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Determining Effectiveness of Pedagogical Techniques with Ascending Surveys

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Summary

Students cannot determine the extent to which a pedagogical technique enabled them to successfully complete a course if they are not asked appropriate questions. The content of these questions and responses should enable students, instructors and colleagues to come to similar conclusions. This paper/presentation will focus on the following.

- A review of efforts associated with reporting pedagogical effectiveness and the various challenges encountered when trying do so,
- A systematic method that can be used to develop an ascending survey to determine the effectiveness of pedagogical techniques.
- The quality of student feedback.

The Excel workbook and Word document that the author developed to maximize efficiency will be demonstrated and made available.

1. Background

The effectiveness of a pedagogical technique is often reported without considering student feedback. One method is to report faculty perception. In order to determine the effectiveness of active learning higher level learning and formative assessment, a peer observer uses a prescriptive list based on the number of and time between active learning exercises[1]. A study on the effectiveness of clickers used self reported data regarding extra time required for class preparation, the amount covered, student attrition and final class grades[2].

Not all student feedback is relevant. To determine the effectiveness of lab report requirements, course evaluations, featuring numerical and comment-based questions, were conducted at the end of each term, covering aspects such as lab instruction, challenge, interaction, student effort, and information. While students considered lab reports time-consuming, they acknowledged the value gained[3]. Without seeing the questions it is difficult to consider the findings as credible. The same is true for the clicker study where questions from the end-of-course evaluations did not reveal any apparent differences between the clicker and control classes[2]. The NSSE annual survey of freshmen and seniors asks students how often they have, for example, participated in projects that required integrating ideas or information from various sources, used e-mail to communicate with an instructor, asked questions in class or contributed to class discussions, received prompt feedback from faculty on their academic performance, participated in community- based projects, or tutored or taught other students. The findings are used to determine how successful a university is at engaging students[4].

Sometimes student feedback contradicts the results associated with academic performance. For example, students thought they learned more, rated the quality of instruction in passive lectures more highly, and expressed a preference to have “all of their physics classes taught this way,” even though their scores on independent tests of learning were lower than those in actively taught classrooms[5]. The questions they were asked to determine how much they learned were never

mentioned.

The conclusions drawn from student feedback can be questionable. A common myth around student feedback is that learners are looking for easy classes to receive high grades, but the survey revealed otherwise. Students with high grades were more likely to evaluate the course negatively if they felt they didn't learn[6]. No mention is made of students with low grades. No results are presented. Selected findings from the 2003 NSSE Annual Report (3) that speak directly to practices in engineering schools include the following: Business and engineering majors are well below other fields in prompt feedback from faculty and the frequency of participation in integrative activities. Engineering students experience more academic challenge and active and collaborative learning than many other fields Engineering students have low levels of student-faculty interaction and supportive campus environment. Engineering students spend less time preparing for class than professors expect[4]. There is no mention as to how this was determined and its significance.

Relying solely on student comments can lead to inappropriate conclusions. One author states the following. I'm not surprised- most of the people in our department that teach Intro use active learning techniques, and some common complaints from students are 'I didn't learn anything', 'I had to teach myself everything'[5]. This this reminds me of "I learned a lot but he was not a good teacher". Many students provided written comments about the clicker class on the end-of-the course evaluations with 70% of those students responding reporting that they enjoyed using the clickers. In addition, 42% of students reported that they enjoyed the anonymity of the clickers. The remaining students were less positive, reporting that they did not like having to pay for the clickers (65%) or that the clickers seemed to interfere with discussion in the classroom (74%)[2]. The written comments are not associated with any question. Thus it is difficult to determine if students perceived them as effective and if not why and what can be done. Presenting positive and negative comments in the same table[7] allows one to identify controversy but without the comments being placed in the context of a rating it is difficult to draw a conclusion.

The numerical analysis of generic or vague questions at best result in indicative results. One survey uses the following scales: 1 is love it and 5 hate it, 1 is not positive and 5 is very positive, 1 is lowest level of disruption and 5 is highest level of disruption. The authors also report the average student response to the following questions without mentioning the scale: How well did class sessions increase your understanding of the subject, How effectively did the instructor facilitate student learning?[8]. Another study used a scale of 0% =no confidence to 100%=total confidence and 1 being least engaged and 5 being most engaged[7]. Without knowing the meaning of the non-extreme points on the scale it is difficult to interpret the results.

I think many of us can therefore empathize with the following statement. Besides the institution, I also do my own student evaluation because I do care what the students think and how the feel about the course. But I use the info only so much because at some point, I don't think they have all the info on how things should be done[5]. Other comments from the discussion include 1) How can teachers address this perception and help students understand the effectiveness of active learning?[5] and 2) What is the definition of "active learning"?[5]. Therefore there is a need to explain it further to students and not just ask a level of agreement question about active learning.

Another paper included the following statement. This paper looks at a class of pedagogies of engagement, namely, those that are classroom-based. We focus particularly on cooperative learning and on problem-based learning. In the next section we present definitions of the classroom-based pedagogies of engagement[4]. If we need to define a pedagogical technique for ourselves we definitely need to define it for our students. Effective feedback can only occur if we are working with the same definition.

The following survey question is an example of one where the response provides concrete student feedback. How did the demonstration help you understand the subject matter? a) Having a chance to examine the demonstration clarified some things that I would probably not have understood from the lecture alone. b) Having a chance to examine the demonstration showed me that I correctly understood the material about electric motors taught in class but didn't help me learn anything new. c) The demo might be cool looking, but it didn't help me understand anything about electric motors d) I honestly didn't bother to look at it much.[9]

2. The Ascending Survey

I was first exposed to what I call an ascending survey during an NSF training session. The possible responses to survey questions were listed worst-to-best. Both the questions and possible responses were detailed focusing on the goal, experience and performance associated with each level. I do not remember if the performance level was mentioned. If so, it was not necessary. I thought I could use this experience to better determine the effectiveness of pedagogical techniques based on student feedback.

I had five pedagogical goals for the Engineering Materials course I was teaching. They were:

1: Students will successfully perform at the analysis and synthesis levels of Blooms Taxonomy throughout the course.
2: Students will value the integrated laboratory experience.
3: Students will value the automatically personal performance updates.
4: Students will value the class-sessions.
5: Students will find the resources available valuable and necessary for constantly increasing the level at which they learned the subject matter.

I saw no potential value in a survey based on the level of agreement with positive phrases associated with the above goals. The survey item associated with the deep/high-level learning goal is shown in Figure 1.

This course emphasized deep/high level learning by requiring you to appropriately break up subject matter and then recombine the subject matter in different ways to solve problems in different contexts. Effectively communicating this was a key component to demonstrating your learning of the subject matter. From the perspective which statement best describes your experience in this course.	
☐ I don't think I was ever really able to effectively solve multistep problems or answer thought questions. I feel that I was never able to either connect processing to structure or structure to properties. ☐ I was only able to effectively solve multistep problems or answer thought questions on those occasions when they replicated what was done in class or elsewhere. I do not think I was ever able to connect the multistep problems and thought questions. Occasionally, I was able to either connect processing to structure or structure to properties. I could almost never do both. ☐ I was usually able to effectively solve multistep problems, answer thought questions and when necessary connect the two. This included being able to connect processing to structure, structure to properties and sometimes both. I rarely found myself able to speculate and make well founded recommendations in the above situations. ☐ Most, but not all, of the time; I was able to effectively solve multistep problems, answer thought questions and when necessary connect the two. Often, I was further able to connect processing to structure, structure to properties and when needed both. I found myself able to speculate and make well founded recommendations in the above situations. ☐ Throughout the Course, I was able to effectively solve multistep problems, answer thought questions and when necessary connect the two. I was further able to connect processing to structure, structure to properties and when needed both. I found myself able to speculate and make well founded recommendations in all the above situations.	Comments

Figure 1: Survey Page Associated with Pedagogical Goal

The question makes it clear what is meant by deep/high-level learning. The performance levels are clearly defined. The order of responses makes it very likely (per conversation with NSF) that the student will pick the lowest level of performance. This is desirable for continuous improvement. By having comment space on the same page as survey responses, the comments can be placed in context.

I adapted an Excel workbook I developed to rate how students felt they learned given topics to allow me to tabulate the survey results. Students had the following options for each topic: Outstanding, Good (Exceeds Expectations), Acceptable (Met Expectations), Marginal (Close to Meeting Expectations) and Unacceptable. The workbook allowed enabled me to tabulate context based comments for each survey question. Below are a small number of student responses regarding integrated laboratory.

A: I could have skipped all of the labs and still been fine.
G: Labs were redundant based on techniques and watching me use machine (note my responsibility of resources)
G: Not always aware of connection to class-sessions. Often made connection after the fact. Suggest more initial explanation.
A: Too much wasted time in lab. Too much waiting. Discussions (which followed waiting) unnecessary.
M: Student not able to make connections. However stated lab kiosks worked well.

The comments were substantive. Students who were satisfied with the experiences offered constructive criticism. A student who was not satisfied identified something positive. The percentage of students making substantive comments is often 50% or more as shown by the

following examples.

“To what extent did you find the class-sessions highly-valuable/necessary for successful course completion?” 10 chose: “The format/structure of the class-sessions helped me, but were not key to my being able; to successfully complete the course. I found the standard opening OK, but not really necessary. The Concept Question and Class Answers usually helped me understand the subject matter being discussed. The In- Class Problem Solving and Thought Question Answering was beneficial. They usually built on the Class Answer. About half the time, I able to leave class with an ability to effectively develop a plan for completing the HW”.

1. Discussion could be helpful, but sometimes unclear how valid conclusions were. Perhaps a deeper explanation of meaning of responses.
2. The biggest problem with the class-sessions was the weekly tests. Since the tests were done alone and made up a 60% of the course grade, Thursday class prep focused on studying for test not preparing for class. Would like group tests.
3. Overall just as effective as any other, but there were times subject matter was just smashed together.
4. Would like more numerical examples worked start to finish
5. The class-session could be hard to follow if student did not do required preparation.
6. The student said the information needed to pass the course was buried under too much other information; that would never be used. It was hard to determine what to retain. "

“To what extend did you find the resources available valuable and necessary for constantly increasing the level at which you learned the subject matter?" 12 chose: “The on-line resources although helpful and effective could have been better connected with the class-sessions, lab-sessions, HW assignments, and tests. The reading assignments enabled me to prepare for each class session. The HW tips helped me complete the HW. The combination of the HW solutions, Test Prep Sheets and Test Diagnostics helped, but did not ensure that I could successfully complete each test. The test keys helped, but did not completely enable me to assess my readiness for the final examination. The on-line class sessions were helpful.”

1. Student suggested I focus on teaching to help students learn. Often thought I was more focused on electronic presentation of subject matter.
2. Cribs this is so both
3. Only complaint test keys listing key points. Would like to have more explanation to see what types of answers I am looking for. (My notes the cover sheet and supplied reference pages show this).
4. Sometimes PDF files would not print (Need more info). HW tips helpful.
5. Key to class success. Having the info there and accessible as well as HW tips really made the class doable (My notes we need to provide students resources outside of class).
6. Liked on-line readily available resources.
7. Did not use website but felt practice tests would have reduced the need for cribs (my notes sample problems provided)

3. Step by Step Development Example

Pedagogical Outcome 2: Students will value the integrated laboratory experience.

Step 1 - Identify the attributes of a student who finds exceptional/high value in the integrated laboratory experience.

- Other than scheduling could not tell where class-sessions ended and lab began and vice-versa.
- Able to understand necessary procedures and explain to others; lab kiosk value (on-line and in-lab)
- Liked the jump in approach
- Could write good technical memoranda
- Found a well established connection between lab and subject matter being presented; both week by week and throughout the course.

Step 2: Write statement which would be a typical response of a student who finds exceptional/high value in the integrated laboratory experience.	
Attributes	Statement
• Other than scheduling could not tell where class-sessions ended and lab began and vice-versa. • Able to understand necessary procedures and explain to others; lab kiosk value (on-line and in-lab) • Liked the jump in approach • Could write good TM's • Found a well established connection between lab and subject matter being presented; both week by week and throughout the course.	I found there to be a well established connection between lab and subject matter being presented in the class-session; both week by week and throughout the course. Other than scheduling one could not tell where class-sessions ended and lab began and vice-versa. The web-based instructional resources both on-line and made available through lab kiosks enabled 1) us to effectively jump-in and start working, and 2) understand the necessary lab procedures to the extent we could learn from each other. The wrap-up discussions enabled me to write effective technical memoranda which furthered my success in the course. (4 min)

Step 3 - Separate the question and the statement a student would choose if they felt they found exceptional/high value in the integrated laboratory experience.

To what extent did you find the integrated laboratory experience valuable and necessary?

I found there to be a well established connection between lab and subject matter being presented in the class-session; both week by week and throughout the course. Other than scheduling one could not tell where class-sessions ended and lab began and vice-versa. The web-based

instructional resources both on-line and made available through lab kiosks enabled 1) us to effectively jump-in and start working, and 2) understand the necessary lab procedures to the extent we could learn from each other. The wrap-up discussions enabled me to write effective technical memoranda which furthered my success in the course.

Step 4 - Write the other levels of performance. I found it easier to go down one step at a time

To what extent did you find the integrated laboratory experience valuable and necessary?	
Level 5	Level 4
• **I always** found there to be a well established connection between lab and subject matter being presented in the class-sessions; both week by week and throughout the course. • Other than scheduling I could not tell where class-sessions ended and lab began and vice-versa. • The web-based instructional resources both on-line and made available through lab kiosks always enabled 1) me and others to effectively jump-in and start working, and 2) understand the necessary lab procedures to the extent we could learn from each other. • The wrap-up discussions enabled me to write effective technical memoranda which furthered my success in the course.	• **Except for one or two exceptions**, I found there to be a well established connection between lab and subject matter being presented in the class-sessions; both week by week and throughout the course. • **Except for one or two exceptions**, other than scheduling I could not tell where class-sessions ended and lab began and vice-versa. • The web-based instructional resources both on-line and made available through lab kiosks enabled 1) me and others to effectively jump-in and start working, and 2) understand the necessary lab procedures to the extent we could learn from each other. • The wrap-up discussions enabled me to write effective technical memoranda which furthered my success in the course.

Step 5 - Combine the question with the responses in ascending order.
To what extent did you find the integrated laboratory experience valuable and necessary?

☐ The lab sessions and the class sessions had no connection. They might as well be different courses. The web-based instructional resources both on-line and made available through lab kiosks were useless. The wrap-up discussions were a waste of time.

☐ In less than half of the lab sessions, I found there to be a well established connection between lab and subject matter being presented in the class-sessions; both week by week and throughout the course. In less than half of the lab sessions, other than scheduling I could not tell where class-sessions ended and lab began and vice-versa. The web-based instructional resources both on-line and made available through lab kiosks only occasionally enabled 1) me and others to effectively jump-in and start working, and 2) understand the necessary lab procedures to the extent we could learn from each other. The wrap-up discussions only

occasionally enabled me to write effective technical memoranda thus hampering my success in the course.

- ☐ In at least half of the lab sessions, I found there to be a well established connection between lab and subject matter being presented in the class-sessions; both week by week and throughout the course. In at least half of the lab sessions, other than scheduling I could not tell where class-sessions ended and lab began and vice-versa. The web-based instructional resources both on-line and made available through lab kiosks usually, but not always enabled 1) me and others to effectively jump-in and start working, and 2) understand the necessary lab procedures to the extent we could learn from each other. The wrap-up discussions usually, but not always enabled me to write effective technical memoranda.
- ☐ Except for one or two exceptions, I found there to be a well established connection between lab and subject matter being presented in the class-sessions; both week by week and throughout the course. Except for one or two exceptions, other than scheduling I could not tell where class-sessions ended and lab began and vice-versa. The web-based instructional resources both on-line and made available through lab kiosks enabled 1) me and others to effectively jump-in and start working, and 2) understand the necessary lab procedures to the extent we could learn from each other. The wrap-up discussions enabled me to write effective technical memoranda which furthered my success in the course.
- ☐ I always found there to be a well established connection between lab and subject matter being presented in the class-sessions; both week by week and throughout the course. Other than scheduling I could not tell where class-sessions ended and lab began and vice-versa. The web-based instructional resources both on-line and made available through lab kiosks always enabled 1) me and others to effectively jump-in and start working, and 2) understand the necessary lab procedures to the extent we could learn from each other. The wrap-up discussions enabled me to write effective technical memoranda which furthered my success in the course.

I will make both a Word document which auto-fills, making the development process faster and the Excel Workbook to make context-based comments easy to tabulate freely available as soon as possible and to the maximum extent practical. I will demonstrate these during my presentation.

4. Concluding Remarks

The purpose of this paper is to share something I developed and found useful with colleagues. I hope to stimulate discussion and collaboration. In order to avoid the paper from having multiple foci which would also entail making it too long I did not include discussion of findings regarding and actions taken regarding pedagogical techniques.

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