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A Mind Map for Active Learning Techniques

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A Mind Map for Active Learning Techniques

Abstract

This evidence-based practice paper describes the creation of and use of a mind map of popular active learning techniques. When faculty members are learning about the implementation of active learning for the classroom, the scope and breadth of techniques can be confusing (or overwhelming) for the beginner. Questions such as "where do I begin," "how deep is the student learning," or "how much prep-time is necessary" are common. A mind map has shown to be useful in categorizing and sorting through the plethora of techniques. The mind map has been used in scores of faculty development workshops and presented to more than 1000 faculty members who are focusing on the implementation of active (and student-centered) learning. The hierarchical mind map breaks down collaborative and non-collaborative classroom techniques with the collaborative techniques divided into four "levels" of preparation and student engagement. This paper can be presented as either a lightning talk or traditional lecture.

Introduction

Increasing emphasis has been placed on the engineering education community to implement student-centered pedagogies which can increase retention and offer the students a more authentic ("real-world") experience. These pedagogies have proven to be more effective than the traditional "chalk-and-talk" passive lecture methods, and include challenge-based learning (e.g., problem-based learning, project-based learning, case-based learning, inquiry-based learning [1]) and a multitude of active/collaborative techniques (e.g., think-pair-share, quick think, jigsaw, and gallery walk). All of these learning methods excel in student learning of content as well as a variety of process skills such as critical thinking, higher-level reasoning, differentiating views of others, and teamwork [2], [3]. They are also highly effective with individual student accountability [4]. In addition, they have proven to be successful pedagogies within STEM education, in particular with regards to achievement, persistence, and attitudes [5].

In May 2009, Lawrence Technological University (LTU) embarked on an eight-year faculty development initiative that would modify 75% of the courses in the engineering curriculum to include active collaborative learning (ACL) and problem-based learning (PBL). Besides traditional engineering courses, such as statics and design, the modified courses include those in the general education core curriculum, such as calculus, history, literature, communication, and the natural sciences. As such, the course modification process trained more than 60 faculty members from multiple departments within three colleges. Each faculty member participated in the two-year faculty development program which consisted of two one-week-long workshops, report-back accountability sessions, closing-the-loop sessions, support teams of faculty from related content areas, coordinators, peer-reviewers, and a leadership team of university administrators, faculty, and staff [6].

The impetus for the faculty development program was a grant from the Kern Family Foundation which set forth to instill the entrepreneurial mindset in engineering undergraduates. LTU was part of the first cohort of partner institutions in the Kern Entrepreneurial Engineering Network

(KEEN, which currently consists of ~60 institutions of engineering education) [7]. Through mapping of entrepreneurial mindset attributes to ACL and PBL process outcomes [6], [8], ACL and PBL were chosen as the primary pedagogical techniques used for course modification. As an additional pedagogical technique, faculty were also trained on group/team dynamics, team formation and composition, and other elements of effective teamwork, but were not required to uniformly adopt a specified team size, etc. This allowed for flexibility for individual course needs and instructor desires.

The first workshop in 2009 focused on PBL, and experts Mark Serva and Richard Donham from the University of Delaware facilitated the PBL workshop. In the following year, the workshop focus was ACL, and LTU brought in expert Karl Smith from the University of Minnesota and Purdue to facilitate the workshop. A new cohort of faculty began the PBL/ACL training during the third year of faculty development, and by then LTU faculty from the first cohort were able to facilitate the faculty development program. Within another year, four LTU faculty members (and a faculty member from Saint Louis University) were asked to facilitate workshops at other institutions (while the faculty development program at LTU continued with more new faculty cohorts). Soon thereafter, KEEN adopted and implemented essential nationwide faculty development programs based on the formative LTU workshops.

The Need for a Map

The workshops demonstrate a multitude of active learning techniques. Many of the techniques can be found in comprehensive texts such as [9] and [10]. When the LTU faculty development facilitators first began to correlate the workshop content from Serva, Donham, and Smith, they found difficulty in building an incremental learning process for the workshop participants. As the workshop participants were experiencing active learning techniques for the first time for the classroom, the scope and breadth of techniques was found to be confusing (or overwhelming) for the beginner. As they were asked to choose and implement ACL techniques for their own classroom, questions such as “where do I begin,” “how deep is the student learning,” or “how much prep-time is necessary” arose. It was becoming clear that a guidebook or map to organize, categorize, and sort through the plethora of techniques was necessary.

Student-centered Learning, ACL, and PBL

Active learning has been defined as any instructional activity that engages students. Collaborative learning is a pedagogical technique where students work in small groups to reach a common goal [3], [8]. Cooperative learning is similar to collaborative learning, but the student groups are more structured in the cooperative learning (among other subtle differences) [11]. For the course modification program at LTU and subsequently the KEEN faculty development programs, faculty are implementing both formal (cooperative) and informal (collaborative) techniques into their courses. For implementation, these pedagogical techniques are collectively referred to as Active and Collaborative Learning (ACL). The literature suggests that ACL is highly effective at improving student learning outcomes if properly implemented [3], [11]-[13]. In an analysis of over 300 experimental studies over a 75 year span, ACL was found to have multiple beneficial outcomes [2]. These include higher achievement and retention of material, critical thinking and higher-level reasoning, differentiated views of others, accurate understanding of others' perspectives, liking for classmates and teachers, liking for subject areas, and teamwork skills. These outcomes are highly general and have been shown to apply to postsecondary STEM education where the main effect of small group (predominantly cooperative) learning on achievement, persistence, and attitudes was significant and positive [5].

Problem-based learning is a highly-formalized ACL which can often be extensive in scope and scale. "The principal idea behind PBL is that the starting point for learning should be a problem, a query, or a puzzle that the learner wishes to solve" [14]. PBL often incorporates less-formal/shorter ACL techniques as part of the overall process and typically have the following common features:

- Learning is initiated by a problem.
- Problems are based on complex, real-world situations (and usually open-ended).
- All information needed to solve problem is not given initially (i.e., ill-defined).
- Students identify, find, and use appropriate resources. (Therefore along with the previous point, it is common that the elements of the problem are "scaffolded," "staged," or "progressively disclosed.")
- Students work in permanent groups.
- Learning is active, integrated, cumulative, and connected.
- Students report solutions [15].

In PBL, the problem is the organizing focus and stimulus for learning. Since new information is acquired through self-directed learning, the teacher acts as a facilitator or guide.

The Mind Map

The attention span of a college-age student during a lecture has been substantially studied and debated. The consensus has determined that it is between 10 and 15 minutes [16]. Regardless of the actual attention span, studies have shown that interspersing active learning throughout a lecture increases attentiveness of students [17]. Thus there is clearly a place for simple one- to three-minute student engagement activities. Additionally, there are those moments when a more complex and nuanced activity is in order to demonstrate or emphasize course content. These activities may require anywhere between a quarter to a full class period. Finally, there are those learning moments where a simulation of real world problem solving or discovery is in order. These are activities that can take a substantial amount of class time or even span multiple class periods.

As the faculty development facilitation team began to plan and organize the structure of a comprehensive ACL/PBL workshop, it became clear that the participants needed some method to categorize the variety of active learning techniques. The team knew that some instructors may want to implement a variety of quick but effective activities, while others may want to create an extensive active learning experience for a "big" topic. How would the facilitation team clearly delineate the various "levels" of ACL and arrange them in "easy to digest" workshop modules? A list was created of all the techniques that could be fit into the workshop, and then the list was informally broken into a hierarchy of "student impact" (i.e., how deep may the material be learned) and "time on task" (i.e., how much time does the ACL require). The breakdown cannot be confirmed; there is no official documentation or research publications that compare and contrast a variety of classroom techniques for impact and time. With that said, collaborative and non-collaborative techniques can be categorized, as can formal (cooperative) vs. informal (collaborative) active learning. At this point, a mind map was beginning to form. The last difficulty was determining how many “levels” of informal ACL should exist and what techniques should be placed in each level. Three levels of informal ACL were determined to be appropriate, with the caveat that Level 3 are borderline formal ACL. After three years of trial and error, with input from faculty (i.e., workshop facilitators and participants) implementing and studying the various techniques, a mind map was created as shown in Appendix A.

Two very important points should be made about the mind map as presented here. First, a mind map is simply a way to organize ideas, concepts, techniques, etc. It should not be considered a one-size-fits-all final objective document. It should be considered a living document wherein the contents can be expanded, techniques can be moved to other levels or removed altogether, etc. For example, there are no set rules on the amount of time spent on a Rank Order and how deep of a learning impact it may have on the students. The author has witnessed a Rank Order with only five items to rank by each individual student for a total class time of about 8 minutes including reflection. Also witnessed is a Rank Order with 15 items to rank, first individually, then in pairs, and finally in teams of four. By this means, the Rank Order takes about 50 minutes including reflection and discussion. Any ACL activity depends largely on the creator and implementer (i.e., what works for one class will not for another). As another example, a “compare or contrast” quick think could be developed as a Level 1 or Level 2 ACL.

Second, the mind map as presented here should be taken for what it was intended. This mind map is intended for a three- to five-day workshop which covers these specific techniques following the widely accepted methods of implementation. Obviously, not all ACL techniques are on the map, and there is intentionally much detail on PBL but not the other formal learning techniques. As stated earlier, the map can and should be added to or allow for deletions – depending on the faculty development program.

Implementation

The mind map presented in Appendix A was created using simple drawing tools available on Microsoft applications; thus workshop facilitators can create their own or can acquire a high resolution digital copy by contacting the author. The mind map here has been distributed to over 1000 faculty members (including K-12 and higher education) in North and South America and Europe. It is presented early during a workshop (typically in both hard and digital copy) so that it can be used as a Table of Contents of sorts throughout. When workshop facilitators are presenting a level or category, they will refer to the map often so that the participants can see where the techniques they will be learning about fit into the big picture. The material does not have to be presented in the order (top to bottom) as presented in the map. In fact, the contents typically have not been presented in the order shown. Often, the workshop facilitators that have been using the map will begin with the participants engaging in a PBL activity, because it gives a very clear picture of student-centered active learning.

During a workshop, participants are often given “development time” where they can begin constructing ACL/PBL activities to fit their learning objectives. During this time, most the participants will keep the hard copies of the map next to their laptops for quick and easy reference. Some will even informally map the Bloom's Taxonomy level of their learning objective(s) to the ACL level(s).

While there is no direct assessment of the effectiveness of the mind map (remember it is not a one-size-fits-all final objective document), much evidence has been relayed to the author of its usefulness. Workshop participants that have advanced to facilitate their own workshops (in particular, at their own institutions) have distributed and taught from the map. It is known that Worcester Polytechnic Institute, Western New England University, University of Dayton, and Lehigh University have used the map extensively and continue to distribute it to faculty who are applying ACL for the first time.

Finally, the map has shown to be a useful tool for experienced and junior faculty alike. Many faculty members keep the map with their course development materials as reference when creating new classroom content. It is consider a one-stop-shop for choosing a classroom technique without wading through various texts and internet sources describing the techniques.

Conclusions

Faculty development workshops on developing and implementing student-centered active learning techniques can be overwhelming and confusing for the participants. Based on a need to organize, sort, and categorize the various ACL techniques, a mind map has been created that displays the techniques in a hierarchical fashion with the easiest to implement and lower impact techniques at the top, and the more time-intensive (for the instructor/organizer and student) and deeper impact techniques at the bottom. The mind map has been shown to be useful for facilitators teaching the techniques, beginners organizing their thoughts on what would work for their class and material, and veteran faculty that are simply looking for a one-page comprehensive listing of techniques to implement. The reader is encouraged to use the mind map as seen fit and edit it for one's own purposes.

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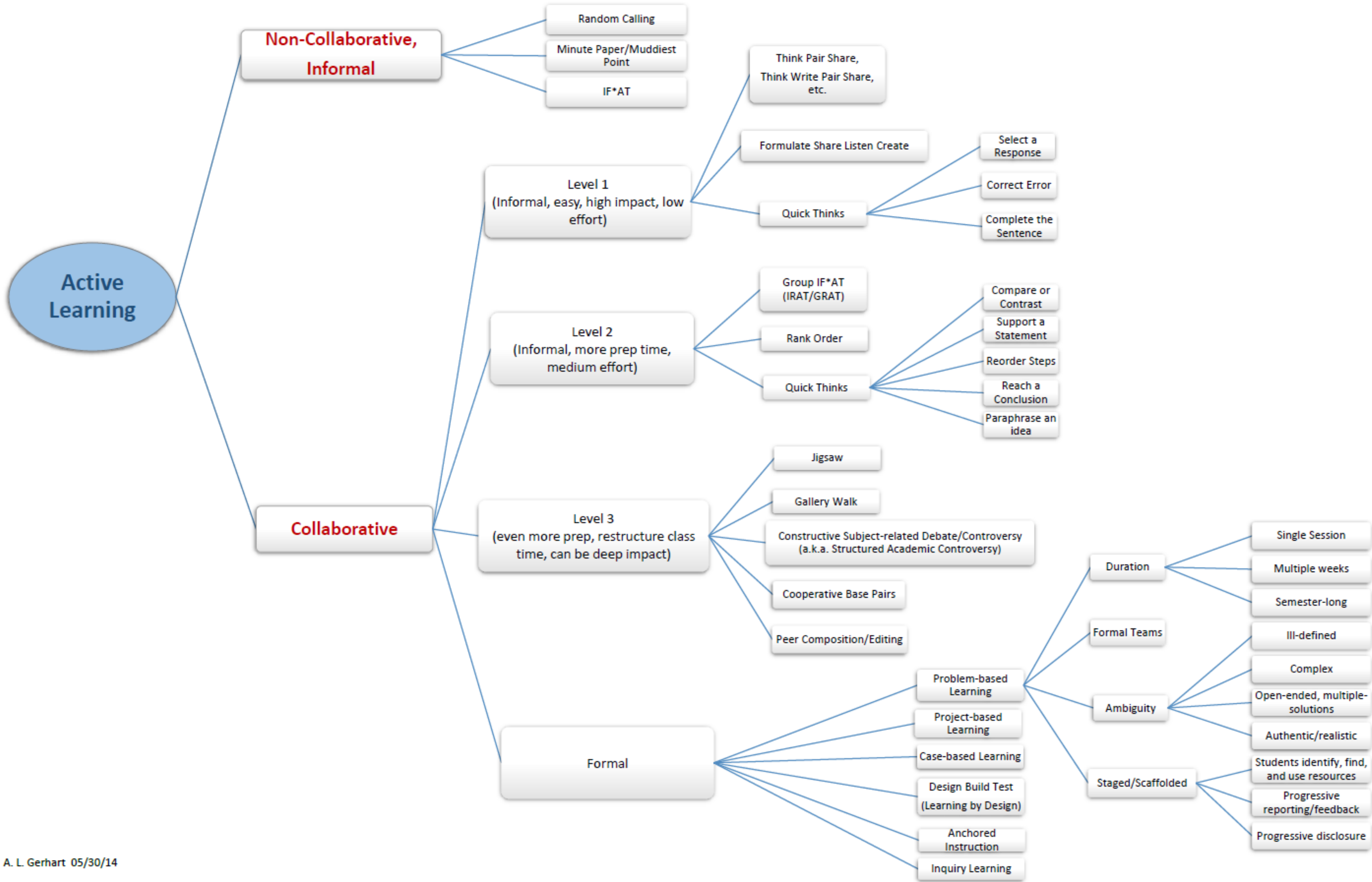
Appendix A – Mind Map for Student Centered and Active Learning Techniques



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