

Classroom, Homework and Beyond - Effective Use of Multiple Tools in the Teaching Environment

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Abstract

The proper selection of tools and techniques for a given topic, as well as mixing and matching tools and encouraging students to use tools outside of the classroom, are important goals in teaching any subject. An example of working through these goals will be given for a course being taught in the department of physics.

Introduction

An important step in the preparation of any course is the choice and implementation of the educational techniques and tools used both inside and outside the classroom. In the following example, we will explore the development of a course in Physics for Engineers and Computer Scientists and the process of choosing the tools and techniques used in this class.

Description of the Tools and Techniques Used in the Course

During the typical classroom lecture, an animated Microsoft PowerPoint presentation is used as the core of the teaching material. Each class period includes one or more of the following: the PowerPoint presentation, a simple quiz on previously taught material, a demonstration of the principles being taught using a real experiment, an interactive exercise where students work together on material that is being taught, and one or more examples of problems worked out on the blackboard by the instructor.

Electronic homework is assigned for each class and includes a portion that centers on the material taught in class. This portion gives the students over 100 attempts to solve the problems and gives instant feedback on correct and incorrect answers. Another portion covers the material to be taught in the next class. This portion of the homework is in the form of true-and-false or fill-in-the-blank questions and allows only one attempt at the answer. Instant feedback on correctness is still given.

A website (<http://devoted.to/physics>) is available for students to use after the lecture. The website includes a syllabus, a link to the website for the textbook, a schedule, grades, a message board, a chat room, a link to NMSU email and a Frequently Asked Questions (FAQ) page. The schedule has links for each day of the class to a summary of the material to be presented, the reading assignment, a link to download the PowerPoint presentation, handouts for the lecture, announcements, lecture objectives, example problems, preparation for the quiz, a link to the homework for the day and a bar chart of current grades in the class.

The course materials have been developed over a two year period and reflect the principles of selection and implementation presented in this paper. Each lecture in the class implements a unique set of tools and techniques. We will discuss the selection process in this section. We will then discuss issues in

implementation. Finally, we will discuss an example of a tool which was implemented in this course and the reason for the choice in each case.

Selection of Tools and Techniques

The selection of the tools and techniques used in each lecture was made by answering several sets of questions.

The Bottom-Line

The first set of questions may be summarized by a single overarching question: **“Does the tool or technique improve the educational process?”** This question is basically one which goes to the bottom-line. If a tool or technique does not aid in reaching the goal of a particular lecture, then it is best to reject it regardless of any other redeeming qualities. To answer the above question, it is important to ask many other questions, three of which are given here.

1) **“Where will this tool or technique add value to the class?”** It is important to go beyond the usual question of whether it will add value and to give a description of the value added. This will enable the instructor to prioritize each tool or technique and choose those that are needed for the success of the class as opposed to those that simply enhance the class. While analyzing time constraints in lecture time, instructor out-of-class time and learning curve, this question will aid in determining which tools and techniques should be immediately implemented, which should be left for future implementation and which should not be implemented at all.

2) **“Will the students understand how to use the technique or tool?”** Not only should the tool be easy to use, but the student should understand how it will enhance the educational experience. Many exceptional tools and techniques have not succeeded because students do not use it properly. An understanding of the purpose for each tool is essential for student involvement. If it is difficult to explain the reason for the tool or technique or it is so difficult to use that the student will not benefit, then it may be best to reevaluate its use.

3) **“Will the students be willing to use this technique or tool?”** We have found this to be the greatest culprit in lack of success for a tool or technique used in the classroom. Each tool or technique should be strongly supported by the instructor. This support could come in many forms. It is possible at times to include the tool in the grading scheme for the class. You might also encourage the use of the tool during the class lecture, citing direct benefits as stated by previous or current students. Finally, you might add questions on homework assignments and exams that can be answered only by use of this tool or technique.

Best practices

A second set of questions is summarized by asking **“Is this the best tool or technique available?”** It is easy to get agreement that only the best tools should be used, but what must be asked in order to answer this question definitively. Although there are a great many other possible questions, the four examined here will help us a great move in the right direction.

1) **“Is this the most efficient tool or technique for the task?”** Fancy tools and techniques are often preferred over those that seem too simple or unexceptional. If, however, a tool or technique can be implemented easily or understood by better by the students, then it should be considered a better tool.

2) **“Is this tool or technique compatible with other tools or techniques used in this class or other similar classes?”** Compatibility is a larger issue than most of us might suspect. If the tools or techniques cannot be grouped together in a consistent manner, they will tend to distract the student from the overall goal of the lecture. For instance, it is easier if all computer tools are accessible from a central location such as an easily accessible website. Expecting the student to search through several websites, or using a different style of questioning for homework, quizzes, exams, and interactive exercises, will tend to lead to confusion for the student and may detract from the overall objectives in the class.

3) **“Has this tool or technique been tested and approved?”** Many excellent new tools and techniques are offered each year. Therefore, it is important to understand their limitations before they are implemented in any class. Any problems experienced with a tool or technique can lead to confusion and eventually distract the students in the class. Feel free to test it yourself first.

4) **“Is this tool or technique versatile?”** As time progresses, new techniques and tools become available. Instructor’s and students’ expectations change and the objectives of certain classes are enhanced. When this occurs, some tools and techniques require a lot of change to stay current; whereas, others are able to make the transition seamlessly. Another concern is the ability of one tool or technique to handle a multitude of tasks. In many cases, these two requirements must be balanced against each other. Elements with large support groups are usually versatile enough to handle a great variety of tasks. However, these same support structures do not lend themselves well to implementation of new or unusual requirements. Therefore, it is important for each instructor to analyze these constraints before a tool is implemented so as to avoid becoming trapped in a tool or technique that cannot handle future needs.

Implementation of Tools and Techniques

The correct implementation of the tools and techniques used in each lecture can enhance the learning experience. Incorrect implementation will lead to more problems instead of providing solutions to existing problems.

Where did all the students go?

Another set of questions that must be asked before implementing the chosen techniques and tools is best summarized by asking **“How do I get the students to use these tools and techniques?”** The answer to this question has befuddled even the best of intents and must be addressed as a new tool or technique is implemented. Here are some other questions that may serve to answer one of our most important concerns as instructors.

1) **“Can I make it a necessary part of the class?”** The ability of the instructor to inspire students to use a tool or technique can make or break its usefulness and utility in the class. To do this, the instructor may employ one of the following of many techniques. **Coercion:** Make it a part of the student’s grade. Although many think that this will lead to a revolt among the students, experience has shown that this is not the case. Care must be taken to explain the educational purpose behind the tool and every effort must be made to make each element as simple as possible. **Exhortation:** Tell the students during the lecture period how the new technique or tool will enhance their learning experience and express general disappointment when, as a whole, the class does not respond. Most students are all too ready to please the person who genuinely expresses concern for their education. **Encouragement:** This is best done by other students. Have some of those who have previously used or are currently using the tool or technique tell others why it is good and what they accomplished as they used it.

2) **“Is the tool or technique simple, fast and reliable?”** A complicated, slow or unreliable tool or technique is much less likely to be used a second time. Therefore, you should not only choose the best

tool for the job, you should also implement it as efficiently as possible. Here are some of the many possible ideas that you might consider. Can I implement this tool all at once? Starting to use a tool and quitting midstream generally leads to frustration and student mistrust. Experience shows that they will be less likely to use other tools available to them. Is this tool available at unusual times and places? A tool that is available using a 56K modem and the internet is most times better than one which requires a student to be in a particular place at a particular time.

3) **“Is this tool or technique something that captures the student’s interest?”** This question is more important in the implementation phase than in the selection phase of the process. The reason is that almost any tool or technique can be interesting or boring depending on how it is presented. Make it a part of a suite of tools and techniques that are an integral part of the class and experience shows that students will find even the most mundane task more interesting. Instructor enthusiasm is a must. If the instructor thinks it is boring, then it probably is. The students will not be likely to use it. Change the tool or technique to suit your needs in the class. An element that seamlessly integrates with the rest of the class will appear natural and lead to a higher rate of use. Whereas, a tool or technique that appears forced will distract and could lead to loss of clarity in the objectives.

Maintenance

Nothing is useful to you or your students if it cannot be maintained. We must always ask **“How do I get help with this tool when I need it?”** This leads to several simple questions.

1) **“Is there a place for students to find instructions and help?”** Are the instructions available and easily followed? Most prepackaged software has this feature built in. Techniques usually require input from the instructor. If it is a tool or technique that you have developed on your own, then it is good for you to create instructions and have the students evaluate the instructions along with the tool or technique at the end of the class.

2) **“Is there a place that the instructor can find help?”** It is not unusual to find that the instructor needs a deeper understanding than the student. It is also not unusual to find that the help they need is not sought until it is required. Experience shows that contacting the help desk when first using a piece of software can lead to a more efficient handling of problems that occur. Beginning or joining a user group of instructors using similar tools and techniques before the class begins can also be helpful.

3) **“What happens if the tool breaks down or the technique does not match the students’ learning style?”** A good backup is just as important as the tool itself. If I rely on PowerPoint during lectures and there is a power failure, can I easily move to more conventional approaches for the lecture? If my website goes down, can the students still access the material? Do they know what to do when the material is not available? Answering these questions before the failures occur will decrease the stress of both student and instructor when they do.

Conclusion - Example of Selection and Implementation of a Tool

In conclusion, we will now discuss a particular tool implemented in a course in Physics for Engineers and Computer Scientists. The reasons for his choice of this tool followed closely with the presentation outlined in this paper. We will explore this choice in depth on the next page as an example of how to use what was presented. The course has been developed over a two year period and is currently being revised. The course uses the website found at <http://devoted.to/physics>. It is listed as New Mexico State University Physics 215 and is currently taught by Dr. DeAntonio.

The tool selected as an example was the Message Board used on the website. This Message Board is provided by <http://bravenet.com>. It is freeware and costs about \$20 per year without popup advertising.

Section	Question	Answer
The Bottom-Line	Does it improve the educational process?	Yes, because homework is used as a learning tool, not for testing.
	Where will this tool add value to the class?	The students use the board for working together on the homework. This is encouraged in this class.
	Will the students be able to understand the tool?	The board is a standard style used on many websites. Most students will have used something similar before.
	Will the students be willing to use this tool?	Most students have used this tool in the past. The current Physics 215 class has nearly 250 entries.
Best Practices	Is this the best tool available?	Not necessarily. But it is close.
	Is this the most efficient tool for the task?	This particular board is simple and does not require login as most do.
	Is this tool compatible with other tools used in this class or other similar classes?	The code for the tool was copied directly to the website. It has options to change color, etc. to match current website design.
	Has this tool been tested and approved?	The tool was tested during the past summer to validate that it worked the way it was advertised.
	Is this tool versatile?	The code for the board is upgraded on a regular basis. The downside is that it does not have options for several topic areas as other more elaborate boards do.
Where did all the Students Go?	How do I get the students to use this tool?	The instructor relies on the usefulness of the tool to speak for itself.
	Can I make it a necessary part of the class?	The instructor prefers encouragement. He asks two students during office hours to begin using the board. The first asks a question. The second answers it.
	Is the tool simple, fast and reliable?	It is one of the simplest message boards available.
	Is this tool something that captures the student's interest?	The students see the need when homework is due. It is a place that both students and instructor learn about the "muddy points" in the class.
Maintenance	How do I get help with this tool when I need it?	The tool has a link to bravenet.com where information is available.
	Is there a place for the students to find instructions and help?	The instructor uses a FAQ page and email to answers students questions about the entire website.
	Is there a place that the instructor can find help?	If the instructor has questions, the bravenet.com service has an elaborate help page.
	What happens if the tool breaks down?	This tool is helpful, but not necessary. It is extremely reliable as well. So, this is not a problem.