

## [Instructions for Using This Template](#)

### [Category](#)

### [Title](#)

[Author\(s\)](#)

[Abstract](#)

[Introduction](#)

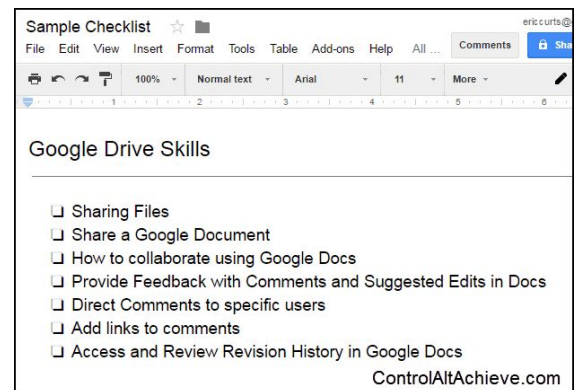
[Results](#)

## Instructions for Using This Template

1. Go to File > Make a Copy. Do not edit the template.
2. Rename the File (yourlastname\_digital\_learning\_workshop)
3. Type appropriate information below the pre-set headings. Information starting on the abstract page count toward the 2-page limit (single-spaced and font as given). Page 1 is only for organizational purposes.
4. When complete, go to File > Download as PDF to upload to EasyChair.

## Category

- Data-Driven Course Design
- MOOC Success Stories
- Blended/Hybrid Learning
- Applications of the Science of Learning (in Online and Blended/Hybrid Learning)
- Innovative Use of Digital Learning Environments (such as interesting uses of MOOCs, etc.)



## Title

Use of In-Class Response Questions in a Large-Scale, Blended Learning, Introductory Physics Class at MIT

## Author(s)

Alexander Shvonski, Aidan MacDonagh, Michelle Tomasik, Peter Dourmashkin

## University or Organization

Massachusetts Institute of Technology

## Abstract

We examine student responses to in-class concept questions given in a large-scale, introductory physics course at MIT. The course has eight sections, and each section's instructor uses the in-class concept questions in different ways. By analyzing the comprehensive dataset of student responses, we hope to understand how the concept questions are used in class, thereby determining the educational experience of the students between sections.

## Introduction

8.02 Electricity and Magnetism is an introductory class which is a requirement for all undergraduates; it is taught in the TEAL (Technology Enhanced Active Learning) format of blended learning, where in-class instruction is bolstered with active engagement such as the interactive “Concept Questions” (CQs), which students answer on our LMS, MITx (Figure 1). In-class participation grades are assigned based on students' CQ responses—students are graded on completion rather than correctness and are aware of this fact. There are eight sections (~90 students per section), each with a different instructor. The set of available CQs is identical across sections, but implementation of the CQs varies from section to section at each instructor's discretion. In many instances, a CQ will be asked twice in succession, this “follow-up” enabling students to discuss and revise their answers.

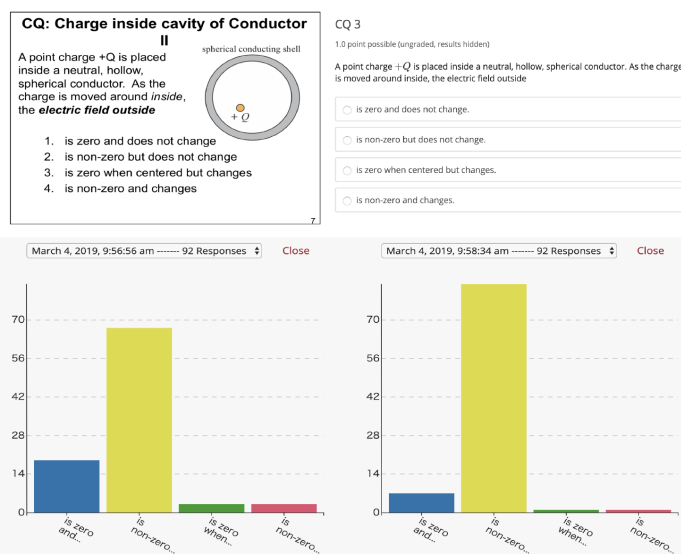


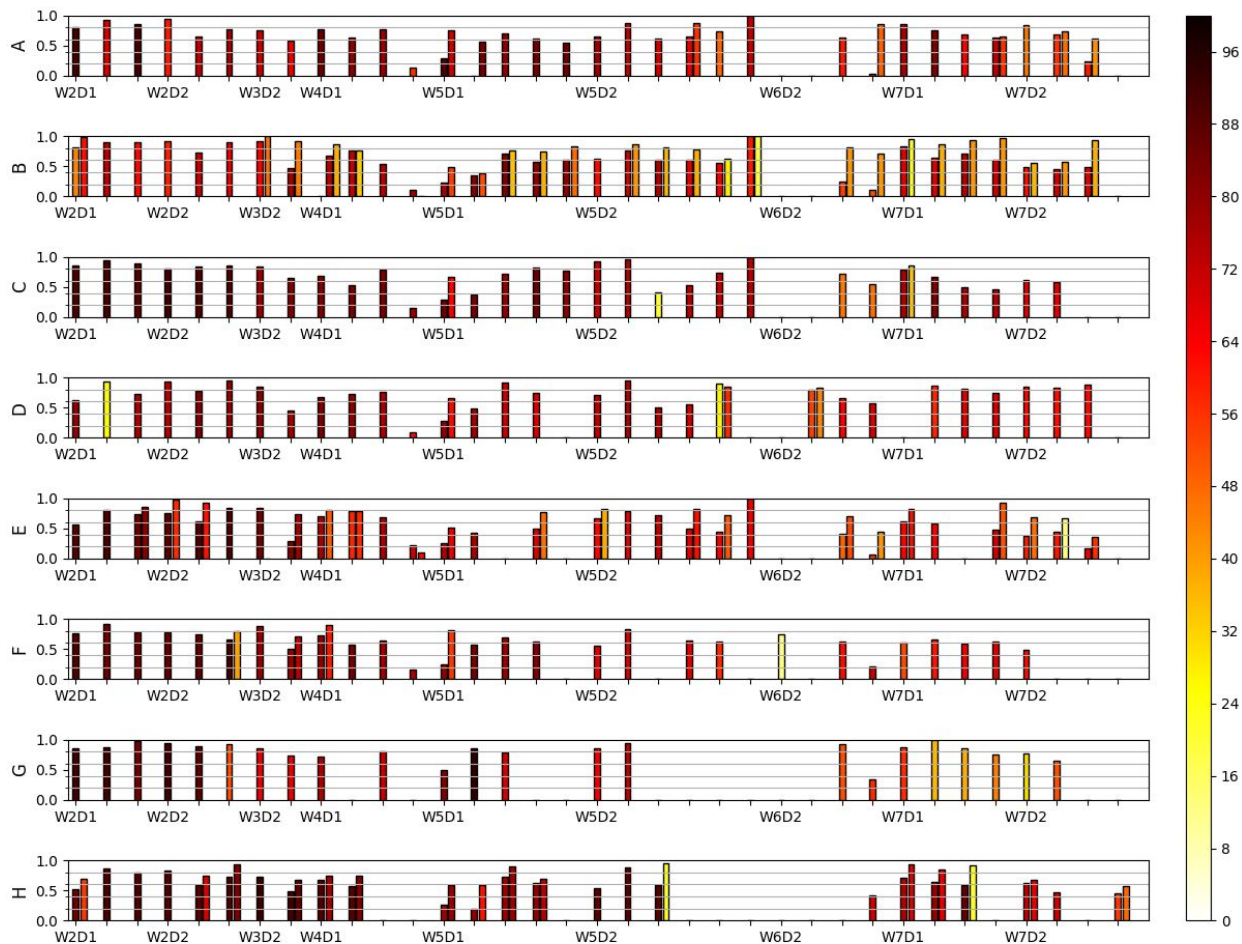
Figure 1: An example CQ (top left); its LMS implementation (top right); and histograms of first and follow-up student responses (bottom).

## Results

In the figure below, we present histograms of the CQ use data over the first seven weeks of the course (before spring break) (Figure 2). There is a histogram for each of the eight sections, labeled A through H. The horizontal axis demarcates individual CQs and the week/day when they were used. CQs were asked once (solitary bar), twice including a follow-up (contiguous bars), or not at all (empty space), depending upon the section. Color magnitude represents the fraction of students in a section who responded to a given CQ (number of students per section included in Table 1). The vertical axis represents the fraction of correct responses.

We also include a table that summarizes the histogram data (Table 1). For each section, the following data are given: (a) the average fraction of CQs given each day; (b) the average fraction of CQs given with follow-up; (c) the average fraction of students who responded; (d) the average fraction of correct responses (averages taken over the 9 days displayed in histogram).

As you can see from Table 1, most students were asked a majority of the questions at least once. Much more variation occurred between sections choosing to ask questions twice as follow-up. This means most students saw similar content but may not have had the same opportunity to discuss the answer with peers. We note that this is a preliminary analysis of the variations in CQ use across the eight sections of 8.02. Topics that might be investigated further include the following: overlap between students answering initial and follow-up CQs; connection between in-class CQ performance and exam concept question performance; connection between in-class CQ performance and physics attitudes and beliefs.



(Above) Figure 2: Histogram of CQ response data per section. Color magnitude is *fraction* of students who responded. Vertical axis is fraction of correct responses. (Below) Table 1: Table of average CQ use and response data per section (averages over 9 days).

Section (enrollment)	Avg % CQ Given	Avg % CQ Follow-up	Avg % Responded	Avg % Correct
<b>A (n=55)</b>	0.92 +/- 0.17	0.22 +/- 0.24	0.72 +/- 0.12	0.72 +/- 0.16
<b>B (n=75)</b>	0.92 +/- 0.17	0.77 +/- 0.34	0.70 +/- 0.08	0.77 +/- 0.20
<b>C (n=83)</b>	0.89 +/- 0.21	0.05 +/- 0.09	0.76 +/- 0.15	0.70 +/- 0.19
<b>D (n=110)</b>	0.88 +/- 0.11	0.09 +/- 0.13	0.70 +/- 0.11	0.73 +/- 0.18
<b>E (n=117)</b>	0.84 +/- 0.19	0.73 +/- 0.22	0.72 +/- 0.11	0.72 +/- 0.18
<b>F (n=97)</b>	0.83 +/- 0.24	0.15 +/- 0.18	0.73 +/- 0.15	0.66 +/- 0.17
<b>G (n=56)</b>	0.74 +/- 0.25	0.00 +/- 0.00	0.65 +/- 0.20	0.82 +/- 0.15
<b>H (n=118)</b>	0.73 +/- 0.25	0.61 +/- 0.33	0.82 +/- 0.09	0.74 +/- 0.15