Active Learning in Small Groups

GROUP MEMBERS

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CHARGE FROM THE STEERING COMMITTEE

The charge to this study group was to review the literature and other curricula to learn as much as possible about active student learning in small groups, the rationale for this type of learning, the structure of small groups and their interaction with group leaders, tutors or resource faculty. In the process models or descriptions of group learning such as problem based learning and case based discussions should be identified and discussed. The application of the small group process to various segments of the curriculum should be defined. Once a broad overview or generic look at active learning in the small group process has been completed, the information will be used to assist the various segments of the curriculum in designing delivery systems.

EXECUTIVE SUMMARY

The Active Learning in Small Groups Study Group held its first meeting on January 11, 1999, and met six times over the course of the next three months. The group has completed its task by submitting the following recommendations.

RECOMMENDATIONS

1. Learning should be organized around patient problems, including during traditionally defined clinical rotations. These events can include using multispecialty/ multidisciplinary rotations, such as the Breast Center or the Geriatric Evaluation and Treatment Clinic.
2. Educational events should be student-centered, as much as possible.
3. Students initially will need help in adapting to a new educational structure.
4. Students will need some direction where they are heading with each curricular segment. (What are the objectives for this segment?)
5. Small group activities should comprise between 60 and 80 percent of the curricular time. These small group activities can include:
    a. PBL format
    b. Clinical skills sessions
    c. Clinical rounds
    d. One on One Mentoring
    e. Gross anatomy labs
    f. Microbiology lab
    g. Mixed year groups
    h. Mixed clerkship group
    i. Senior student mentoring
    j. Technology education
6. Educational events should occur which support the small group activities. These should include sessions with content experts.
7. Pre-clinical education should match as closely as possible the clinical setting where students will be using the information.
8. Need to have consistent expectations of the small group activities and students across the years in all areas: cultural, expectations, and assessment. The faculty is responsible for assessing all domains in which the students participate.
9. Clinical years should use small group process along with content experts from both the clinical and basic science domains.
10. The constituency of small groups should vary over the course of the curriculum. These groups should, at times, include students from the same class as well as more senior or junior classes.

Issues to Address for Implementation

1. Faculty will need to be recognized and given credit for direct on to one teaching as well as development and maintenance of the infrastructure of the system.
2. Faculty will need knowledge and skill development in becoming a facilitator versus instructor.
3. Resources for the space needs of the curriculum will need to be identified.
4. Assessing how faculty across departmental lines will need to be supported needs to be assessed and managed.
5. Student assessment must evaluate the content and process of what happens in the small group activities.
6. A thorough introduction to the curriculum needs to occur each year for matriculating students.
7. Given the number of faculty in designing and delivering the curriculum, a continuous quality management program needs to be in place for the all aspects of the curriculum and its delivery.

> To begin with, the fact must be accepted that one cannot expect to become a skillful practitioner of medicine in four or five years allotted to the medical curriculum. Medicine is not a trade to be learned but a profession to be entered. It is an ever-widening field that requires continued study and prolonged experience in close contact with the sick. All that the medical school can hope to do is to supply the foundations on which to build. When one considers the amazing progress of science in its relation to medicine during the last thirty years, and the enormous amount of scientific material which must made available to the modern physician, it is not surprising that the schools have tended to concern themselves more and more with this phase of the educational problem. And while they have been absorbed in the difficult task of digesting and correlating new knowledge, it has been easy to overlook the fact that the application of the principles of science to the diagnosis and treatment of disease is only one limited aspect of medical practice.
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> The Care of the Patient. JAMA, 1927. [1]

> The aim of medical education is to produce doctors who will promote the health of all people, and that aim is not being realized in many places, despite enormous progress in the biomedical sciences… These defects have been identified for a long time, but efforts to introduce greater social awareness into medical schools have not been notably successful. Such facts have lead to mounting concern in medical education about equity in health care, the humane delivery of health services, and the overall costs to society.
>
> World Federation for Medical Education, 1988

> Over the last 60 years, most medical schools have done little to correct the major shortcomings in the way they educate their students, even though these deficiencies have been documented repeatedly.
>
> Association of American Medical Colleges, 1992

Active learning and small group teaching are deeply interrelated concepts. Both are important features of PBL. They represent two different types of theories, however. Activeness is a theory about how we learn, that is it is a learning theory. Teaching in small groups, on the other hand, is a theory about how we can encourage and support learning in others. It is, as a consequence, a pedagogical theory.

Understanding how adults learn is important when trying to decide on the format of learning that should be applied. Adults use experience as a major resource in learning situations. They tend to be life centered. They use active participation. They learn best in a comfortable supportive environment.

In addition to educating adults, medical schools also aspire to develop expertise in their students. Expertise is highly dependent on the application of knowledge gained through learning and experience. The development of expertise is dependent on learning from experience, not just having experience. Or as Bereiter and Scardamalia phrase it, learning within the experience.

The means in which people acquire and incorporate new information (learn) has been described by Regehr as a process involving four domains.

Meaningfulness of the Information

Learning and retrieving information is easier if it is made to be meaningful in some concrete way. Pre-clinical students often are asked to learn disconnected lists of information. As a result students memorize. Instead, since meaning has an important function, we should use "just in time" learning. This is where information is provided at the time when students have a perceived need for it. Students will incorporate information that they recognize is vital to them. Research findings also conclude that preparation for tests that emphasize retention of facts often leads to the acquisition of "inert" knowledge, encapsulated information that is rarely accessed again unless a specific cue to activation is given, such as an expected examination question.

Encoding

The way that we learn something affects the way we can retrieve it from memory. We often organize teaching in the pre-clinical years around diseases. We teach a disease with a list of features that go along with it. In the clinic, however, the process is reversed. We see features of a disease and have to identify a diagnosis for the patient. The way that the information was learned or "encoded" in the first place is inconsistent with how we expect students to bring the information back. A suggestion is to match the training with the task; that is, we should teach around a patient presentation. Also, there is inefficacy in wisdom gleaned from other's experiences. While clearly people can learn something from the imparting of information, what they do not acquire are the sensitivities necessary to use relevant information in new situations.

Context

The context is an important memory aid and can serve as a powerful retrieval cue. For students, pre-clinical learning usually occurs in a lecture room. When students are put into the clinical setting, it becomes more difficult for them to retrieve information. That learning is not a simple process of passively stockpiling a store of facts about the world is an well-accepted finding, substantiated by Piaget's (1953) empirical studies of the conceptual development of children. This is not to say that one can not learn in a passive way, but rather that information so acquired tends to be "inert": that is inaccessible and difficult to apply in real world contexts.

Practice

Any skill requires practice. Practicing the retrieval of a piece of information will increase the proficiency of retrieval. There is not a specific retrieval skill. It is better to train people to bring back defined pieces of information. In medicine, we tend to use the vaccination approach: when students have learned something, they do not need to learn it again. Instead, we should continuously reinforce the retrieval of previously learned information. Knowledge acquired in the context of practice will not only be more accessible for use in similar contexts, but will be qualitatively different from the "same" knowledge presented outside of such context.

Some researchers have concluded that traditional schooling practices interfere with the development of expertise because content knowledge is artificially isolated from contextual knowledge. They propose an apprenticeship model in which learning occurs in the context of practice and instruction involves modeling the behavior students are to acquire, coaching or observing students in action and providing guiding feedback, scaffolding, or providing assistance for tasks that students demonstrate an inability to accomplish, and fading, the gradual moving out of the performance situation so that students stand on their own. Glaser (1984) emphasizes the value of teaching thinking in the context of the acquisition of new knowledge. Inquiry approaches to instruction use newly acquired knowledge (or knowledge being acquired) as a vehicle for honing reasoning skills. In such approaches the teacher persistently confronts students with cases, counter-examples, demands for prediction and other forms of the Socratic dialogue, repeatedly challenging their thinking process within a content domain. Subject matter content serves to promote the development of sound reasoning and problem solving.

Therefore, in order to ensure that there is not a gulf between pre-clinical and clinical years, we should make sure that the pre-clinical education matches as closely as possible the clinical setting where students will be using the

information. Specific recommendations, from several authors, include using small group content; organizing teaching around patient presentation, not diagnoses; and mixing in previously-studied with new information, to help in retrieval.

Small Group Learning

Benefits of small group learning include 1) gaining a sense of ownership 2) active participation in the learning process 3) obtaining immediate feedback on mastery of material 4) allowing students to become "teachers" and thereby strengthen their understanding of the material 5) a more supportive environment for learning. In addition small groups facilitate dialogue, reflection, discovery, collaboration, active listening skills and skills in conflict resolution.

Although many articles on the topic of small group learning cite historical sources, including the Koran, the topic is addressed in accessible literature as early as the 1940s. Benne and Sheats (1948) and Bales (1950), suggested that students could learn some things more effectively in collaborative groups than they can on their own. This idea was revisited by Abercrombie (1979) and has subsequently been repeated by most others who have written on the topic.

Not only do students appear to learn more effectively in collaboration, there is sufficient evidence to indicate that student whose learning occurs in groups discover that there are multiple ways to view and approach most issues and problems. Collectively, group members individually acquire understanding with greater breadth, depth, and accuracy than they would independently in the same amount of time . These authors continue to state that, due to the power their teachers have in their lives, some learners uncritically accept their teachers' points of view and suspend, or never develop, their own thinking. In this regard, the National Panel on the General Professional Education of the Physician and College Preparation for Medicine (1984) did recommend increased opportunities for students to be active learners and reduce the amount of time they are expected to listen passively to others.

The concept and practice of small group learning has many forms and applications. Many authors take great pains to explain that small group learning is not the same as problem based learning and vice versa. Many phrases have been introduced: facilitated learning, cooperative learning, problem based learning, collaborative learning, project-oriented, practice-based, and case-based sessions. Project-oriented education appears to be popular among some engineering programs. Practice-based learning is an approach to continuing medical education among Canadian physicians . The comprehensive-case method is popular among business schools . Many medical schools use a case-based approach. Case based learning (learning in a small group setting, centered on a patient case) additionally allows for information to be gathered in a clinically meaningful way.

Popular as case- or problem-based learning is with some educators, its principal advantages are embedded in the larger context of "collaborative" small group learning. "Collaborative learning" refers to an instructional method in which students at various performance levels work together in small groups toward a common goal. Collaborative learning may include case-based learning, but it is possible to use collaborative learning paradigms that are not case-based. Case-based learning is not always a welcome teaching tool to basic science teachers, who (with some justification) fear that clinical material can come to dominate the instruction in the first two years of the curriculum -- at the expense of proper education in the relevant academic disciplines. The collaborative learning paradigm addresses this concern of the basic science teachers and also the larger and more important concern having to "water down" our course work to make space for the clinical material. Proponents of collaborative learning claim that the active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking. Johnson and Johnson report that there is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than students who work quietly as individuals. Cooperative learning fosters the development of critical thinking through discussion, clarification of ideas and evaluation of other's ideas. However, drill and practice and collaborative learning are found to be equally effective in gaining factual knowledge. Therefore, if the purpose of instruction is to enhance critical-thinking and problem solving skills, then collaborative learning is more beneficial.

For collaborative learning to be effective, the instructor must view teaching as a process of developing and enhancing a student's ability to learn. The instructor's role is not to transmit information, but to serve as a facilitator for learning. This involves creating and managing meaningful learning experiences and stimulating

students' thinking through real world problems. This change in role of instructors led to the creation of the concept of "student-centeredness" versus "teacher-centeredness" education.

The student versus teacher centered dimension relates to the extent to which, in any course, the learners have responsibility for learning and can influence what, how and when they learn. In a true "student-centered" course, students may also set themselves assessment targets and judge how well they have reached these, for example by setting up a learning contract with their teachers. While this degree of autonomy is unusual in medicine, it is not uncommon in other subjects. In contrast, teacher-centered curricula attempt to use the teacher as a role model, repository, selector and communicator of knowledge, assessor and standard setter. In some schools basic science curricula epitomized the teacher-centered model. "Vast quantities of knowledge were poured out in lectures to passive students who were expected to absorb and regurgitate it later to prove their readiness for the clinical arena."

Student-centered curricula may be more appropriate when the school wishes to emphasize the student's roles in the curricula, to increase motivation, or to prepare for continuous learning. Teacher-centered approaches place fewer demands on teachers, or may be appropriate where students traditionally are passive in their approach to learning.

This distinction, between being a facilitator of learning versus being solely a provider of information, is important, because to encourage lifelong, self-directed learning skills, the curriculum must become student-centered, not faculty-centered.

In medical schools throughout the world PBL is the name that has come to be given to any curriculum or segment of curriculum in which there is small group interaction and medical problems are somehow involved. This very broad definition obviously allows for many variants of small-group teaching. (See Appendix A). Because they all are labeled Problem-Based Learning, it makes it virtually impossible to predict a uniform set of outcomes. Unfortunately, in the literature most studies of the efficacy of problem-based learning fail to acknowledge that results do not generalize across all programs labeled PBL. Similarly so-called meta-analysis of data as to efficacy of PBL are difficult to assess because they fail to distinguish among the variants in PBL programs.

Problem Based Learning has an approach with many variations (see Appendix D), but the key ingredients are

- active learning through posing questions and seeking answers
- integrated learning by tackling problems for which knowledge of several sub-disciplines is necessary
- cumulative learning, by a succession of increasingly more complex problems, working up to those which would be typically handled by a young professional
- learning for understanding, rather than for the retention of facts, by providing time for reflection, by frequent feedback, and by opportunities to practice the skills which have been learned.
- adapting to, and participating in change
- problem solving in unfamiliar situations
- reasoning critically and creatively
- using a systems, or holistic approach
- collaborating productively in teams
- identifying one's own strengths and weaknesses, and committing oneself to lifelong learning as a means of addressing the problems

Efficacy of Small Group Learning

No gold standard has been set for a definitive outcome measure in medical instructional methods. However four items have been consistently used in outcomes studies: NBME test results; clinical ratings of graduates in clerkships and residency; satisfaction ratings of student's experience in the curriculum; and degree of life-long learning.

A recent analysis of the extensive literature on the effectiveness of collaborative learning shows that collaborative learning can be used with some confidence at every age level, in every subject area, with any curriculum and with any task. The classic evaluations of small group learning in the health professions are found in two meta-analyses. One by Albanese and Mitchell, the other by Vernon and Blake. (The validity of the results of these analyses are

questioned due to their methodology in combining studies. Nonetheless these studies are frequently quoted and re-quoted.) Vernon and Blake's analysis showed that PBL student's clinical performance was superior to traditionally trained students. In addition these students felt better about their programs. PBL students did not differ from traditional students in tests of factual knowledge and tests of clinical knowledge. Albanese and Mitchell's analysis showed that PBL students find their learning more nurturing and enjoyable, perform as well and sometimes better on clinical examinations and faculty evaluations and they are more likely to enter family medicine. They also found that PBL students in a few instances scored lower on basic science examinations engaged in backward reasoning and had some gaps in their cognitive knowledge base. However, four other studies have not found any difference in USMLE Step 1 or 2 scores. Ripkey's study compared 54,890 students from 118 schools, looking at differences on USMLE Step 1 scores as a function of curriculum type. The means of scores were not significant between students in a traditional curriculum, PBL curriculum, or organ-system based curriculum.

No differences in clinical skills have been found in an Obstetrics and Gynecology clerkship . Though PBL students received significantly higher ratings from housestaff and faculty in clinical ratings in Internal Medicine and Surgery clerkships. Within our own institution PBL students tend to do better in early clerkships, though standard students appear to "catch up" by the end of their clerkship year. The Bowman Gray School of Medicine found similar results at an even greater time interval. They evaluated the clinical effectiveness of their PBL track student in residency and found no significant difference.

One aspect of small group learning that may be an advantage is that students "teach themselves" and develop a lifelong habit of learning. One study by Shin et al looked at adherence to current clinical practice guidelines for management of hypertension as a function of time since graduation. This study found no change for graduates from a PBL school, but a decreasing trend from students from a standard curriculum. The conclusion is that PBL students may be keeping more up to date.

Students' perceptions of their experiences in the curriculum are best reported from a study of Harvard Medical School's "New Pathways" curriculum. Moore et al.'s analysis of this program noted that first and second year students in this curriculum, prior to their clinical years of training, learned more from reflection, preferred active learning and demonstrated greater psychosocial knowledge, better relational skills and more humanistic attitudes. They felt more challenged, and had closer relationships with faculty.

Possible Concerns For Small Group Learning

Many PBL curricula have an alternate track and students are selected for that track. As such, self-selection may be playing a role in the final outcome measure of the students' satisfaction with their educational experience. Students who may be more introverted or feel they learn better from a more traditional approach may feel threatened. This process is a dramatic change from the educational experience most students have experienced since first grade. "The students may not necessarily appreciate having this support suddenly withdrawn. Some students view the approach as a threat or as some kind of game, and a few may become sullen or hostile when they find they have no choice about playing. When confronted with a need to take more responsibility for their own learning, they may grouse that they are paying tuition-or their parents are paying taxes-to be taught, not to teach themselves. If cooperative learning is a feature of the instruction, they may gripe loudly and bitterly about other team members not pulling their weight or about having to waste time explaining everything to slower teammates."

Woods (1994) observes that students forced to take major responsibility for their own learning go through some or all of the steps psychologists associate with trauma and grief:

1. Shock: "I don't believe it-we have to do homework in groups and she isn't going to lecture on the chapter before the problems are due?"
2. Denial: "She can't be serious about this-if I ignore it, it will go away."
3. Strong emotion: "I can't do it - I'd better drop the course and take it next semester" or "She can't do this to me - I'm going to complain to the department head!"
4. Resistance and withdrawal: "I'm not going to play her dumb games - I don't care if she fails me."
5. Surrender and acceptance: "OK, I think it's stupid but I'm stuck with it and I might as well give it a shot."
6. Struggle and exploration: "Everybody else seems to be getting this-maybe I need to try harder or do things differently to get it to work for me."

7. Return of confidence: "Hey, I may be able to pull this off after all - I think it's starting to work."
8. Integration and success. "YES! This stuff is all right - I don't understand why I had so much trouble with it before."

Felder and Brent have reported many concerns that faculty have had in facilitating student-centered experiences. Their questions and responses are listed in Appendix C.

Resource allocation is also a concern about small group learning. Mennin and Marinez-Burrola have probably done the most extensive analysis of faculty devotion of time in a small group learning setting. They found that there were no differences in total teaching time, but there were differences in how teachers spent their time with students. Teachers in the small group learning forums spent 28 percent "preparation time" and 72 percent in student contact. Traditional curricula showed 61 percent "preparation time" and 39 percent of time in student contact.

Financial considerations regarding costs in terms of physical plant adaptations to facilitate small group learning, faculty recruitment, training and implementation are a concern. Bowman Gray School of Medicine has published the direct costs for their teaching as $11,000 per student in the PBL track (includes standardized patient costs) versus $3,723 for students in the traditional curriculum. Albanese and Mitchell in their review note that for medical schools with class sizes over 100 the cost issues are of particular concern. Though our class size is less than this, this issue of economic feasibility remains to a large extent an unknown. If Bowman Gray's (Wake Forest) costs are equivalent to ours the total cost for 72 students per year will be $792,000 versus $268,056.

The Liaison Committee on Structure and Function of a Medical School has defined 4 standards that indicate a key role for "content experts": (1) In designing the curriculum, the faculty must introduce current advances in the basic and clinical sciences…; (2) The curriculum must contain the current content of those expanded disciplines that have traditionally called [basic sciences]; The faculty of a discipline should set standards of achievement by students in the study of the discipline; and Effective teaching requires knowledge of discipline and an understanding of pedagogy including construction of curriculum consistent with learning objectives, subject to internal and external evaluation. The development of the curriculum, its evaluation structure, and the standards for student performance should rely on all available "content experts".

Due to the school's relatively small numbers of faculty, it seems likely that most student groups will be tutored by non-experts. This will result in a greater likelihood of tutors being relatively "non-directive". These of non-expert tutors poses some potential problem in the ability of tutors to assess student understanding of both basic science and clinical issues and to assess the quality of student sources.

Summary

In summary, the literature on small group learning is extensive. However the literature consistently points to equal efficacy as traditional programs in training students in the basic knowledge and in problem solving skills. Small group learning however may produce physicians who can relate better to patients and who develop a life long habit of learning. As well as perceiving their educational experience in a more positive light.

It is unclear who was first to realize that small group learning was more effective than the traditional lecture-to-large-classes approach. Nor is it clear whom the first administrator was that realized that small groups were highly demanding upon faculty time and resources. Both observations appear to have been made simultaneously, however. Once that relationship was established, the literature did explode with reports justifying the more efficient learning of small groups with regard to higher use of Deans' resources. Although it is not clear when the argument was made that small group facilitators need not be content-expert faculty members, it does appear that the success of these student-facilitated groups may provide justification for non-expert tutors in some small group learning programs. Overall, the pedagogical rationale appears to have carried greater influence than institutional penury.

As a final note, instilling collaborative learning can have long-lasting consequences that extend far beyond medical school. Allowing our students the opportunity to learn to work cooperatively in teams to solve problems may afford them benefit in fitting into the group practices and heavily integrated healthcare systems of the future. In addition

it may also provide students more interested in the professional structure of medicine and allow them to be "good citizens" of the profession.

Appendix C: Responses to Faculty Concerns for Student-Centered Instruction

If I spend time in class on active learning exercises, I'll never get through the syllabus.

You don't have to spend that much time on in-class work to have a significant impact with it. Simply ask questions occasionally and give the students a short time to come up with solutions and answers, working either individually or in small groups. Then collect answers from several randomly selected individuals or groups. One or two such exercises that take a total of 5-10 minutes can keep a class relatively attentive for an entire period.

If I don't lecture I'll lose control of the class.

That's one way to look at it. Another is that several times during a class period your students may become heavily involved in working on or arguing about what you're trying to get them to learn, and it may take a few seconds (never longer once you get the hang of it) to bring their attention back to you. There are worse problems!

I assign readings but many of my students don't read them and those who do seem unable to understand the material independently.

In our experience, the only reliable way to compel most students to read the assigned material is to test them on it without covering all of it in class. Some instructors use short quizzes at the beginning of every period for this purpose; others who don't want to spend that much class time giving and grading quizzes prefer to include questions on the readings in their regularly scheduled examinations. In either case, the instructors soon learn that testing students on material not explicitly covered in class inevitably leads to vigorous protests. There are several ways to ease the students' transition from reliance on the instructor to self-reliance. Create graphic organizers that visually illustrate the structures and key points of the readings and later ask the students to do so. Prepare study guides that summarize critical questions answered by the readings and then include some of the questions on the exams. Give brief or extended writing assignments that call on the students to explain portions of the readings in their own words. Well-constructed writing assignments compel students to process material actively, identifying important points or connecting the material to their prior knowledge.

Some of my students just don't seem to get what I'm asking them to do-they keep trying to find "the right answer" to open-ended problems, they still don't have a clue about what a critical question is, and the problems they make up are consistently trivial.

An essential feature of any skill development program is practice and feedback. Most students have never been taught to solve open-ended problems or think critically or formulate problems, so that the first time you assign such an exercise they will probably do it poorly. Collect their products and provide constructive comments. In addition, reproduce several products (perhaps slipping in one of your own as well), hand them out without attribution, go over some of them in class to illustrate the sort of thing you're looking for, and suggest ways to make good products even better. Modeling of this type helps students understand the process they need to go through to improve their own work. After several similar assignments and feedback sessions, students will start giving you the kind of results you're looking for and they will also begin giving one another meaningful feedback in group work. This approach serves a double purpose: the students gain more skill and confidence and you gain a classroom of teaching assistants who can help each other learn. By the end of the course some of them may be performing at a surprisingly high level.

When I tried active learning in one of my classes, many of the students hated it. Some refused to cooperate and made their hostility to the approach and to me very clear.

Instructors who set out to try student-centered instruction in a class for the first time are often unpleasantly surprised by the fierce negativity of some responses. Many who don't anticipate such reactions get discouraged when they encounter them, give up, and go back to more comfortable but less effective methods.

To minimize resistance to any student-centered method, try to persuade the students from the outset that you are neither playing a game nor performing an experiment, but teaching in a way known to help students learn more and understand better. You can reinforce your point about the effectiveness of SCI by offering variations on one or more of the following observations:

- You've all had the experience of sitting through a good lecture, believing that you understood it, and then later when you tried to do the homework you realized that you didn't get it at all. By putting you to work in class I'm giving you a jump start on understanding the material and doing the homework efficiently.

- Unless you're a Zen monk, you can't sit still and keep your mind focused on one thing for more than a few minutes. In lectures your attention drifts, first for short intervals, then for longer ones, and by the end of a straight 50-minute lecture you're probably getting less than 20 percent of what's being said. Doing something active from time to time during the lecture substantially increases the amount of information you actually get. It also cuts way down on boredom.

- When you go out to work, I guarantee you'll be working in teams. When companies fill out surveys asking them what skills they want their new employees to have, teamwork skills are usually ranked either first or second Since working in teams is what you're going to be doing on your job, you may as well start learning how to do it now.

- (To students complaining about being slowed down by having to explain material they understand to slower teammates.) If you ask any professor, "When did you really learn thermodynamics (or structural analysis or medieval history)?" the answer will almost always be "When I had to teach it. " Suppose you're trying to explain something and your partner doesn't get it. You may try to put it in another way, and then think of an example, then another one. After a few minutes of this your partner may still not get it, but you sure will.

In our experience, most students bright enough to complain about being held back by their classmates are also bright enough to recognize the truth of the last argument.

I'm having a particularly hard time getting my students to work in teams. Many of them resent having to do it and a couple of them protested to my department head about it.

Cooperative learning tends to be the hardest student-centered method to sell initially, especially to high academic achievers and strong introverts. The points given above about the prevalence of teamwork on most jobs, the importance of teamwork skills to most employers, and the fact that we learn best what we teach, can help. Perhaps the most effective selling point for cooperative learning (unfortunately) involved grades. Many research studies have demonstrated that students who learn cooperatively get higher grades than students who try to learn the same material individually. Before assigning group work for the first time, we may mention a study in which an instructor taught an introductory computer science course three times, once with the students working individually and twice using group work, with common examinations in the first two classes. In the first class, only 36 percent of the students earned grades of C or better, while in the classes taught cooperatively, 58 percent and 65 percent of the students did so. Those earning A's in the course included 6.4 percent (first offering) and 11.5 percent (second offering) of those who worked cooperatively and only 3 percent of those who worked individually. There was some student resentment about group work in the first cooperative offering and almost none in the second one, presumably because the instructor was more skilled in the method the second time and possibly because the students in the second cooperative class knew about the results from the first class.

Persuading students that group work is in their interest is only the first step in making this instructional approach work effectively. The instructor must also structure group exercises to promote positive interdependence among team members, assure individual accountability for all work done, facilitate development of teamwork skills, and provide for periodic self-assessment of group functioning. Techniques for achieving these goals are suggested by Johnson, Felder and Brent, and many other books and articles in the recent education literature. Instructors new to cooperative learning are advised to have several such references handy when planning activities and assignments and dealing with problems.

If I assign homework, presentation, or projects to groups, some students will "hitchhike," getting credit for work in which they did not actively participate.

This is always a danger, although students determined to get a free ride will usually find a way whether the assignments are done individually or in groups. In fact, cooperative learning that includes provisions to assure individual accountability-such as individual tests on the material in the group assignments-cuts down on hitchhiking. Students who don't actually participate in the homework will generally fail the tests, especially if the assignments are challenging (as they always should be if they are assigned to groups) and the tests truly reflect the skills involved in the assignments. If the group work only counts for a small fraction of the overall course grade (say, 10-20 percent), hitchhikers can get high marks on the homework and still fail the course.

One way to detect and discourage hitchhiking is to have team members individually or collectively distribute the total points for an assignment among themselves in proportion to the effort each one put in. Students want to be nice to one another and so may agree to put names on assignments of teammates who barely participated, but they are less likely to credit them with high levels of participation. Another technique is to call randomly on individual team members to present sections of project reports or partial solutions to problems, with everyone in the group getting a grade based on the selected student's response. The best students will then make it their business to see that their teammates all understand the complete solutions, and they will also be less inclined to put a hitchhiker's name on the written product and risk having him or her be the designated presenter.

Many of the cooperative teams in my class are not working well-their assignments are superficial and incomplete and some team members keep complaining to me about others not participating.

The interpersonal challenges of cooperative learning may be severe. Students have widely varying intellectual abilities, work ethics, and levels of sensitivity to criticism, and a substantial part of the cooperative learning experience is learning how to confront and work through the conflicts that inevitably arise from these variations.

One way to get groups off to a good start is to have them formulate and write out a set of team standards and expectations, sign it, make copies for themselves, and turn in the original to you. As the course proceeds, have them periodically evaluate how well they are working as a team to meet those standards and what they might do to work more effectively. You may invite teams with serious problems to have a session in your office. If they do, try to help them find their own solutions rather than telling them what they should do.

Taking a few minutes in class to focus on critical teamwork skills can make a major difference in how groups function. Periodically select an important activity like brainstorming or resolving conflicts and offer tips in class on effective ways to carry out the activity. An effective technique is to present a short scenario describing a common problem and brainstorm solutions with the class.

You may also give teams the last resort option of firing uncooperative members after giving them at least two warnings, and you may give individuals carrying most of the workload the option of joining another group after giving their uncooperative teammates at least two warnings. In our experience, teams almost invariably find ways of working things out themselves before these options have to be exercised.

Teams working together on quantitative problem assignments may always rely on one or two members to get the problem solutions started. The others may then have difficulties on individual tests, when they must begin the solutions themselves.

This is a legitimate concern. An effective way to minimize it is for each team member to set up and outline each problem solution individually, and then for the team to work together to obtain the complete solutions. If the students are instructed in this strategy and are periodically reminded of it, most of them will discover its importance and effectiveness and adopt it. There is also merit in assigning some individual homework problems to give the students practice in the problem-solving mode they will encounter on the tests.

I teach a class containing students in minority populations that tend to be at risk academically. Does active, cooperative learning work in this kind of setting?

In fact, the most frequently cited cooperative learning success story comes from the minority education literature. Beginning in the mid-1970's, Uri Treisman, a mathematics professor then at the University of California-Berkeley, established a group-based calculus honors program, reserving two-thirds of the places for minority students whose entering credentials suggested that they were at risk. The students who participated in this program ended with a higher retention rate after three years than the overall average for all university students, while minority students in a control population were mostly gone after three years. Treisman's model has been used at many institutions with comparable success. In another study, George tested several cooperative learning techniques on a predominantly African-American psychology class and compared their performance with that of a control group taught noncooperatively. She found that group work led to significant improvements in both academic achievement and attitudes toward instruction.

When using cooperative learning in classes that include minority students-ethnic minorities, or women in engineering and other nontraditionally female fields-try to avoid groups in which the minority students are isolated. Felder report a study of cooperative learning in a sequence of engineering courses. Women responded to group work with overwhelming approval, but many indicated that they tended to assume less active roles in group discussions and some reported that their ideas tended to be devalued or discounted within their teams. The likelihood of these occurrences is reduced if a team contains more than one member of the minority population.

Even though I've done everything the experts recommend, some of my students still complain that they don't like the student-centered approach I'm using and they would have learned more if they had taken a "normal" class.

They could be right. Students have a variety of learning styles and no instructional approach can be optimal for everyone. In the end, despite our best efforts, some students fail and some who pass continue to resent our putting so much of the burden of their learning on their shoulders. One of our students once wrote in a course-end evaluation, "Felder really makes us think!" It was on the list of things he disliked. On the other hand, for all their complaints about how hard we are on them, our students on the average do better work than they ever did when we just lectured, and many more of them now tell us that after getting through one of our courses they feel confident that they can do anything. So you may lose some, but you can expect to win a lot more.

Appendix D: Active Learning Resources

Simple Paired Activities:

Having students work in pairs on a task is a low-risk strategy that virtually ensures 100 percent participation in classes of any size. Below is an example of this

Think/Pair/Share

The objectives are to engage the class with the material on an individual level, in pairs and finally as a large group. The activity can help to organize prior knowledge, brainstorm questions; or summarize, apply, or integrate new information. Approximate time: six to eight minutes.

The procedure is as follows

1. individuals reflect on and write brief notes for one minute in response to a question
2. students pair up with someone sitting near them and share their answers verbally for two or three minutes, or they may choose to work together to create a better answer,
3. the instructor randomly chooses a few pairs to give thirty-second summaries of individual or joint answers.

Active Learning Strategies And The Lecturer:

1. Questions -- Student must feel free to ask and answer questions without the fear of an adverse response if he or she should provide a wrong answer. Instructor should provide a 10 to 20 second wait time depending upon the type of question asked.
2. Modified lectures. The lecturer pauses every 12 - 18 minutes and provides students with 2 -3 minutes to work in dyads in order to clarify and assimilate the material just presented. The process is reinforced by a 3-minute period at the end of the lecture in which students are asked to record everything they can remember through free recall. It has been demonstrated that student performance on subsequent examinations is significantly improved upon when this technique is used.
3. Guided lectures: designed to help students synthesize lecture material and develop their note-taking skills. Students are provided with the lecture objectives in advance of the session. In this setting students are required to listen to 20 - 30 minutes of lecture and not take any notes. At the end of the session, the students are given 5 minutes to record everything he or she can recall. At he end of the period, the students are asked to form dyads or triads, reconstruct and discuss the lecture and in the process complete their notes. During this time the instructor is available to clarify any issue or question that may arise with in the groups.
4. Feedback lectures: are designed around supplementary study guide that provides the students with learning objectives, assigned readings m pre- and post tests and in some instances an outline of the lecture notes. The format of the contact session consists of two 20-minute mini-lectures which are separated by a study session. During the study session, students for dyads or triads and discuss the questions provided by the instructor or the study guide. Eighty-eighth percent of student s surveyed indicated that they preferred this format over straight lecture. The disadvantage to the instructor is the extensive planning and preparation required to implement this teaching strategy.
5. Responsive lectures: provide a forum in which students may generate open-ended questions for the instructor on topics pertinent to the subject. These sessions can be held on an occasional to weekly basis depending upon course structure an available contact time. In the initial phase of the lecture, the students generate a series of open-ended questions and a reason for each question's importance. The instructor lists the questions of the board or overhead as they are generated. Once this in complete, the students are asked to rank the questions in order of importance from their perspective. The ranked questions then become the outline for the reminder of the lecture. This type of educational forum can place significant demands upon the instructor and is not for the faint of heart. If the instructor finds that the process is too wide open for his or her taste, then the students can be asked to generate or submit the questions in the preceding lecture period. Alternatively, the instructor can stop halfway through the lecture and ask students to form groups of 3-4 individuals. Five minutes is then provided for the groups to each decide upon one questions which they would like the instructor to answer. This technique permits the students to sort information and become actively involved in discussions, thinking and peer teaching.

Brain storming:

This technique is less time efficient for information transfer than the lecture, but actively engages students in the learning process. The instructor must have a clear idea of what he or she wishes to be revealed or discovered in the process and plan accordingly. In some instances the instructor may need to interject points in order to keep the process on track. However, it is important to guard against excessive manipulation of the process once it has started. In addition, the instructor must be flexible enough to depart from his or her preconceived ideas when necessary. The instructor initiates the process by asking students to tell him or her everything they know about a topic. Everything foes, and no evaluations are made or the suggestions or comments put forward by the students. The instructor records the points, as they are made, on a chalkboard or an overhead projector. During the process, the ideas are then categorized or placed in groupings by the instructor with the students' guidance. The lecture becomes a process of arranging and reordering ideas and concepts regarding the topic into a coherent and rational pattern. The final creation reflects what the students and instructor consider important about the topic. Curing of the lecture, students have spent their time thinking about and organizing the salient concepts or points of the topic as opposed to imply recording information.

Other active learning strategies:

- cooperative learning
- debates
- drama
- role-playing and simulation
- peer teaching .

Appendix E: Lectures (From Ohio State University Faculty Handbook)

Strengths of the Lecture Approach

1. Lectures can communicate the intrinsic interest of the subject matter. The speaker can convey personal enthusiasm in a way that no book or other media can. Enthusiasm stimulates interest, and interested, stimulated people tend to learn more.
2. Lectures in university settings can provide students with role models of scholars in action. The professor's way of approaching knowledge can be demonstrated for students to emulate.
3. Lectures can convey material otherwise unavailable, including original research or recent developments that have not yet made it to publication.
4. Lectures can organize material in a special way. They may provide a faster, simpler method of presenting information to an audience with its own special needs. Lectures are particularly useful for students who read poorly or who are unable to organize print material.
5. Lectures can convey large amounts of factual material.
6. Lectures can speak to many listeners at the same time.
7. Lectures permit maximum teacher control. The instructor chooses what material to cover, whether to answer questions and other courses of f action.
8. Lectures present minimum threat to students. They are not required to do anything, which they may prefer.
9. Lectures emphasize learning by listening, an advantage for students who learn well this way.
10. As Eble noted, lecturing beats textbooks or video in that it offers "face-to-face confrontations with other talking, gesturing , thinking feeling humans".

Weaknesses of Lectures

1. The lecture puts students in a passive rather than active role. Passivity can hinder learning.
2. Lectures lack feedback to both the instructor and the student about the student's learning. They encourage one-way communication.
3. Lectures require an effective speaker who can vary tone, pitch, and pace of delivery. Lecturers must be verbally fluent, as skill that is not stressed nor learned in many Ph.D. programs and is, in general, distributed unevenly among people.
4. Lectures place the burden of organizing and synthesizing content solely on the lecturer. They are not well suited to higher levels or learning such as application, analysis, and synthesis.
5. Lectures are well suited to complex, detailed or abstract material.
6. Lectures assume that all students are learning at the same pace and at he same level of understanding, which is hardly ever true.
7. Lectures do not sustain student attention, which wanes very quickly in 1 to 25 minutes.
8. Lectures tend to be forgotten quickly.

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