Enhancing Learning at the Polytechnic University: Interactive Classroom Techniques

Adeel Khalid[1], Bernice Nuhfer-Halten[2]

[1]Assistant Professor, Systems Engineering, Southern Polytechnic State University

[2]Professor, Social and International Studies, Southern Polytechnic State University

Abstract:

Polytechnic students often present a special challenge to instructors, not because those students are dull, but because they are smart. In this paper, the authors explore tools, techniques, and methodologies that instructors can use to keep the polytechnic students engaged, awake, attending, and interested in the broad fields of knowledge, including science, engineering, mathematics and arts. Simple techniques can be used to invigorate enthusiasm in students. It is observed that tools like using props, making connections with past, and quiz bowl keep students interested and involved. In this paper, authors discuss how teachers use deductive or inductive methods in different disciplines. Comparison is drawn between different methods to see which are applicable to the polytechnic students.

R.M. Felder [1] defines active learning in his research, "Active learning is anything course-related that all students in a class session are called upon to do other than simply watching, listening and taking notes." In student-centered teaching, research indicates that the focus in the classroom must shift from the instructor to the student. Students become actively involved in the teaching-learning process through activities that include brainstorming, problem solving, case studies, explaining, debating, etc. This is made possible by using deductive techniques of presentation, the Socratic Method, cooperative learning, etc. The abundant research we use includes the work of R.M. Felder, R. Brent, and others [2]. In addition, in order to avoid having these activities consume too much time, a method of constructing activities introduced by C. Knop will also be offered: Overview, Prime, Drill, Check [20]. Research also indicates an appropriate number of activities to be included in the class hour for effective learning in which the material is internalized and "owned" by the students.

A number of ideas are presented including highlighting the muddiest point, think-pair-share, quiz bowl exercise, use of props, candy questions etc. Additionally, various techniques like mind breaks, news share, and stretch etc. are discussed. Active learning is known to be more effective than passive learning.

Scholarship of Teaching and Learning

The Scholarship of Teaching and Learning (SoTL) is a growing movement in post-secondary education. SOTL is scholarly inquiry into student learning which advances the practice of teaching by sharing this research publicly [3]. Sharing the teaching style that an instructor finds useful in a classroom is what makes it scholarship.

SoTL builds on many past traditions in higher education, including classroom and program assessment, K-12 action research, the reflective practice movement, peer review of teaching, traditional educational research, and faculty development efforts to enhance teaching and learning. Terms closely related to the scholarship of teaching and learning are: good teaching and scholarly teaching. Good teaching promotes student learning and desired outcomes and is recognized by student satisfaction, peer review, etc. Scholarly teaching is regarded as an area of study. Teaching and learning knowledge base is regarded as an additional discipline in which expertise could be developed.

Research methods in SoTL include reflection and analysis, interviews and focus groups, questionnaires and surveys, content analysis of text, secondary analysis of existing data, quasi-experiments (comparison of two sections of the same course), observational research, and case studies, among others. As with all scholarly study, evidence depends not only upon the research method chosen but the relevant disciplinary standards. Dissemination for impact among scholarly teachers may be local within the academic department, college or university, or may be in published, peer-reviewed form [3].

In this paper we have explored various methods, techniques, tools and methodologies that faculty members in different disciplines at a Polytechnic University have used to enhance their teaching and student learning. The following list is not intended to be comprehensive. It is our desire to continue to grow the list and include all the possible methods that help improve student learning.

Interactive Techniques

The interactive techniques, as the name implies, are intended to get the student involved in the teaching and learning experience. Active learning refers to techniques where students do more than simply listen to a lecture. Students are 'doing' something including discovering, processing, and applying information. Active learning "derives from two basic assumptions: (1) that learning is by nature an active endeavor and (2) that different people learn in different ways" (Meyers and Jones [4]. Research shows greater learning when students engage in active learning. It is important to remember, however, that lecture does have its place and that an instructor should not do active learning without content or objectives. The elements of active learning are talking and listening, writing, reading, and reflecting [4]. Bonwell and Eison [5] state that some characteristics of active learning are:

Students are involved in more than listening, less emphasis is placed on transmitting information and more on developing students' skills, students are involved in higher-order thinking (analysis, synthesis, evaluation), students are engaged in activities (e.g., reading discussing, writing), and greater emphasis is placed on students' exploration of their own attitudes and values.

There may be some resistance to active learning by students who are accustomed to lectures, students who prefer passive learning, or students in large classes (who don't expect it). Bonwell et. al assert that the instructors need to prepare students. 'Explain your objectives and the benefits of the active learning techniques explicitly to students. Expect both successes and failures as you try active learning techniques. Solicit feedback on the activity afterwards from the students to improve it in the future.' Some active learning techniques take little faculty preparation and may be done spontaneously; others require much more preparation. Active learning techniques can occur in class or outside of class (e.g., computer simulations, internships, WWW assignments, class Internet discussion lists, independent study research). Active learning can be used with all levels of students from first year through graduate students. Teaching a mass class does not prohibit the use of active learning techniques; in fact, they may be especially important to promote interest and learning in a mass class.

Drueke [6] listed nine strategies to allow for active learning. These included:

1. Talking informally with students as they arrived for class.

2. Expecting that students would participate and acting accordingly.

3. Arranging the classroom to encourage participation including putting chairs in a cluster or circle.

4. Using small group discussion, questioning, and writing to allow for non-threatening methods of student participation.

5. Giving students time to give responses, do not rush them.

6. Rewarding students for participating by praising them or paraphrasing what they say.

7. Reducing anonymity by introducing yourself and asking the students for their names. Ask the class to relate previous library experiences as you do this.

8. Drawing the students into discussions by showing the relevance of the library to their studies.

9. Allowing students time to ask questions at the end of class.

Most of the approaches that Drueke listed are identical with minor modifications to points made by proponents of active learning [6]. This shows that with a little effort any lecture can be turned into an active learning experience.

Below, are a few examples of in-class active learning techniques used in small and large classes, and with all levels of students.

Jigsaw

An innovative active learning teaching technique is called a jigsaw [8]. Using the jigsaw, students work in groups studying an issue. Each of these groups works on a small portion of the overall issue. The jigsaw is put together when the groups report their findings to each other. This allows the entire issue to be covered in a single class but also allows for each student to be involved in learning the material. Ragains [7] wrote about his use of the jigsaw in library instruction at Montana State University at Bozeman. He successfully used the jigsaw to teach students skills in marketing research, mechanical engineering, historical methods, and earth science.

Most Important – Muddiest Point

The Muddiest Point is not only one of the simplest classroom assessment techniques; it is also remarkably efficient, since it provides a high information return for a very low investment of time and energy [9]. The technique consists of asking students to jot down a quick response to one question: "What was the muddiest point in_____?" The focus of the Muddiest Point assessment might be a lecture, a discussion, or an assignment.

The Muddiest Point technique provides information on what students find least clear or most confusing about a particular lesson or topic, which can tell faculty which points are most difficult for students to learn and to guide their teaching decisions about which topics to emphasize. This technique underscores the instructor's effort to help students master the course content and usually produces a powerful positive effect on their attendance and learning.

Think – Pair – Share

Think-pair-share is a cooperative discussion strategy that provides structure in the classroom while allowing students "think time" to internalize content. Students follow a prescribed process that keeps them on task and holds them accountable for their results.

The instructor gives students a task such as a question or problem to solve, an original example to develop, etc. Students work on this 2-5 minutes alone (think). Then they discuss their ideas for 3-5 minutes with the student sitting next to them (pair). Finally, the instructor asks or chooses

student pairs to share their ideas with the whole class (share). This technique has been used in classes ranging from 12 to 340 students [10].

Advantages of the think-pair-share strategy are that it does not take much time, motivates students with intrinsic rewards, can be adapted to all levels, engages whole or parts of a class, and allows instructor to circulate among the students to advise, correct, and evaluate students. The immediate reinforcement this process provides allows students to move from one positive learning experience to another with little time for wandering from the task.

Quiz Bowl for Studying

Quiz bowl is a fun, educational technique that utilizes a game format. This technique is derived from the TV show called College Bowl. In most cases, the quiz-bowl questions are based entirely on one subject, typically the subject covered in the previous lecture. But the instructor can make it interesting by including non-curricula questions. It keeps the students engaged and encourages them to actively participate in class. The amount of knowledge that students can absorb can be significant. Students learn from each other – the role of the instructor becomes that of a facilitator. Most of the participants in quiz bowl contests enjoy the experience especially when the instructor helps them relax and laugh at their own mistakes. Participants can get caught up in the contagious spirit of the game. Using this technique, the individual and team efforts are recognized. It provides an opportunity for the students to demonstrate their knowledge. While strong leadership and coaching contribute to individual or team success, individuals involved inevitably pursue their own independent learning through research for answers. Members can also learn by helping to develop questions for the quiz bowl [11].

Use of Multi-media

Multimedia has the potential to extend the amount and type of information available to learners. Multimedia can offer layers of beneficial resources, provide gratuitous information leading to frustration and overload, or anything in between [12]. For example, online encyclopedias can provide links to videos and additional articles on specific topics of interest. News stories can reference links to audio commentaries, replays of video footage, and links to websites with additional resources. Online instruction can include explanations, links to resources, simulations, illustrations and photographs, and myriad types of activities that can also include multiple media [12].

Well-designed multimedia helps learners build more accurate and effective mental models than they do from text alone. Shephard [13] synthesized studies showing potential benefits of well-designed multimedia, including:

1. Alternative perspectives
2. Active participation

3. Accelerated learning
4. Retention and application of knowledge
5. Problem-solving and decision-making skills
6. System understanding
7. Higher-order thinking
8. Autonomy and focus
9. Control over pacing and sequencing of information
10. Access to support information

Mayer also describes potential benefits of multimedia [14]. Given that humans possess visual and auditory information processing capabilities, multimedia, he explains, takes advantage of both capabilities at once. In addition, these two channels process information quite differently, so the combination of multiple media is useful in calling on the capabilities of both systems. Meaningful connections between text and graphics potentially allow for deeper understanding and better mental models than from either alone.

Use of Props

Props are mental or physical images used the classroom which helps students as they learn new topics. When well used, props can help better understand the course material. They can also be used to anchor the message, to get a laugh, and to wake up the group. They reinforce the point, support humorous interaction and introduce variety. Props can also prevent the instructor from becoming a 'talking head'. The information that the instructor wants to impart can best be understood, related to and used when real example is shown or used. The authors have extensively used props in the engineering and liberal arts classes and have found them to increase student interest in class and the course material in general.

Candy Questions

One of the greatest motivators to improve student behavior is to provide an incentive or reward for active participation in class. The author has used this technique in several classes over the years and has experienced that students are generally more motivated and interested in actively participating in class when they know that there is a possible reward. The instructor can ask oral questions from the material that was recently covered in class, and the student who gets the right answer gets the award. The award not only acknowledges the active participation from students, but students also get a sense of accomplishment when they receive the award in front of their peers. This also motivates others to actively participate. The word 'Candy Question' is used here symbolically. Careful consideration should be given to messages rewards and incentives send to the students receiving them. There are many effective ways to motivate students other than food. These include, but are not limited to, partial quiz grade, praise, extra credit, help teach class etc.

Mind Breaks

Mind breaks are used to refresh the listener's attention span during more demanding presentation components, for example, 'take a 2 minute break to chat with your neighbor before we move on…' [15]. The author often uses questions that are completely unrelated to the class e.g. in an engineering class, the author would ask 'what is the capital of Canada?' This helps students who have otherwise zoned out, bring their attention back to class. The exercise typically takes less than a minute but it prepares students to listen and pay attention for the next several minutes. The author also uses 'Asides' during the lecture. These include items of interest that may or may not be related to the course material. Students often admire the asides. The author has observed that often times, asides are the most important item students will remember from a class.

News Share:

One of the ways to give a mind break is to have students share the latest news from around the world. The author has used this approach and found it effective. It gives all the students a chance to participate in class. The instructor can spend the initial few minutes every once in a while or do this exercise in a middle of a long lecture. It gives all the students a sense of presence.

Hand Raise – Stretch:

If an instructor teaches a long class, it is inevitable to become tedious for students to sit through it. One of the ways to give a 'mind-break' is to have all the students stretch their arms or standup in their places for a few moments. This helps re-circulates blood through the body and gets the students focused again.

Engaged Tests

The educational literature indicates that student engagement is generally recognized as one of the better predictors of learning [16, 17, 18]. Thus, creating classroom conditions that enhance student engagement will lead to increased student learning, which is a primary goal for both students and teachers [19].

There are a number of ways to engage students and grade them during the process. Instead of traditional tests, students can be asked to record the material and present a video of their material in class. The grades can be based on their performance in the video and peer evaluations. The videos can even be uploaded to social media sites e.g. youtube and students can be asked to review all the class videos outside the class. Students can also be asked to present their material in an online environment. Several universities including Southern Polytechnic State University offer online classes and use the online portals that are accessible to all students. These engaged tests get students motivated. Often times they put in more time and effort and therefore end up learning and retaining the material for longer time.

Overview, Prime, Drill, Check

Constance Knop developed a model for setting up and carrying out classroom activities [20]. This model applies to exercises as basic as mechanical grammar drills and as complex as small-group role-plays, and listening and reading activities using authentic texts. This paradigm is useful for setting up activities, giving clear instructions, getting students "on task" right away, following through without wasting time, and checking to see that students actually understood and learned.

It is a strategy for helping instructors systematically and consciously plan their lessons. By using the sequence of "overview, prime, drill, and check," instructors can be certain that they have included an introduction and motivation to an activity, examples and review of material necessary for conducting the activity, varied and appropriate drilling techniques, and evaluation of students' progress. This sequence gives instructors a secure base for lesson planning, and attempts in this way to reduce the insecurities and anxieties felt by so many novices at the start of their practicum. In addition, this approach can be used as a means of analyzing the teaching and learning actually accomplished in a class. Thus, it could become an instrument for developing skill in self-critiquing which may well be the most valuable and long-lasting skill that instructors can develop [20].

Cone of Learning

Dale's Cone diagrams effectiveness of learning according to the media involved in learning experiences [21]. The chart illustrates the results of research conducted by Edgar Dale in the 1960s. According to Dale's research, the least effective method, the top of the cone, involves learning from information presented through verbal symbols, i.e., listening to spoken words. The most effective method, the bottom of the cone, involves direct, purposeful learning experiences, such as hands-on or field experiences.

Confucius once said:

"If all I do is hear, I will forget. If I hear and see, I will remember. If I hear, see and do, I will understand"

The original labels for Dale's ten categories are: Direct, Purposeful Experiences; Contrived Experiences; Dramatic Participation; Demonstrations; Field Trips; Motion Pictures; Radio – Recordings – Still Pictures; Visual Symbols; and Verbal Symbols. Learning by doing is generally longer lasting than learning by seeing. The author believes that one of the best teaching methodologies is to get the students involved in the process – often known as student centered learning. In the Dale's cone of learning, reading, hearing and seeing are considered passive forms of learning. In other words, the student is not actively involved in the learning process. Dale claims that students are only likely to remember in two weeks, 20% of what they read and hear. Whereas, when students are encouraged to participate in class either by presenting, asking questions, answering questions, and demonstrating what they have learnt, they are actively

engaged in the process. Dale claims that, after two weeks, a student is 90% likely to remember what they say and do.
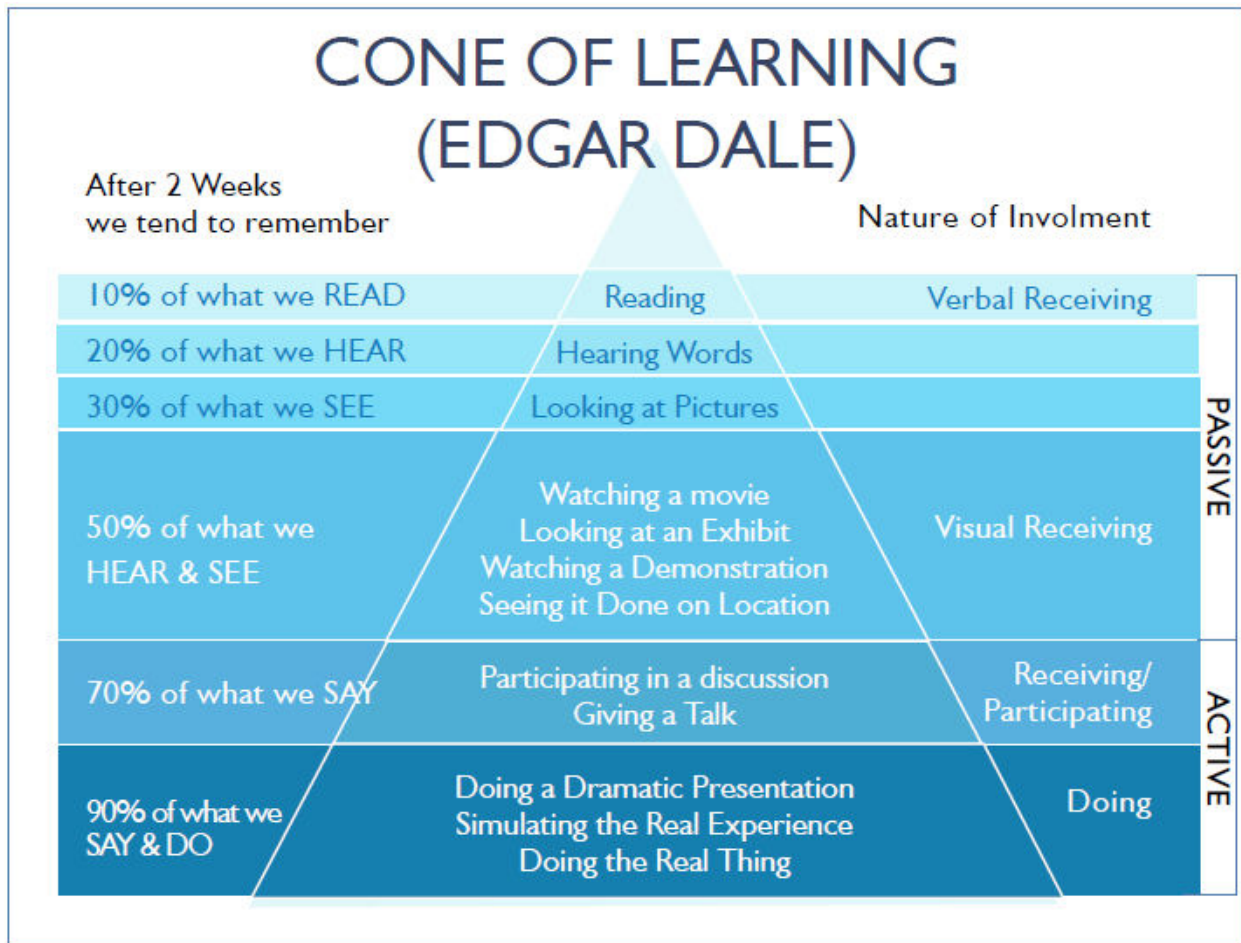
CONE OF LEARNING (EDGAR DALE)

After 2 Weeks we tend to remember | | **Nature of Involment**

10% of what we READ	Reading	Verbal Receiving	PASSIVE
20% of what we HEAR	Hearing Words		
30% of what we SEE	Looking at Pictures		
50% of what we HEAR & SEE	Watching a movie / Looking at an Exhibit / Watching a Demonstration / Seeing it Done on Location	Visual Receiving	
70% of what we SAY	Participating in a discussion / Giving a Talk	Receiving/ Participating	ACTIVE
90% of what we SAY & DO	Doing a Dramatic Presentation / Simulating the Real Experience / Doing the Real Thing	Doing	

Figure 1: Cone of Learning[21]

Getting students actively engaged will result in long lasting learning experience and make the learning interactive. Often time students remember the material because of the activity they participate in.

Scholarship

Some of the techniques discussed above have existed for years and other are relatively new. These have all successfully been implemented in various disciplines. The primary goal of this research is to identify a few techniques that are most applicable in polytechnic institutions. The secondary objective is to emphasize the fact that the ideas can become scholarship when shared

with the larger academic community. Scholarship has been defined as a systematic reflection on teaching and learning made public [22].

Conclusion

In this paper, the authors have identified a number of interactive classroom techniques. These techniques are used to actively engage students. Research has proven that active classroom participation leads to better learning and longer retention. The techniques discussed include jigsaw, muddiest point, think-pair-share, quiz bowl for studying, use of multi-media, use of props, candy questions, mind breaks, engaged tests, and overview-prime-drill-check. This is not a comprehensive list of techniques. The goal of the authors is to continue to explore other ideas, techniques, methodologies that can help a polytechnic instructor to become an effective teacher and help students learn the material better.

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