PRE-INSTRUCTIONAL MINITESTS: AN EFFICIENT SOLUTION TO THE PROBLEM OF COVERING CONTENT

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This article is directed to two very different groups of our colleagues. One group consists of those who would like to increase their students' higher-level thinking, group interaction, and problem-solving skills but don't feel that they have time to do it because of the volume of material that they feel has to be "covered." Our aims with this group are to (a) challenge their often unrecognized (and, in our view, invalid) assumption that the only way to ensure that students are exposed to course concepts is by personally going over the material in class, and (b) describe an alternative approach for covering content that allows students to achieve a better understanding of course concepts than do lectures but requires only a fraction of the available class time. The other group to whom this article is directed consists of the rapidly growing group of our colleagues who are already using what we have come to call "minitests." Members of this group have often implemented the approach with only a very general understanding of how to go about it and are seeking additional guidance that they can use to refine their current approach and/or material they can give to interested colleagues.

Background

We initially developed, and continue to use, minitests as a component of team learning (see Michaelsen, 1992; Michaelsen, Watson, Cragin, & Fink,

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1982; Michaelsen, Watson, & Schraeder, 1985). Key features of team learning include (a) permanent and purposefully heterogeneous work groups; (b) grading based on a combination of individual performance, group performance, and peer evaluation (see Mechaelsen, Cragin, & Watson, 1981); (c) devoting the vast majority of the class time to small-group activities (necessitating a shift in the role of the instructor from dispenser of information to manager of a learning process); and (d) a six-step instructional activity sequence, repeated several times per term (see Figure 1). Doing so makes it possible to focus the vast majority of class time on helping students develop the ability to *use* concepts as opposed to simply learning about them (i.e., develop higher-level cognitive skills; Bloom, 1956).

Using Minitests to Cover Content

Probably the most unique feature of the minitests is that we give them at the *beginning* of each major block of material (see Figure 1, Steps 2-5). We have found that this enables us to eliminate a tremendous amount of class time that used to be wasted in covering material that students can, and will, learn on their own if we just give them the chance to do it. Empirical evidence from controlled studies (e.g., see Jones, 1982; Wilson, 1982) clearly demonstrates that using properly designed minitests allows students to achieve equal or greater concept mastery of basic course content in less than one third of the class time that would be required for lectures over the same material.

GUIDELINES FOR DESIGNING MINITESTS

In general, minitests should be as brief as possible without sacrificing the ability to assess students' understanding of key concepts (i.e., concepts that must be mastered to avoid frustration when they move on to either advanced material and/or application-oriented activities and exams). As a result, we try to limit minitests to 15 to 20 multiple-choice and true-false questions, three or four short essay questions, or one or two problems per minitest. This, in turn, has saved additional class time because we have been forced to make decisions about what is and what is not important.

Effective minitest questions. We use three different sources to generate questions for minitests. These are the test bank in the instructor's manual, questions that we write ourselves, and questions written by students. Whatever the source, we have found that ideal minitest questions have these characteristics:

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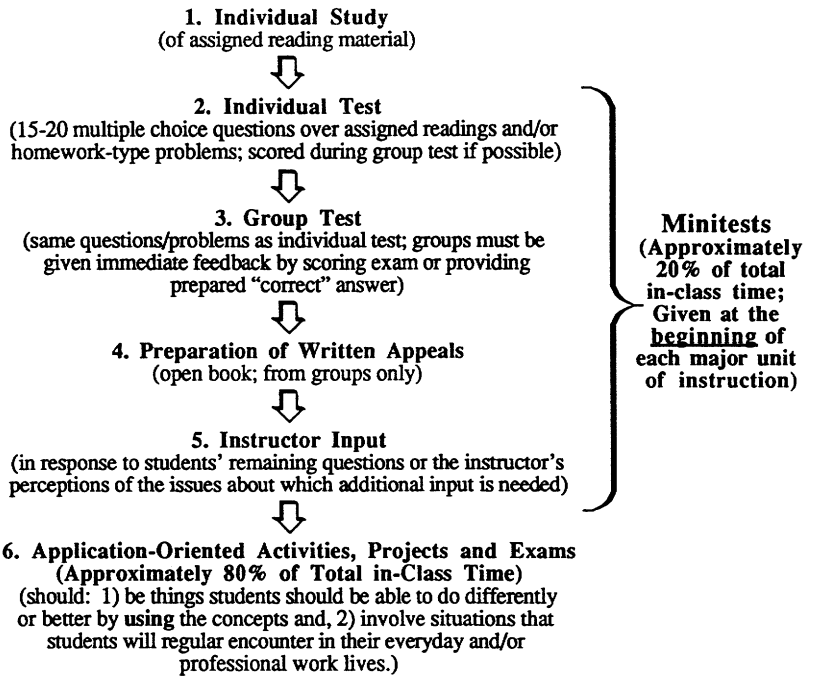


Figure 1: Team Learning Instructional Activity Sequence
NOTE: Typically repeated 5-7 times in any given course for each major unit of instruction.

- They are sufficiently difficult to promote a productive discussion of key issues. (The very best questions and problems stump the majority of individuals but are correctly answered by the majority of groups.) Thus we try to avoid questions that are purely definitional in nature.
- They go beyond facts and test students' understanding of concepts. For example, asking who developed a particular theoretical approach would not be likely to produce an informative discussion—either students know or they don't—whereas a question about what might be gained by using the theoretical approach would be much better.
- They involve higher-level thinking skills (see Bloom, 1956; Hampton, 1993), such as applying the concepts to a specific concrete situation or creating a synthesis between two or more concepts.

Student-generated minitest questions. When we invite and/or require students to write questions, we provide them with a handout containing the above guidelines, and set specific deadlines for turning in questions (based

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on the amount of time we need to select the best ones for inclusion in the minitests). When we use student-generated questions, we acknowledge their authorship on the test itself and also have the group evaluate any appeals that are submitted from other groups.

Having groups generate questions increases learning in several ways. First, it gives students an additional bonus for completing their homework assignments (they never miss a question they submit). Second, it increases group cohesiveness (having groups evaluate appeals increases the cohesiveness of both the group(s) making the appeal(s) and the group granting or denying them). Third, it increases learning (writing questions helps students understand and prioritize concepts). Finally, it is an excellent way to build a bank of test items that generate in-depth discussions of course concepts.

GUIDELINES FOR MANAGING MINITESTS

Unless properly managed, the minitest process can be chaotic to the point that it detracts from its value as a learning activity. Fortunately, most of the potential confusion can be avoided by following the procedures and using the supporting materials described below.

Handing out and collecting materials. One potential source of confusion during the minitest is the procedure that is used to pass out and collect tests and answer sheets. We have learned to deal with this problem by using group folders to distribute and collect test-related materials. This reduces the number of objects we have to handle (to one per group) and also minimizes the time required to get materials into students' hands.

The folders are used multiple times during each minitest. Specifically, the steps in the minitest process are as follows:

1. We distribute group folders that contain tests and answer sheets, and students begin taking their individual exam.
2. As members complete the exam, they return their answer sheet to the group folder.
3. As soon as all members' answer sheets are in the group folder, a group member brings the folder to the front of the room, and exchanges the folder for a group answer sheet.
4. Students then retake the exam as a group while we score the individual answer sheets.
5. When the group exam is completed, a group member brings the group answer sheet to the front of the room, runs it through the scoring machine, and picks up the group folder containing the individual answer sheets (that have already been scored).

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6. After the appeals and instructor input, we have the groups collect all of the test materials, put them in the folders, and hand them in.

Timing. One of the most difficult aspects of using group activities, including minitests, can be finding a way to minimize the time that groups spend waiting for other groups to finish. If you shift to the next activity too quickly, the slower groups miss out on productive discussions. If you wait too long, the faster groups finish their work and often complain about wasting class time waiting on the slower groups. Further, setting a specific time for either the individual or group tests is seldom very helpful because of the difficulty of predicting how long it will take either one to complete the test. In fact, our experience has been that setting specific times typically leads to student complaints about either being rushed or having to sit and wait for the more deliberate test takers.

We have, however, discovered an effective way to deal with the timing problem in managing the minitests. This involves using what we call the "5-minute rule" to govern the amount of time available for both individual and group portions of the minitests. In using the 5-minute rule, we allow the groups to start the group exam as soon as they have turned in the group folder containing all of their members' individual answer sheets. Thus, the first group always starts the group exam while the rest of the groups are waiting for their slower members. When approximately a third of the groups have turned in their *group* exam, we announce that the remaining groups have 5 minutes to complete their group exam.

Theoretically, it is possible for a very slow individual to use all of the time for his or her group's exam. From a practical standpoint, however, it never turns out that way. The fact that other groups are getting a head start (coupled with the fact that their faster peers are having to wait) is a very powerful incentive for the slower members to complete their test as rapidly as possible. In addition, basing the overall timing on the first third of the groups has proven to be a very practical way to adjust for differences in the time it takes to complete the group exam. In most cases, students rarely have to wait for any significant length of time and the groups that finish first have the advantage of having more time for appeals (or for celebrating the achievement of a perfect score).

Providing immediate feedback. One of the reasons for the effectiveness of minitests in the team learning model is the fact that the process provides multiple opportunities for students to receive feedback on their understanding of course concepts (see Figure 1). These include feedback (a) from their

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peers during the group exam, (b) from the instructor when he or she scores individual and group answer sheets, (c) from the reading material while in the process of preparing written appeals, (d) from the instructor's input that follows the appeals, and finally, although not generally until the next class, (e) from written feedback on appeals.

With true-false and multiple-choice questions, the most effective way to provide immediate feedback is by using optically scanned answer sheets and scoring them, on the spot, using a portable mark-sense scoring machine.[1] This minimizes scoring errors and, at the same time allows instructors to provide immediate feedback on both the individual and group exams.

In instances where the minitests consist of problems or short-answer essays, we recommend having students put their individual answers in a clear plastic folder during the group test (so that they can see it but won't be tempted to change their individual answers) and hand both the individual and group answers in at the same time. We would then recommend giving a "solution" (or list of key points that should have been covered), which can be prepared and duplicated prior to class.

Appeals. The appeals process (see Figure 1) can be a very effective way to increase both learning and group cohesiveness. When properly managed, the act of preparing written appeals harnesses students' negative emotional energy from having missed an exam question into a focused review of potentially troublesome concepts. Further, even in instances where an appeal is not granted, the process builds group cohesiveness because it allows members to act together to defend the reputation and well-being of the group.

After having used and/or observed a number of approaches for managing the appeals process, we recommend the following:

- Attach a written explanation of why you allow appeals and instructions for preparing and submitting them on the inside of the group folder. On the first minitest, have the first person who finishes the individual exam in each group read over the instructions so that he or she can coach the group through the appeals process.
- Insist on written appeals. (We recommend using an appeals form that asks students to specify the question involved, their preferred correct answer, the basis for their appeal, and the evidence that supports their point of view.) Requiring groups to put their thoughts in writing forces students to formulate their reasoning in a systematic way and also gives the instructor the opportunity to evaluate their arguments in the privacy of his or her office and avoid a public debate about the merits of the appeal.
- Accept only *group* appeals. Individual appeals are detrimental in three ways. First, individual appeals are a barrier to group cohesiveness because they re-

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move an important source of interdependence between group members. Second, individual appeals reduce the learning that normally takes place as groups prepare appeals (i.e., if individuals can get credit on their own, without having to challenge others' ideas, there is no incentive for working to achieve agreement as a group). Finally, allowing individual appeals can be a great deal of extra work with far less pay-off from a learning standpoint than occurs with group appeals.

- When an appeal is granted, give credit to both the group and each individual in that group but not for members of other groups. This both encourages appeals (i.e., there are no penalties for appealing) and enhances group cohesiveness because it forces each group to act on its own behalf.

Instructor input. The instructor input following the appeals should be very focused and brief because both he or she and the students already have a foundation to build on. By this point in the minitest process (see Figure 1), most groups have successfully developed a sound understanding of the majority of the material covered in the readings. This, however, is the instructor's opportunity to resolve any student misunderstandings that may still exist. Thus we typically remind students that the reason for the minitests is to prepare them for the application-oriented activities and projects that are to follow and ask *them* to identify any of the questions that they would like us to discuss before we move on to the next activity or the next unit of material.

MINITESTS AND CONCEPT MASTERY

An extremely important benefit of minitests is that we almost never have to go over basic concepts or answer simple questions. In courses in which we use minitests, students master the vast majority of the basic content on their own because of three important aspects of the process.

First, because of the ongoing opportunity to compare performance across groups, the minitests are extremely effective at building group norms that promote learning. Groups soon discover that they can't compete unless their members complete their assigned homework and come to class regularly. As a result, the groups quickly develop norms that virtually ensure consistent individual study and class attendance.

Second, because we control the content and scoring of the minitests, we can be much more certain of what students actually know and don't know than we ever were when we were relying on lectures as our principle means of covering content. As a result, we virtually never lecture for more than a few minutes at a time and our remarks are specifically directed at either correcting misunderstandings that have been revealed through the testing

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process or at extending students' understanding beyond the material in their assigned homework.

Finally, the minitests are effective at building a sound understanding of basic course concepts because students are exposed to key concepts at least six different times and in very different ways (see Figure 1). In most instances, the students are initially exposed to concepts through assigned *readings*. The additional exposure during the *individual tests* helps reinforce their memory of what they learned during their individual study (for a discussion of the positive effects of testing on retention, see Nungester & Duchastel, 1982). During the group test, students receive *oral input and feedback from their peers* that often broadens their understanding. In addition, they also benefit from acting in a teaching role (for a discussion of the cognitive benefits of teaching, see Bargh & Schul, 1980; Slavin & Karweit, 1981). While *preparing appeals*, students are highly motivated to engage in a focused restudy of particularly troublesome concepts. This is followed by *oral input from the instructor* that is specifically aimed at resolving any remaining misunderstandings unearthed by the three previous steps in the process. Finally, students in classes taught using team learning receive an additional exposure *when they use the concepts* during group activities that are designed to develop their higher-level thinking and problem-solving skills.

Additional Benefits of Minitests

In addition to ensuring that students master basic concepts, using minitests to cover course content results in a number of other positive outcomes. These include an increased emphasis on concept application and problem-solving skills, development of students' interpersonal and group decision-making skills, and increased student awareness of the positive potential of problem-solving groups.

MORE TIME FOR APPLICATION AND PROBLEM-SOLVING SKILLS

Minitests dramatically increase the class time available for the development of students' application and problem-solving skills for three reasons. First, minitests motivate students to carefully study reading assignments because doing so positively affects both their grade and the ability of their group to perform effectively. Second, because they are given at the beginning of the class time scheduled for each of major blocks of material, minitests capitalize on students' propensity to "cram for exams." Third, minitests

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provide opportunities for students to fill in gaps in their understanding by teaching each other. Thus, unlike the situation that typically exists when lectures are used to cover the content, students master basic concepts while the majority of class time is still available for activities designed to develop their concept application and problem-solving skills.

As a result, we typically find that we can spend approximately 75% to 80% of class time working with assignments that are aimed at developing students' abilities to use the concepts. Thus we can be sure that students have mastered basic concepts and still spend the large majority of class time on group activities, such as experiential exercises; preparing for and analyzing the results of field studies and projects; and on projects and exams that require students to relate course concepts to complex case material, such as novels and full-length feature films.

Further, we have found that using class time for group projects increases the quality of their work and their learning in two ways. One is that it ensures that the groups will have a time when all students can meet together to coordinate their work. The other is that because we are available to answer their questions, groups are far less likely to waste time and become frustrated when they have difficulty understanding the assignment.

DEVELOPMENT OF INTERPERSONAL AND GROUP DECISION-MAKING SKILLS

Minitests also create a situation in which groups have both opportunities and incentives for developing interpersonal and group decision-making skills. Every question provides an opportunity to practice influencing skills. Because the scores count and the groups are permanent, members simply can't ignore interpersonal problems that may arise. In addition, because of the immediate feedback on both individual and group performance, it is impossible for members' contributions (or lack thereof) to go unnoticed.

As a result, students develop interpersonal and group decision-making skills in two ways. First, they have to face up to the consequences of their own behavior. For example, students who aren't very good listeners continually find themselves in the awkward position of having to "eat crow" when their answers turn out to be wrong, and unassertive students find themselves being seen as letting the group down because they were unwilling to speak up. Second, students improve their interpersonal and group decision-making skills through being exposed to the positive role models in their groups. Over time, groups develop an appreciation for members who are good at sorting out information and building a group consensus.

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INCREASED STUDENT AWARENESS OF THE POSITIVE POTENTIAL OF GROUPS

One extremely important, but often overlooked, benefit of using minitests is the valuable lesson they teach about the positive potential of group problem solving. Few of our students are likely to do very well either in their jobs or in other aspects of their lives unless they are fully aware of the positive potential of using groups to make important organizational decisions. Unfortunately, inappropriate group assignments such as group papers can (and often do) inadvertently lead students to the conclusion that group work is more of a hassle than it is worth.

By contrast, data from the minitests provides powerful and concrete evidence of the positive potential of group consensus decision making. Students learn, through their own experience, three important lessons about groups. One is that, over time, groups will become increasingly effective at using their members' input (e.g., see Watson, Michaelsen, & Sharp, 1991). Another is that, over time, groups will become increasingly less dependent on their best member (e.g., see Watson et al., 1991). Finally, because virtually all of the groups will score higher than their best member (the actual figure is 97%, see Michaelsen, Watson, & Black, 1989), students learn that by working together, they can achieve a level of decision-making effectiveness that none of them could achieve working on their own.

Avoiding Potential Problems

Although using minitests is a highly effective way to cover course content, some instructors have used them in ways that significantly reduced their effectiveness. These include failing to recognize and respond to students' expectations about the instructor's role in the education process, using poorly designed minitests, and getting into win-lose confrontations with respect to individual minitest questions.

MANAGING STUDENT EXPECTATIONS

Using lectures as a means of covering course content is so common that neither students nor instructors are likely to consider other alternatives. In fact, our peers often fantasize that they would face an open rebellion if they announced that they were going to use minitests to make sure that students mastered basic course concepts (e.g., "We pay thousands of dollars in tuition to hear what you have to say, and you aren't going to lecture?"). Fortunately, this problem is more imagined than real *if* the instructor sets the stage

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properly in the beginning and then follows through by using meaningful and challenging group activities and assignments subsequent to the minitests.

Setting the stage. We set the stage by emphasizing that the objective of ensuring that students master course concepts is important, but it is equally important to provide students with the opportunity to (a) learn to use the concepts and (b) develop the ability to work effectively in small groups. In addition, we point out that if we use class time to talk about material that students could master on their own, they won't really be taking advantage of our expertise.

Following through. A second key to using minitests is following through by using the class time that they save for group activities that are explicitly designed to develop students' higher-level thinking and problem-solving skills. In our experience, the key is using activities that have face validity for students. As long as they feel that they are learning to solve the kinds of problems they will face in their future professional and/or personal lives, the vast majority will feel that the additional effort required to study prior to coming to class is time well spent.

DESIGNING EFFECTIVE MINITESTS

Because a primary goal of the minitests is to provide the opportunity for peer teaching, it is essential that the minitest generate discussions about course concepts. Our experience suggests that a significant number of faculty members are likely to encounter one of two problems the first time they use minitests. One is using test questions that are too easy. If everyone has the same answer, students don't learn from each other because there is nothing to discuss. The other is using what students commonly call "trick" questions (i.e., getting the correct answer depends primarily on being able to correctly interpret the wording of the question). With questions of this type, group discussions tend to focus on the wording of the question as opposed to the nature of the concepts.

Fortunately, neither of these problems is fatal, and both tend to correct themselves over time. Even questions that everyone gets correct are of some value in that they pinpoint concepts that students have already mastered and tend to build confidence in the capabilities of the groups. We recommend, however, that instructors replace easy questions with more difficult ones as they gain experience with the minitest process. On the other hand, including trick questions doesn't really solve the problem either. Although they do generate a great deal of group discussion, they seldom produce much real

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learning. Fortunately, when students are given the opportunity to appeal questions they have missed, they typically both identify problematic questions and provide a sound basis for making revisions for subsequent tests.

AVOIDING WIN-LOSE CONFRONTATIONS

Probably the most common problem that new minitest users encounter is being drawn into win-lose confrontations during the instructor input phase of the process (see Figure 1). Students who have convinced their peers to accept an incorrect answer will often try to save face by trying to defend their point of view orally. This creates problems for two reasons. First, they are often so emotionally involved that they are unable to hear any point of view other than the one they are advocating. Second, the majority of the class usually does not care one way or the other and will feel that their time is being wasted if the discussion lasts for any length of time at all.

When faced with students who appear to be orally defending an appeal, the problem can be minimized in several ways:

- Remind the class (and yourself) that the purpose of the discussion is to make certain that they (the students) understand the concepts before they are asked to apply them (*not* to give students the opportunity for oral appeals).
- Make it clear that you cannot and will not make a judgment on their appeal at this point because you would not be able to do a thorough job of evaluating the appeal until you have the opportunity to consider both the evidence they provide and the context from which it was taken. As a result, the argumentative student will have to wait until you have the chance to look back over the reading material before you can make thoughtful decisions on the appeal.
- Focus your input on the concepts rather than on the questions.

Summary and Conclusions

Using minitests results in a fundamental shift in the roles of both the instructor and the students. The instructor's role as a dispenser of information is greatly reduced and his or her involvement as a designer of group activities and as a manager of a learning process is greatly increased. As a result, the process will fail unless students accept the primary responsibility for mastering basic concepts. Fortunately, the process ensures that the vast majority of students are willing to try and, with the help of their peers, are able to succeed. The net result is like being able to "have your cake and eat it too." Instructors can be sure that students master basic course concepts and still use the majority of class time for developing their higher-level thinking and interpersonal and group decision-making skills.

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Note

1. We use a machine from Scantron Corporation. They provide the scanning equipment free of charge as long as we or the students purchase a minimum volume of forms on an annual basis. For more information, call 1 (800) 421-5066, extension 650.

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