Abstract

Students enrolled in our current Engineering courses were probably born in the early 1990s, at the time when the first Nintendo game consoles and video games first captured the imagination of teenagers. The generation of students that came to our schools after that has been trained to expect more than a static, chalk-and-blackboard lecture. This paper describes various techniques that can be used to enrich simple PowerPoint-based presentations. These techniques include line animation, dynamic creation of plots and graphs and step-by-step equation building.

Introduction

The methods used by prehistoric societies to pass important knowledge to the younger generations cannot be easily documented, but surely they must have included a healthy dose of active learning; it would be hard to teach the appropriate techniques for spear fishing in the absence of an actual demonstration. However, as Education (with a capital "E") evolved to a more formal process, teaching methods converged to what you probably remember from High School: the *lecture format*. In this format, a wise man (or woman) set out to introduce a group of young adults to the wonderful world of knowledge. To accomplish this, the teacher employed his/her verbal skills to communicate complex concepts, with the help of the blackboard and a piece of chalk. We did this for hundreds of years - while the World evolved around us, and the imagination of our Engineering students took flight.

The Roman educator Quintilian, back as early as the first century A.D., had already urged teachers to "motivate students by making learning interesting and attractive"\(^1\). And yet, our classrooms were tethered by the limitations of teaching technology. Sometimes we could use large sheets of paper and colored markers; some other times we used colored chalk. Even the introduction of the overhead projector in the 1940s did little to allow for a more dynamic representation of the subject matter of our lectures.

And then the fire of a great revolution spread from - of all places - entertainment technology. Radio, the Movies and even Television were not it: yes, you could be entertained, but all these media did their best to replicate the sounds and images of reality. Because these new media sources really introduced very few new stimuli, our good old lecturing professor could still compete.

The real troubles began with the introduction of the computer to this arsenal of new media that threatened to capture the attention of our students for good. Because of the computer, a child can now receive and - more importantly - interact with literally millions of images, all moving around on a color screen. We are faced with a difficult choice: either we keep trying to force the traditional lecture paradigm onto our students, or we attempt to capture some of that magic. This paper intends to demonstrate that it is possible to inject a modicum of *pizzazz* into our lectures, while keeping the overall objective of an Engineering lecture intact.
The need to keep up with our students' expectations of what constitutes a good teaching/learning experience has been widely documented. According to Windham, "Faculty must toss aside the dying notion that a lecture and subsequent reading assignment are enough to teach the lesson. Instead, the Net Generation responds to a variety of media, such as television, audio, animation, and text."²

Barger et al³ dissect the components of an effective lecture into three basic categories: **Delivery** (clarity and definition, pace and stimulation of the audience), **Enthusiasm** and **Content Command**. The education and career motivation of an Engineering professor presumably take care of the latter two, but there is much to be said about **Delivery**.

Many authors have advanced the notion that the actual skill of teaching is not explicitly taught to College Professors-in-training, although significant efforts are spent promoting the development of effective teaching technologies for K-12 teachers⁴. In our doctoral training, we tackle our challenging graduate coursework, we learn and eventually demonstrate the ability to do quality scientific research, but we develop a teaching style by a seemingly random process. We tend to incorporate the attributes of one or two lecturers who inspired us along the way, and mostly we just plod along and hope for the best.

During the last ten years, the availability of so-called "Intelligent Classrooms" - incorporating a computer-projector combo and Internet access - has grown exponentially. In parallel with this development, many publishing companies have begun to offer ready-made packages that can be used to support lectures; these packages are rigidly based on a particular textbook. Other companies sell computer-based videos that may illustrate particular topics in our curriculum. However, I believe that the majority of my Engineering colleagues really would prefer an exciting/dynamic medium which they can control and shape to their particular needs, and ready-made packages very rarely serve that purpose. This paper is a modest contribution to the development of effective delivery in our Engineering lectures, by suggesting we harness a widely available resource: **Microsoft's PowerPoint**.

**Lecturing with technology**

*Microsoft Office PowerPoint* was originally developed by Bob Gaskin and software developer Dennis Austin under the name *Presenter*, which was released for the Apple Macintosh in April 1987. It ran in black and white, generating text-and-graphics pages for overhead transparencies. A new full-color version of PowerPoint shipped a year later after the first color Macintosh came to market. In 1990 the first *Windows* versions were produced.⁵

*PowerPoint* is a very complex piece of software, and many of its features go well beyond what I would consider central to the composition of an effective lecture. The three PowerPoint techniques that I have found most useful for an Engineering lecture are clearly related to the three components of effective delivery mentioned above (clarity and definition, pace and stimulation of the audience). These techniques are: *line animation, dynamic creation of graphics* and *step-by-step equation building*. 

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A word of caution: many of the tools discussed in this paper cannot be properly introduced in a written medium. They have to be experienced within the context of a PowerPoint presentation.

**Clarity and Definition**

The presentation of particular Engineering concept during a lecture many times requires three actions: (i) a complete statement of the concept, (ii) a longer explanation by the lecturer and (iii) supporting graphical elements. These actions, in the *good old days* were constructed by the professor on the blackboard, in "real time".

PowerPoint can be effectively used to accomplish tasks (i) and (iii). This requires the preparation of the graphical elements, preferably non-annotated (incorporating the annotations by the use of animation imparts *video* quality to the process.) For example, Figure 1 represents a possible sequence of "snapshots" of the slide used in the presentation of Weierstrass Theorem.

Snapshot (a) shows the slide at the moment task (i) has been completed. The student is exposed to the full statement of Weierstrass Theorem in all its glory. Task (ii) will require the Professor to explain the concept in words that the students will easily grasp. This explanation is best supported by the use of a graphical display of the meaning of the Theorem, which is represented by snapshot (b). To punctuate and highlight the various components of the explanation, the lecturer can exert mouse-clicking control of the labels that magically appear at the appropriate points. The appearance of all this various elements - the *pace* of the presentation - requires the application of a few animation routines available in PowerPoint.

**Pace**

In traditional lectures, the Professor used words on the blackboard surface to control the pace of the lecture. He could, for instance, write a question and elicit answers from the students, before writing the definitive answer himself. Control of the *pace* of the presentation actually became more difficult with the introduction of the overhead transparencies: in typical circumstances, everything would be displayed on the screen at the same time. Students no longer needed to follow the Professor's discussion - they could just read ahead. There is no mystery left in a novel, when the killer is revealed in the first page!

The text animation routines can be effectively used to control the pace of the presentation. In the program, these routines are called "Custom Animation". Figure 2 shows the "drop down menu" access to animation routines in PowerPoint.

Although the software offers a range of animation choices, the most useful for lines of texts are "Fly in", and for more complex elements (such as graphs), "Fade" and "Faded Zoom" can be quite useful. A possible sequence of steps to construct a slide with custom animation is presented in Table 1.

The key to an effective PowerPoint lecture is planning each "slide". This involves appropriate slicing of the lecture concepts into paragraph-size bits, a good feel for the pace to be used and significant trial and error.
Figure 1. Weierstrass Theorem
1. Plan the concepts to be introduced in each individual slide
   1.1. To be effective, each slide should discuss not more than 2-3 concepts
   1.2. Use "bullet points" and plan to supplement each point with a verbal explanation
2. Prepare any additional elements to be used in the slide (such as graphics)
3. Choose a uniform "Entrance" effect. Multiple effects may be distracting
   3.1. The use of the same consistent effect will reduce the novelty effect and keep the audience's attention focused on the concept itself
4. Select additional highlighters to key words and concepts, such as arrows or underlining
5. Set-up animation control by either mouse click or navigation arrow. Use this control to elicit the audience's participation

Table 1. Building Custom Animation in a PowerPoint Slide

![Custom Animation menu](image)

**Figure 2. The Custom Animation menu**

Many Engineering courses also rely on graphical representations of mathematical functions to illustrate a particular point. The process of building such graphical representations on the blackboard, laborious as it might have been, allowed the instructor to tailor the explanation to the introduction of visual elements. In other words, the instructor controlled the pace of the discussion to highlight key concepts and support his verbalization of the concept.

The pace of lectures became constrained by the introduction of overhead transparencies. The instructor was reduced to scribbling notes and tracing color lines with a marker, right on top of the transparency. PowerPoint offers some powerful routines to either "build" a graphical element or annotate the element at a controlled pace.

The process of building a graphical element on a slide is presented in Figure 3.
Equation Building

In many cases, a lecturer may use algebraic manipulation to convert a particular mathematical expression into a more useful form. Again, this process was traditionally accomplished by judicious use of chalk and eraser, and overhead transparencies made the process more difficult.

Animated algebraic manipulations for a PowerPoint-based lecture require more work than other elements of the presentation. These manipulations can be prepared by the use of motion paths (see the menu reproduced at Figure 2). When done properly, an animated algebraic manipulation scheme can liven up a lecture at precisely the point when such stimulus is needed.

The Key to a Stimulating Lecture

As you learn to organize your teaching performance around these new sophisticated animation tools, it pays to keep in mind that you can put too much of a good thing into your lecture. Proper use of animation can significantly enhance a lecture; too much animation will distract the students from the fundamental goal of the lecture: to understand and learn the course material.

Conclusions

The three techniques discussed in this paper barely scratch the surface of potentially useful routines available in PowerPoint. In my experience, the use of such a limited menu of possibilities can accomplish much:

a) They significantly enhance the visual appeal of the lecture, providing a step in the right direction of approaching the expectations of students of the Net Generation

b) These visual enhancements can be programmed to provide the lecture pace and control of the traditional "chalk and talk" lectures

c) Incorporation of PowerPoint into a course introduces a learning curve that faculty should be prepared to traverse, if they are to keep up with the visual expectations of our students.

References

1. Draw the complete graph, using any graphics software (i.e. MS Paint) 
   Save it as "Image 3"

2. Erase some elements of the image; save this version as "Image 2". 
   Erase some more elements; save as "Image 1"

3. Place each of the "versions" on the PowerPoint slide, in sequential order, 1 at the bottom.

4. Set up a "wipe" animation for each (left or right, as appropriate). Control each individual "wipe" with a mouse "click".

5. Use the "Draw > Align or Distribute" commands in PowerPoint, to ensure a matching overlap of all the versions.

Figure 3. Steps in the Creation of a Dynamic Graphical Element
Biographical information

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