool supports visualization of students' quiz results, and it is expected to aid teachers to easily measure the levels of comprehension amongst their students. The use of this tool may correspond to improvements in students' achievement. For future work, we intend to use questionnaires and other means to verify the effectiveness of this graphical tool. We will also investigate the use of visualization in statistical pattern recognition and other fields.

Acknowledgements

This research was supported by a Grant-in-Aid for Young Scientists (B) No.24700898 (2013) from the Japanese Ministry of Education, Culture, Sports, Science and Technology.

References

- Bälter, O., Enström, E., & Klingenberg, B. (2013), The effect of short formative diagnostic web quizzes with minimal feedback, *Computers & Education*, 60(1), 234–242.
- Chen, C. & Chen M. (2009), Mobile formative assessment tool based on data mining techniques for supporting web-based learning, *Computers & Education*, 52(1), 256–273.
- Dyckhoff, A. L., Zielke, D., Bültmann, M., Chatti, M. A., & Schroeder, U. (2012), Design and Implementation of a Learning Analytics Toolkit for Teachers. *Educational Technology & Society*, 15(3), 58–76.
- Moore, J. & Churchward, M. (2010), *Moodle 1.9 Extension Development*, Packt Publishing.
- OECD (2005), *Formative Assessment: Improving Learning in Secondary Classrooms*, OECD Policy Brief, November, OECD, Paris.
- Pedraza-Perez, R., Romero, C., & Ventura, S. (2011), A Java desktop tool for mining Moodle data. In M. Pechenizkiy et al. (Eds.), *Proceedings of the 3rd Conference on Educational Data Mining 2011* (319–320). Eindhoven, The Netherlands: International EDM Society.
- Romero, C., Ventura, S., & García, E. (2008), Data mining in course management systems: Moodle case study and tutorial. *Computers & Education*, 51(1), 368–384.