

Assessment Tracking Protocols and Design Documents as Monitoring Tools for Assessment and Evaluation of Teaching Innovations in Bioengineering

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Abstract

This project aims at developing methods to track the assessment and evaluation of educational practices that incorporate learning sciences and technology with bioengineering. Preliminary studies with courseware innovations have returned positive preliminary findings revealing increased student involvement and accomplishment. Also, controlled evaluation studies are being conducted in bioengineering classrooms over a series of semesters and across institutions. However, detailed monitoring is needed to archive these efforts. To address this issue, assessment tracking protocols and design documents have been developed to capture and archive the necessary information that assesses and evaluates the classroom innovations employed by an instructor. This project is part of a larger university project known as the Faculty Innovations Profile Project that hopes to use such innovations to the benefit of a wider audience.

Introduction

The wealth of knowledge now available at a person's fingertips necessitates that education is brought beyond plain memorization. A higher demand is being made on our graduates to adapt to new situations. Students must be able to critically analyze facts and figures and understand their conceptual basis, make sound judgments on a plethora of information, and have the confidence to create informed decisions and opinions. Therefore, our models of instruction and assessment must be increased to meet these demands. This work is part of a large cross-institutional project aimed at designing and researching innovative methods for teaching biomedical engineering students on college campuses. One of the goals of this project is to evaluate the effectiveness of our instructional methods and to demonstrate the reuse of the learning materials we are designing. Therefore, we are conducting both control and replication studies to verify our achieving our goals. Achieving this research agenda requires a rigorous tracking protocol. This paper presents the process being developed to systematically document and track the various assessments and evaluations methods used to capture data related to the projects' research goals. We start by presenting a rationale for the need of a rigorous methodology and a description of the system we are designing to support the process.

Rationale for an Assessment Tracking Protocol

Assessment and evaluation is crucial to the continual development and improvement of any research project. Therefore, developing tracking documents that allow accurate assessment and evaluation is vital. Without specific details, a project may contain unacceptable levels of misinterpretation and uncertainty. Monitoring the implementation and subsequent effects of new learning science theories and technologies in the classroom presents an interesting problem. If the students average scores raise, is it necessarily the introduction of learning science and technology or is it the ability of the teacher? If a teacher who normally produces quality students suddenly has a drop in his performance rating, is this a result of with the new technique or his inability to implement it effectively? The assessment and evaluation of these practices over time and across instructions is exceedingly important. To account for these needs, we are developing assessment tracking protocols and design documents to systematically track the implementation of innovations in our classrooms to facilitate comparison and replications of these novel instructional methods.

Assessment Tracking Protocols – The purpose of an assessment tracking protocol is to capture the important details of an assessment method. The methods are designed to answer specific questions related to the underlying learning sciences theory and to measure students' progress toward specific learning outcomes. The assessment methods will be used in multiple comparison studies, which will require consistent administration of the assessment measures. The assessment tracking protocols will help ensure consistency in the assessment and evaluation of the methods as well as note any discrepancies that may have significant impact on the overall interpretation. These documents will undergo continual refinement in order to improve the efficiency of data collection (See Appendix).

Design documents – The implementation of our projects instructional materials and instructional model will vary form year to year and from instructor to instructor. Therefore, methods are needed to record the fundamental features of the materials intended by the designer. This includes identify what are the major activities that relate to the learning objective and the corresponding assessment items. These features must be maintained to ensure a valid comparison. These documents will allow classes to maintain coherence between different sections and institutions (See Appendix).

Methods to track the assessment and evaluation of new practices are essential to the continued growth and success of any project. Detailed descriptions of classroom environment and dynamics, philosophical approaches, the instructor, the types of tests, and the types of questions being asked all contribute to the end product. Assessment tracking protocols will answer important questions that will insure that others will be able to note significant differences in student testing administration. Rigorous documentation of content and practices will allow confidence in assessment and evaluation so that changes from an established norm can be properly addressed while fulfilling the need consistency between the assessment and evaluation of tests. The design documents will archive important information about the course content and methodology and address the need to possess some aspect of uniformity between classes. We emphasize this because we believe focusing on one instructor and his students' progress will

limit our focus. We want data that shows that the novel methods work among various instructors in different environments within and across institutions. The need for detail is then evident. Without accurate and detailed records, it will be difficult to determine the source of any alteration in student performance. Detailed records of year-to-year content and practices will assist in maintaining a good level of consistency in implementing innovations between sections and institutions. Since class dynamics tend to change between institutions, teachers, or even sections, it is vital that each class maintain a level of consistency when implemented in order to insure that discrepancies between sections or institutions are accounted for and is not the overriding factor for alteration in student performance. It is vital that the application of innovative learning strategies in the classroom result in a positive long-term impact on the quality of education in the classroom and that this holds true regardless of the instructor. This will be a difficult task. It is evident that we can not predict every possible facet that will arise as an important criterion for investigation so we plan to be tenacious in the collection of data at all times in order to insure proper analysis in the future. We expect the documents to show that the implemented learning sciences theory have a positive effect on the student's overall ability to handle conceptually difficult questions. We believe that these documents will prove to be an effective way to archive the necessary information due to their ease in adaptability and simplicity in manner.

Because these documents are still in their infancy, we anticipate continual refinement to arising needs for additional data to be gathered. For instance, if tracking documents misses an important detail, then what becomes of that data? Is it completely useless? There is also the concern of variation in recording. What if one individual takes meticulous recordings on every aspect of the assessment test environment while another individual only records specific points excluding potentially revealing data? These are real concerns but should not deter the use of tracking documents. It must be reminded the task of improving educational outcomes is not a small task and there must be ways to reflect on past efforts in order to move forward in the proper direction and this cannot be done without rigorous documentation. Therefore these documents will be revamped regularly, which will undoubtedly lead to a certain level of change. This allows these documents to serve a second purpose of documenting the changes in the classroom from the instructor's point of view. It is important that these documents undergo revision throughout the duration of their use. Continual refinement and ambition to improve these documents will be one of the driving factors in the continual need to enhance the quality of education.

Current Undertaking

The development of the documents is well underway and controlled studies are being conducted across institutions. This is relatively new undertaking and data analysis has not yet taken place. Because these documents are still in their initial stages, we are expecting the documents to undergo continual refinement in a relatively short amount of time.

Next Step

The next step in this project is to implement a web based form of these documents. This provides some real advantages. First, a web-based form allows for prompt viewing for key individuals across institutions for immediate evaluation. Second, instructors will have access to these forms not only to track their own classes, but to draw information from other similar classes as well. This will allow a foundation by which instructors can begin discussing what differences they may have had in their classroom and reporting them online to be reviewed and analyzed. Third, because of the scale of this project, it provides a much simpler way of dissemination and communication between institutions and any confusion can be dispelled in a much timelier manner.

Summary

Together, assessment tracking documents and design documents will aid in providing an accurate description of the factors that went into the classroom. The documents will over exaggerate necessary detail to ensure the capture of material that might become important upon later evaluation. The over exaggeration of details is an important step as it is impossible to predict what details will become crucial analytical points in the future. It is important to note that these documents are only part of a larger university project and that they will themselves have supplementary material to add to the wealth of information needed for a project of this magnitude. Altering the course of our educational system requires delicate care and these documents are an essential piece to those delicate needs. With time these documents will reach a point where a perception exists that further refinement is unnecessary. This would be a mistake. There should be no roof on a project as important as the continued growth within the classroom. Therefore it is important that documents such as assessment tracking protocols and the design documents undergo constant revision in order to follow the change in educational practices as well as drive it.

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Appendix

Example of Assessment Tracking Protocol:

Attribute	Innovation		Comparison	
Faculty				
Administrator Email				
Grade/Level				
Number of Students				
Core Class (Y/N)				
School				
Domain Area				

Testing				
Name of Test:				
Timing:	PRE	POST	PRE	POST
Date				
Time Allowd				
Number of students tested				
Number of test items				
Test items that match exactly				
Item formats for those that match exactly				
Nature of the differences between assessments. Pre1 vs. Pre2; Post1 vs. Post 2; Pre vs. Post; Pre1 vs. Post1				

Scoring				
Type (rubric, summed score, % correct, rating...)				
Min/Max Possible Score				
Scorer(s)				
Reliability				
Date of reliability assessment				
Who conducted reliability assessment				
Reliability Estimate				

Fig 1. This is an example of a possible assessment tracking protocol. This example is not the form in use but is representative of how a form could look. Each section of the assessment tracking protocol intended to capture as many variables of a testing situation as possible. The fields represent the minimum amount of information to be gathered. It is vital that excess information be gathered so if it becomes apparent new fields are needed, that the information from previous versions contains the material.

Example of Design Document:

A module will need to be described by:
1. Significance: How will the proposed module or granule address a critical curricular need.
2. Learning Objectives. (i.e. What are students expected to be able to do once they have been through this module/granule?) <ol style="list-style-type: none"> What educational level(s) will use this granule? What will the learning objectives be at each level (in terms of content and learning process)?
3. Specify Inputs in some detail for each educational level/audience that the module is intended for: <ol style="list-style-type: none"> What science background is required/recommended for utilization of the module? What engineering background is required for utilization of the module? What cognitive background is required for utilization of the module? Which other modules are required and which recommended before this one? What additional software and hardware is necessary to utilize different aspects of this module? <p>(These questions could be part of a set of decision switches to guide user and could have certain stock answers, so that they do not each have to generate a lot of text.)</p>
4. Specify expected time required to fully master this module by students at different educational levels (e.g. number of hours of student/faculty interaction; number of hour of individual or group study time)
5. What is/(are) the role(s) of the teacher at different levels (if any). Does the module contain material that is accessible without a teacher (e.g. for just-in-time learning)?
6. What materials will be needed? (e.g. text (web or hard copy), lab, problems, video, simulation, etc.).
7. Prepare a "teacher manual" explaining what background knowledge the teacher should have before running the module. Teacher's manual should include discussion of teaching and learning methods, or refer to other materials.
8. Specify outputs: <ol style="list-style-type: none"> What modules can a student go on to after this (vertically within the specific taxonomy and horizontally to other ones)? What is a student expected to be able to do, as a result of taking this module, in terms of: <ul style="list-style-type: none"> • domain knowledge • technical abilities (lab skills, simulation skills...) • design capabilities, etc. What cognitive and learning skills are enhanced in a student taking this module?

Fig 2. The design document is an outline of the intention of a lesson or class (i.e. module). Its intention is not to restrict an instructor but to minimize the variation of content.

**Note that neither example is an exact replica of the actual documents used but a sample for the purposes of visualization.*

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