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Introduction

Innovative educational methods are of interest to new engineering educators and appear to be an important avenue for information transfer at the university level. Such methods are varied and include a broad range of instructional media from slides, videos, and filmstrips to comprehensive interactive computer-based multimedia. Despite these modern teaching tools, the lecture is not dead. In fact, it will continue to play an important role as a facilitator of information transfer between the experts and their classes.

This paper will review the characteristics of a good information transfer procedure and how the lecture meets these requirements. In addition, appropriate times when a lecture may be the optimal choice for information transfer will be suggested. With accents on potential pitfalls, the framework of a good lecture will be explored and related to three qualities: delivery, enthusiasm and content command.

Characterization of Information Transfer Techniques

One good way to characterize information transfer techniques is to say that it is a function of its delivery, enthusiasm, and content command and may, therefore, be written as:

\[ \text{Information Transfer} = f(\text{Delivery, Enthusiasm, Content Command}) \]

All viable information transfer techniques will have a significant weighting factor, i.e., high level of dependency on at least one of these characteristics. The task is to recognize the degree of coupling among these variables and the information transfer technique options available. Finally, the optimal technique must be tailored to the target audience.

It is useful to review these variables in the context of specific information transfer techniques. Important qualities of delivery include clarity, pace, and stimulation. Video productions certainly have the potential of a high weighting factor associated with delivery. For example, a well-produced video will be visually stimulating with the subject matter arranged in contiguous scenes that clearly present the message at a pace that most humans will find quite acceptable.

Currently at the apex of the enthusiasm variable is the computer-based multimedia presentation. Such presentations are usually characterized by a spontaneous and often unpredictable sequence of events. The capability to juxtapose time and space coordinates with this media demands high audience involvement. As a
result, these productions may project large quantities of free energy and ultimately inject some of that energy into the audience.

The third and last variable of the information transfer function, \textit{content command}, reflects the level of expertise and familiarity of the subject matter. An ultimate example for this variable is a well-documented non-fiction manuscript. Every engineering discipline has a plethora of texts and reference books that meet these criteria.

\section*{Lecture as an Information Transfer Technique}

An outstanding lecture is a difficult information transfer technique to master. It is the result of a speaker who understands and optimally manipulates the three functional variables of the information transfer model; delivery, enthusiasm and content command. Such a speaker selects the weighting coefficients of each variable and adjusts their values for maximum coupling with the audience even as the lecture progresses. To examine how the information transfer model is expressed in a lecture, specific lecture features will be analyzed with respect to the model variables.

\subsection*{Delivery}

The delivery of any information that is meant to be absorbed by the audience should be well defined as well as verbally and visually clear. The lecturer creates verbal clarity and definition with the following tools: short sentences, precise definitions, and specific repeated vocabulary. Visual clarity is accomplished with crisp single-concept visual aids. These aids must be designed for easy visual processing. They must have sharp contrast black and white or color features, large bold print type fonts, and uncluttered illustrations characterized by large blocks of empty space.

The second characteristic of delivery, pace, reflects the rate of presentation of the material. Pace should be compatible with both the degree of difficulty of the material and the background of the audience. The lecturer can manipulate the presentation pace in many ways. Good lectures contain the better known tools: well-placed pauses, focused repetitions, rhetorical questions, discussion-stimulating remarks, verbal or oral “pop quizzes”. or virtual excursions. Such excursions are often initiated with the phrase;

"Imagine you are a molecule (or gear, transistor, beam, etc.) and you"

The last characteristic of delivery, stimulation of the audience, is also important. The tricks that lecturers use to stimulate an audience are grouped under the headings of physical presence or presentation tone. Physical presence includes traits such as volume, pitch, diction, inflection, enunciation, and activities such as eye contact, hand and body motions, and proximity to the audience. Presentation tone is the use of tools such as comedy, drama, oration, story telling, etc., for mood adjustment.

\subsection*{Enthusiasm}

Enthusiasm is best characterized by its influence on the listener as well as the speaker. For the listener the impact is direct, immediate and short-lived. For good lecturers it should be the same. Unfortunately, many lecturers either behave like a dead mackerel or an effervescent used car salesman. In both cases the result is the same, the speaker is remembered not for what was said but how.

Like magnetism, enthusiasm is best detected and most effective when it changes. Good lecturers will
keep their audiences involved by adjusting the level of enthusiasm to meet the presentation’s immediate needs. The goal is to avoid audience inattention. Too much enthusiasm breeds multiple, uncontrolled audience chatter that only serves to raise the level of white noise in the room. Low levels of enthusiasm seed boredom, as can be detected by doodling, newspaper scanning, or even, completing different course assignments. Boredom ultimately results in contempt. This contempt is manifested as nonattendance, tardiness or snoozing in class. The task is to continuously adjust and couple the speaker’s enthusiasm to the audience as the lecture progresses to avoid either of these two extremes.

**Content Command**

In familiar engineering jargon, content command is characterized by a level of breadth and depth of knowledge of a particular subject. Unlike the other two variables of the information transfer model, the speaker must have complete control of the lecture’s content. Students always know and are always discontented when the professor does not have command of the material.

Unfortunately, developing content command for a particular course requires time and talent. Inevitably, a first year instructor, no matter what their talent, will struggle to deliver a JIT lecture. Eventually, this “Just-In-Time” survival strategy will wane and the real characteristics of content command will evolve. This maturity must develop before a lecturer has any hope of using content command as a tool to present a good lecture. If a lecturer must have complete content command to avoid student discontent, how can the lecturer adjust this variable to maximize the impact of the information transfer?

The answers are quite simple. The lecturer can stick to a well-planned script. Unfortunately, any deviation to a less familiar topic can cause the lecturer to present disjoint arguments and explanations and perhaps even incorrect information. Sometimes the lecturer skips details. And sometimes fantasy is used to facilitate the understanding of a complex concept. Interestingly enough, the latter two techniques are commonly used by good primary grade school teachers to fix complex ideas in young, blank minds. The only difference at the university level, is that the lecturer must adjust to an audience that has matured beyond tabula rasa, and, therefore, be more subtle and selective in implementing these tools.

Clearly, a lecturer needs to be able to adjust lecture content at will. It is only after the lecturer develops an intimate relationship with the material that such manipulations are possible. This is a highly developed skill because it cannot be uniformly applied across an entire lecture. There will certainly be some topics in a lecture for which the details must be reduced, modified, or omitted, and others in the same lecture that must be precisely developed to the last detail.

**Advantages and Disadvantages of Lectures**

Teaching experts throughout the world espouse the traditional occasions when a defined lecture maybe the best mechanism to get information to the students. According to McKcachie, lectures should be used when there is no available printed material, when it is necessary to provide up-to-date information on a subject, when materials from a variety of scattered sources must be integrated, when a broad outline of a body of material is to be established, and when an instructor wishes to set guidelines for independent study. Additionally, McKeechiae emphasizes that material can be presented in an alternate style than is traditionally done to better suit a particular audience. The lecture is also assumed to be the information transfer modality of choice when the audience will be large. What is it about the lecture format that stands the test of time? Alternatively, why is there a continued search for other methods of teaching?
The lecture format has offered, and continues to provide, an efficient method for transferring information. If a lecture is prepared properly, it can focus the students’ attention on the specific concept and bring together features of past learning experiences. Good lectures are dependent on the speaker and must be designed to suit the needs of the audience.

On the flip side, since the lecture is dominated by the instructor, students often assume a passive role, are easily distracted, and may not provide immediate feedback. This is particularly difficult to overcome when the class includes the full spectrum of student abilities. The lecture format tends to treat a classroom of individual students as a single entity with one learning style and cloned backgrounds. This lack of individualization is often seen as a major roadblock; however, students can and do learn with the proper combination of lecture and support materials (references, texts, homework assignments, etc.).

There is one more common “yin-yang” type experience associated with lectures. A major benefit available in the lecture information transfer technique is the ability to respond spontaneously to the student needs and questions. Unfortunately, if the instructor becomes too comfortable and neglects the responsibility to keep his material fresh, these questions never get asked and no student needs are ever identified. Ultimately, the presentation becomes routine and rote. The lecturer tends to rush through the material without making eye-contact. This in turn minimizes audience feedback and assures the presence of a communication chasm between the speaker and the audience.

Lecture Framework

To be sure, Winston Churchill and Howard Cosell were great speakers but did not usually deliver lectures. The term lecture refers to a classroom presentation rather than a formal speech or a blow-by-blow commentary. As such, lectures are required to have definition and structure to match their function. The classic structure of a lecture has been defined by many experts in the field. In general, its basic framework should include an introduction, a body, and a closure. Of course, there are a variety of good ideas for developing each of these parts, and the development of each is closely linked to the pace and timing of the lecture.

Introduction

Although engineering students are certainly not tabularasa, it is prudent to assume that as they enter the classroom, the on-going lecture is the last thing on their minds. Therefore, the first tasks are to mentally and physically corral the group. Richard Feynman, Nobel Prize winning Physicist and noted lecturer at California Institute of Technology, used to quickly quiet the din by beginning his lecture with statements such as “. . . I remind you that a summary of the last lecture topics is listed on the board to the right. Today, we are going to discuss . . . “.

Quickly taking command of the room is a primary precept of the introduction. Feynman used his opening gambit to accomplish this task. In addition, he was able to focus the class on previous lecture material and then direct their attention to a brief general overview of the current lecture. Alternative techniques that can be used in the introduction include raising a question that will be answered by the end of the lecture, explaining the relationship of the lecture to its professional “real world” applications, telling the students how they are expected to use the lecture material, or stating a historical or current problem that relates to the lecture content.

Body

The body is the predominant component of the lecture. The students are in the classroom to acquire the
information that is to be delivered during this part of the lecture. There are several approaches that work well to assist in assembling a coherent presentation of this important material. Some of these are, a problem-solution approach, a chronological approach, a cause-effect approach, and a topical approach.

The appropriate use of these approaches is where the difficulty in developing an effective body of a lecture arises. The lecturer cannot mix modes during one presentation. If a problem-solution approach was selected as the way to present the day’s material, it is ineffective to switch to a cause-effect approach in mid lecture or before completing the earlier solutions to the posed problems. In addition to not covering the intended material, a mode change always produces confusion for the students.

Once an approach has been selected, it is important to remember the following tips as the body of the lecture is being prepared. The lecturer should allow for:

- flexibility
- prepare illustrative examples for important concepts
- use simple and appropriate vocabulary
- insure frequent mental breaks
- use the blackboard to visually reinforce concepts and provide repetition of subject matter.

Ultimately, the lecturer must be prepared to balance all of these elements spontaneously so that the lecture content is related, rational, and relevant.

Closure

Closure does not mean conclusion. Seldom will an engineering lecturer be able to provide the ultimate conclusion by the end of the hour. However, the lecture must have several important elements of closure. It is important that main points be restated, students be made aware of where they stand in the search for the conclusion, and students do not leave with unanswered questions. Naturally, the answers to their questions may be incomplete, but they must give the student a sense of progress in their search for knowledge.

Ironically, during closure it is not a question from the students but to them that reveals the effectiveness of the presentation. The last activity that the lecturer should undertake is to pose some form of the following question, “What are the key ideas presented during this lecture?” If this is a habitual question at the end of every lecture, the students will be compelled to focus on the question during the lecture. As a result of this exercise, their answers will soon provide a true reflection of what was learned as a result of your lectures.

Summary

Lectures are a viable mode of information transfer. They are a structured medium that provides maximum flexibility for an instructor by allowing manipulation of the information transfer functional variables. With the careful adjustment of delivery, enthusiasm and content command, a good speaker can relate the lecture message to almost any audience under any circumstance at any time. This can range from Winston Churchill presenting an address during the bombing of London to Howard Cosell expounding on the dangers of boxing during his resignation from the Olympic Boxing Committee. Most likely, an engineering professor’s lectures will not have such an immediate global impact, but they will certainly have a lasting influence on the students enrolled in a course.
Therefore, it is in the best interest of teaching engineering that professors strengthen their ability to deliver good lectures. Engineering and other professions have historically relied on teaching their own how to teach. As Wankat points out, many professors are merely mimicking the inferior teaching to which they were exposed. Recognizing this flaw and other disadvantages, as well as minimizing their deleterious effects are only the beginning steps in improving the lecture. The lecturer must follow this with positive constructive steps that optimize the delivery, enthusiasm, and content command in every presentation.

Bibliography


Biographical Information

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