

Design of an Assessment Tool for Courses Offered Using Blackboard



Suban Krishnamoorthy¹, Zhenguang Gao²

¹Computer Science, Framingham State University, Framingham, MA 01701, USA
 skrishnamoorthy@framingham.edu

²Computer Science, Framingham State University, Framingham, MA 01701, USA
 zgao@framingham.edu

Abstract: The features available on Blackboard to assess a course are not directly suitable to compute the extent of student learning and its contributions to the program. This paper describes the design of a tool to assess a course using the course data available on Blackboard and the data the instructor creates. The instructor data indicates the contributions of various questions to course objectives and the level of contributions of course objectives to program objectives. Relevant data to be processed is downloaded from Blackboard into Excel readable files. Macros are created with VBA to process the downloaded data. Needed charts are generated to easily visualize the outcome of the course. Weighted values are used to indicate the contributions of the course to the program objectives.

Keywords : Blackboard, course assessment tool, design, online course

INTRODUCTION

Many institutions offer online courses using Blackboard. In some schools even in-class course assessment information is kept on blackboard. All the course data including assessment information such as homework, quizzes, exams, projects, extra credit, and discussion board participation points are kept on blackboard. The assessment related features available on blackboard do not provide the kind of information that the instructor, the department and the institution wants. Hence, the relevant data has to be extracted from blackboard and processed to generate the needed information and reports. This paper describes the design of a tool for assessing an online course offered using blackboard.

The course data is downloaded to a computer and stored in one or more files in a form that can be read by Microsoft Excel. They are processed in Excel and needed assessment information and reports are generated. The rest of this paper describes the design methodology, steps for downloading assessment related data, various computations performed and reports generated.

In this paper quiz and exam are not differentiated from assessment point of view. Therefore, in the rest of the paper the term exam is used to represent either quiz or exam.

TERMINOLOGIES

In this paper the terms 'objective' and 'outcome' are defined as follows:

Objective: An objective is a goal to be achieved or aimed.

For example, one objective in an operating system (OS) course could be: "after taking the OS course, the student should be able to explain what an operating system is". All objectives should be stated in a way that they are measurable.

Outcome: An outcome is the actual result obtained for an objective. ACM CS2013 document states outcomes as, "outcomes indicating the intended level of mastery" [1]. It is the reflection of the students learning or performance in the course. For the above OS objective, if 8 out of 10 students in the course are able to explain what an OS is then the outcome is $8/10 = 0.8 = 80\%$. Objectives are assessed using a set of criteria. For example, the

objectives of a course may be assessed using homework, projects, exams, quizzes, presentations and optionally, extra credit work. Evaluation of these gives the outcome for each objective of the course.

Mission: A mission is similar to an objective however described at a broad level whereas an objective could be very specific. A set of objectives supports the mission.

The small business chronicle [2] defines mission and objective as,

“The differences between an objective and a mission statement are vast, but subtle. While the mission statement expresses the big picture, the objective is more grounded and more attainable than the mission. The mission statement is supported by objectives. The objectives are designed to make the

broad-minded mission statement an achievable one.” [3].

Invariably an institution has a mission statement. In some institutions, each program offered has a mission statement.

HIERARCHICAL ASSESSMENT STRUCTURE

Assessment is a hierarchical structure as shown in Fig. 1. The institution’s mission is at the top and course at the bottom. Courses support programs and programs support institution’s mission. In some places, there may be program objectives under program mission and in other places program mission and objectives may be one entity.

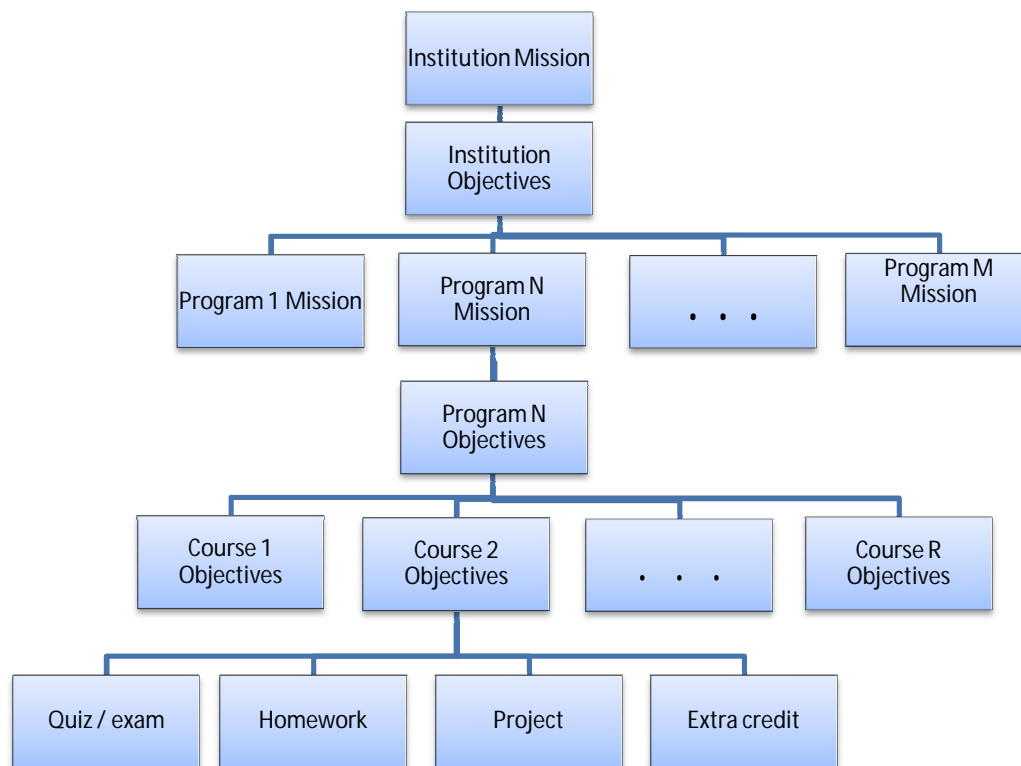


Fig 1: Hierarchical Assessment Structure

COMPUTATION OF COURSE OUTCOME

Course Assessment: A course is assessed using one or more of the following mechanisms:

- Exams and quizzes.

- Assignments (also called homework)
- Projects
- Class presentation
- Discussion board participation

Using both exams and assignments to assess a course is common.

Exams: In this paper, it is assumed that the exams are multiple choice questions. However, it is possible to have explanatory written questions also in the exams; the approach outlined in this paper can be applied for this case also.

Assume there are N questions in an exam. Each question contributes to one or more course objectives. In this paper, we will assume that in a multiple choice exam each question contributes to one objective only. For each exam Q_i , a vector OQ_i is defined as follows indicating the objectives satisfied by the N questions in the exam:

Let,

N be the number of questions in the exam Q_i

M the total number of course objectives

O is the list of objectives in the course numbered 1 to M

$OQ_i[j]$ is the objective satisfied by the question j in the exam $Q_i \forall j=0$ to $N-1$, and $OQ_i[j] \in O$

Table I shows sample entries for $N=5$ questions and $M=3$ objectives

Table I: Vector OQ_i

1	2	3	4	5	← Question#
2	3	1	3	1	
0	1	2	3	4	← Index

Total number of questions $TOQ_i[k]$ in Q_i contributing to an objective k can be computed as follows:

for ($k=1$; $k \leq M$; $k++$)

{ // for each objective k

if($OQ_i[j] == k$)

$TOQ_i[k-1]++$; $\forall j=0$ to $N-1$;

} // end for k loop

Table II shows the values of TOQ_i for values in Table I.

Table II: Vector TOQ_i

0	1	3	←Index
2	1	2	
1	2	3	←Objective#

Total number of questions $TO[k]$ in the course contributing to objective k can be computed as:

Let,

R be the number of exams in the course.

$TO = 0$; // Vector of size M

for ($k=0$; $k < M$; $k++$)

{ // for each objective

$TO[k] = TO[k] + TOQ_i[k]$

$\forall j=0$ to $R-1$; // for each exam

} // end for k

Computation of Outcome from Exams

The outcome, which is the actual student responses to exams, can be computed as follows.

The total number of correct answers AOQ_i in the exam Q_i contributing the various objectives can be computed as follows:

Let,

S be the number of students in the course

AQ_{ix} is the N answers to exam Q_i by student x

AQ_i be the $N * S$ answers to questions in the exam Q_i by all S students

$AOQ_i = 0$; // vector of size M

for ($x=0$; $x < S$; $x++$)

{

for ($j=0$; $j < N$; $j++$)

{ // for each question

if($AQ_{ix}[j] ==$ correct answer)

{ // OQ_i is the objectives satisfied by questions in exam Q_i

$AOQ_i[OQ_i[j]]++$;

} // end if

} // end for j

} // end for x

Total number of correct answers $AO[k]$ in the course contributing to objective k in all the exams can be computed as:

Let,

R be the number of exams in the course.

$AO = 0$; // vector of size M

for ($k=0$; $k < M$; $k++$)

{ // for each objective

$AO[k] = AO[k] + AOQ_i[k]$; $\forall j=0$ to $R-1$

} // end for k objective

Let, TO[k] be the total number of questions in all exams for objective k in the course.

The ratio of AO to TO gives the actual outcome from exams as a fraction; it can be expressed as percentage also. It can be computed as follows:

Let,

PO of size M be the outcome expressed as percentage from exams

M is the total number of objectives

PO = 0;

PO[i] = AO[i] / TO[i] * 100; $\forall i=0$ to M-1

A report in the form of a chart can be produced from PO.

Assessing Assignment and Projects

An assignment (homework) or a project often contributes to multiple objectives just like an exam. The scheme outlined above can be used to compute outcomes for these as well. The computation will be similar to exams.

By combining the outcomes from all assessment criteria, the course outcomes can be computed.

ASSESSMENT INFORMATION ON BLACKBOARD

Blackboard contains answers from each student for each exam[4-5]. It indicates whether a question was answered correctly or not. However, the students' answers alone in the form of correct or incorrect (true or false) cannot be imported as a worksheet from blackboard. The downloadable exam information from blackboard has the following data:

Username, Last Name, First Name, Question ID, Question, Answer, Possible Points, Auto Score, and Manual Score.

Each item appears as a column with Username being the first column (Column A) and Manual Score as the last column (Column I). The data can be downloaded either comma separated or tab separated. Both formats are readable in Microsoft Excel.

The following steps can be used to download the exam information:

1. Click/select Grade Center

2. Click on Full Grade Center

3. Scroll to the desired exam

4. Click on the down arrow to display options

5. Select Download Results

6. Select delimiter type (Comma or Tab). Default is Tab

7. Select Format of Results (By User or By User and Question). Default is By Users. Selecting By User and Question will be easier to process since it displays all the questions of first student and then all the questions of second student and so on.

8. Select Only Valid Attempts in the Attempts to Download

9. Click on Click to Download results

10. Select either to open the data in Excel or to save it in a file to open it later

11. Click OK

The Question ID values appear as, Question ID 1, Question ID 2, and so on. This textual description cannot be used as index to an array as such. The numerical value has to be extracted to use as an index. This can be done in Excel using MID, and VALUE functions as =VALUE(MID(D2,13,3)) assuming the question ID string is in cell D2 and the number of questions $N < 1000$, which is three digits.

For a multiple choice question, The Auto Score value appears as "Possible Points" for a correct answers and zero for a wrong answer. It can be treated like true (non-zero value) or false (zero value).

Each username in the Username column is unique and hence it can be used as a key to identify transition from one user to another as needed. To identify the end of one student (username) to another student (username), it is necessary to identify change of username as we walk through the rows. This can be done by comparing the previous value to the current value. This is needed only if each student's contribution to the course objectives is needed; otherwise, all the student answers could be processed until the end.

Since the number of students in each course varies in each semester, the assessment tool should be able to handle this. In order to do this, the end of all answers in the row should be identified to stop

computation. This can be done by looking for an empty cell.

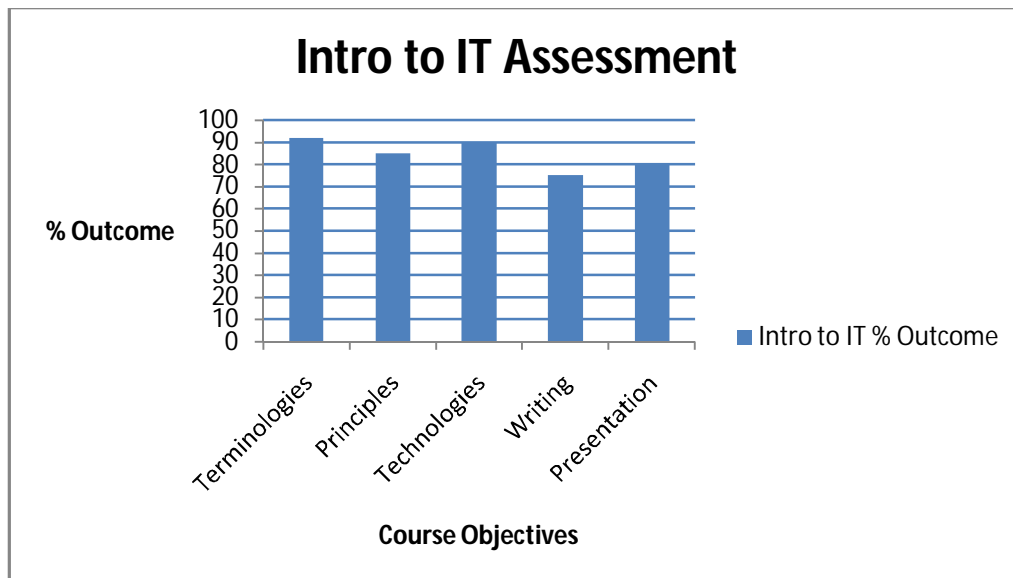


Fig 2: Graphical representation of course outcome.

Outcome Graph

The outcomes from exams in a course can be presented in a graphical form as shown in Fig. 2 to quickly visualize the result.

Similar outcome graphs can be created for other course assessments such as homework, projects, etc. Combining all the course assessments, the course outcome graph can be created.

Randomizing Questions: If randomizeexam questions feature is used then blackboard randomizes each student exam questions. In this case, the instructor question number and student question number may not be the same. It makes correlation and computation difficult. Care must be exercised in selecting this option.

Weighted Assessment of Objectives

The number of points or percentage of points assigned to various exams, assignments, and projects vary. A sample assessment for an introductory computer science course is given below:

4 Exams	: 50% (= 500 points)
4 Assignments	: 50% (= 500 points)

A sample assessment of an operating system course is given below:

Midterm : 20% (= 200 points)

Final exam : 20% (= 200 points)

Programming project consisting of 3 assignments

Assignment 1 : 10% (= 100 points)

Assignment 2 : 25% (= 250 points)

Assignment 3 : 15% (= 150 points)

Presentation Project: 10% (= 100 points)

Extra credit : 5% (= 50 points)

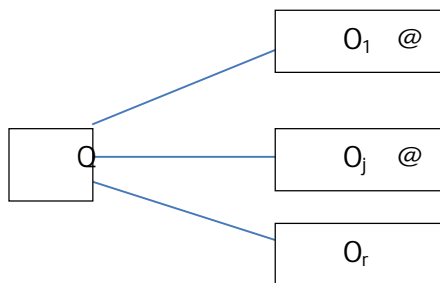
In addition, an assignment may cover more than one objective. The level of each objective covered by an assignment may vary instead of being equal. For example, let us say assignment 1 for the above operating system course covers objects 1, 3, and 5 with objective 1 at 50%, objective 3 at 20% and objective 5 at 30% out of 100% of the points assigned to that homework. In other words, objective 1 is covered for $100 \times 50\% = 50$ points = 5% of total course, objective 2 for $100 \times 20\% = 20$ points = 2% of total course and objective 3 for $100 \times 30\% = 30$ points = 3% of total course out of 100 points = 10% of total course for assignment 1. When looking at the total

course percentage, objective 1 is covered at 5%, objective 2 at 2% and objective 3 at 3% level. The same may apply to an exam also. This type of assessment is called weighted assessment in this paper.

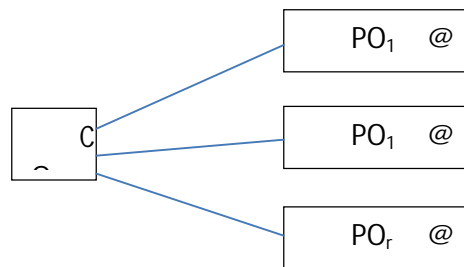
Similar weighed assessment has to be done at the course level as shown later since the level of

coverage of each objective varies in the overall course.

In general, each question covers a set of objectives O at certain percentage level P as represented in figure 3(a)below for a total of N questions and M objectives an exam or an assignment or project in a course:



(a) Question to course objectives



(b) Course objective to Program objectives

Fig 3: Mapping (a) question to course objectives and (b) to program objectives.

MAPPING COURSE OBJECTIVES TO PROGRAM OBJECTIVES

The objectives of a course in a program contribute to one or more program objectives at certain level as shown in Fig. 3(b). Table III shows mapping of a course objectives 1 to 7 to the program objectives *a* to *k*.

For example, the description of the program object (b) could be, “An ability to analyze a problem, and identify and define the computing requirements

appropriate to its solution” as presented in a CSAB/ABET workshop. [6-7].

Words such as strong, moderate, fair, and none are used to describe the levels of contributions. For computational purpose using Excel, the verbal description of levels have to be represented by numerical values such as 100 for strong, 75 for moderate, etc.

Table III: Course objectives to program objectives mapping
 Coverage level: S = Strong, M = Moderate, F = Fair, N or Blank = None

Course Objectives ↓	Program Objectives										
	A	b	c	d	e	f	g	h		J	k
1	S	M	S								S
2	S	M	S								
3	S	M	S								S
4	M										S
5											
6					F	M					
7								F			

International Journal of Science and Applied Information Technology (IJSAIT), Vol. 4 , No.3, Pages : 01 - 07 (2015)
Special Issue of ICCET 2015 - Held on July 13, 2015 in Hotel Sandesh The Prince, Mysore, India
<http://warse.org/IJSAIT/static/pdf/Issue/iccet2015sp01.pdf>

ACM 2013 CS curriculum defines coverage of a topic in terms of minimum number of hours [1].

Note that for the objective 5 the row is blank indicating that objective 5 does not contribute to any program objectives.

ASSESSMENT OF INSTITUTION OBJECTIVES

In order to compute the institutional outcomes, the outcomes of all the programs in all the departments of the institution have to be computed first. Next, the contributions of all the programs to the institution outcomes have to be computed. The approach similar to computing the program outcome described earlier can be used for each program and then aggregated to get the institution outcomes based on the weighted level of contribution by each program.

CONCLUSION

The assessment tool presented in this paper is simple to use. The presentation of the assessment result in the form of a chart gives an easy way to

understand the outcomes of the course. Changing questions require change of objective mapping vector. In order to obtain the program outcomes, all courses that contribute to the program objectives must be assessed. It requires department-wide efforts. The implementation of the tool at all level requires additional coding. In addition, it requires negotiation, agreement and adoption of the tool by various departments and by the administration. Assessment is an ongoing effort.

REFERENCES

1. <http://www.acm.org/education/CS2013-final-report.pdf>
2. smallbusiness.chron.com
3. <http://smallbusiness.chron.com/difference-between-objective-mission-statement-24872.html>
4. <http://blackboard.com>
5. <https://framingham.blackboard.com>
6. <http://www.csab.org/>
7. <http://www.abet.org/>