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Innovative Instructional Strategies: Successful Learning Systems for Military and Civilian Educational Environments

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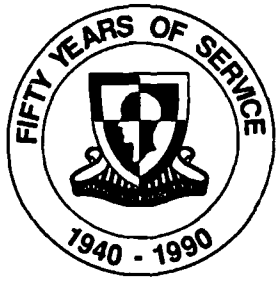

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Innovative Instructional Strategies (IISs) are teaching systems based on principles of operant conditioning. They directly reinforce academic work, immediately feedback knowledge of results to students, and structure the learning environment so that student control and decision making is optimized. Four strategies "Personalized System of Instruction," "Feedback Lecture," "Guided Design," and "Microteaching" are selected for review and recommendation for continuing basic educational research. Each advanced technology that corresponds with a specific innovative strategy and is partly responsible for its successful implementation, is presented. Implications for military settings are discussed.

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TABLE OF CONTENTS

Introduction

Considering Innovative Instructional Strategies

Why Consider Innovative Education Now?

Education is once again a hot topic among editorials and thirty-second sound bites in the media, on the minds of policymakers, in the laboratories of scientific investigators, and certainly in the classrooms of schools across America. State legislatures and Federal agencies, as opposed to communities and private citizens, play a more active role in making decisions that directly affect student learning. George Bush has proclaimed that he wishes to be remembered as the "Education President." More students are enrolled in college courses than ever before. A good education still commands respect and offers youth a better chance for a good job and upward mobility. Private and public sectors provide grants, matching fund opportunities and other incentives to encourage young students to attend and excel in school. Various branches of the Armed Forces continue to present education to recruits as a means of acruing points toward promotion, a method of bettering oneself, and a tool for transforming superior classwork into a successful professional career.

Yet, despite the fanfare and some pockets of improvement in certain communities during the past decade, recent reports on the status of the nation's level of academic achievement (Bennett, 1983; 1988) still suggest relatively low test scores for students across a wide variety of disciplines. For example, the Army deserves high commendations for improving the quality of its soldiers to the point where the average Army enlisted recruit is now a high school graduate. However, with the integrity and performance of public education under fire, any generalization about the utility and potential transfer of recruits' basic knowledge to meet Army needs lacks potency. Defense and civilian-scientists employed by the Army Research Institute for the Behavioral and Social Sciences

(ARI) must therefore continue to look for educational systems that will maximize performance and transfer of learning while minimizing cost in terms of manpower, materiel and time. Some suggest a return to more traditional methods of teaching and focus on essential skills in the classroom. Others recommend a radical restructuring of how information should be delivered and who should make decisions concerning course content and evaluation. Everyone agrees that something needs to be done now, but few can agree on the proper means to carry out the necessary changes.

Perhaps now more than ever, education within and in support of the Armed Forces requires sucessful, well-established teaching techniques based on principles of operant conditioning. These Innovative Instructional Strategies (IIS) are flexible enough to be both conservative in the domains they stress (science, math, and literature, e.g.) and progressive in the style of delivery and support available for student-centered classes:

- Research evidence, accrued in recent years, now substantiates real and do-able IISs. ARI is in an enviable position to sponsor instructional systems research on the cutting edge to identify parameters and conditions by which IISs advance student achievement.
- Living in an era of budget constraints and increased demands for fiscal responsiblity means that military financial resources are limited. Belt-tightening appears to be the order of the day for Department of Defense projects. At present, Innovative Instructional Strategies are especially appealing, because they are cost-effective and because they work. That they can be readily adopted for use by DoD schools for dependents makes them doubly functional.
- The Army is likely to retain its all-volunteer character for the forseeable future. Since education remains one of the key selling points under these circumstances, IISs may be particularly appealing to the individual soldier who volunteered to join the Army and who may have a slightly greater apprecation for self-motivated learning than the average person.

Why Consider the Army for Research in Innovative Education?

The Army is well-suited for conducting research in Innovative Instructional Strategies. First, ARI's Office of Basic Research is designed to fund and

monitor scientific research that can create a foundation for direct testing of the educational system in any or all of ARI's applied laboratories including Manpower and Personnel, Training and Systems. Second, Army field units contain many of the basic facilities that a large organization needs to conduct scientific research in education: classroom environments, on-site support staff, hi-tech equipment (computers, e.g.) for evaluation purposes, and a subject population. Third, the complexity of Army training scenarios in the field naturally lend themselves to testing an educational system's capacity to transfer across content domains or across learning conditions. Fourth, ARI has conducted research in instructional systems for many years, but more deliberately within the last decade under the auspices of the Army Training Management Institute (TMI). One current thrust is that of increasing the development and use of self-paced instructional systems within the bounds of appropriate performance criteria (Zeidner and Drucker, 1988). Fifth, and quite recently, upper echelons in the Department of Defense have encouraged greater research efforts within military organizations themselves, minimizing outside contractual work. Renewed interest in instructional systems affords a propitious opportunity to bring this objective to fruition. Lastly, the Army's dependent school network in the United States and around the world contains a large subject pool, standardized classroom conditions, access to staff and materiel; in short, a splendid laboratory setting to examine basic elements of the innovative systems chosen here and to apply them immediately. Thus the Army benefits doubly by backing this kind of educational research, for its rank and file as well as its family constituents.

Why Choose "Innovative" Instructional Strategies?

What distinguishes innovative from more traditional teaching strategies? What can delivery systems with a particular behaviorist bent under appropriate training conditions offer the Army that traditional teaching omits? The

standard lecture is a time-honored practice dating back to ancient times in Western culture. Typically, a single instructor stands before an audience which can range in size from just a few to hundreds of students, and delivers a lecture on a given topic. The talk generally summarizes key concepts that the instructor deems important for student learning. Occasionally, the lecture may be punctuated by questions from students, those posed by the teacher, or audio-visual highlights. If a course makes use of texts and supplementary readings, instructors may gear their lectures toward more detailed or interesting aspects of the text material. However, some teachers prefer repeating ideas presented in the book in the hopes of ensuring that students will learn the "basics" despite the appearance of redundancy. There is usually no attempt, save the examination, to ascertain students' learning or performance level immediately after the lecture.

The lecture remains a mainstay of higher education: in class it is useful, even preferable for summarizing and highlighting accompanying text information in a way that a large audience can "digest", especially if the number of meetings times is limited. If the instructor is knowledgable, experienced, and a superior orator, so much the better; s/he offers the "human" touch that written words lack. Nevertheless, the lecture's utility is limited. It minimizes the spontaneity that seems naturally to accompany a student's fervent desire to learn. Adults and children usually initiate the learning process in their everyday environments by investigating causes of events, posing questions to their peers and superiors, seeking knowledge about how things work. The lecture alters this natural process by, at the very least, putting a brake on these activities and, at worst, grinding the individual student's capacity and interest in learning to a halt. Unfortunately, the lecture can represent the epitomy of an instructor's control, and hence interference, over every aspect of a student's opportunity to learn course material. In some cases, lectures

actually reinforce the opposite of what they intend to impart. Students will spend time looking for "short cuts" to learn material and attention may be swayed or completely lost during long and dreary talks. Indeed, there is often little reason for students not to think that instructors care little for their mastery of a subject when they are not consulted about topics of interest, when their understanding of information is not immediately assessed, and when the most vital message delivered is that they require a "grown up" to teach them because they are lack the capacity to learn the material on their own.

Innovative Instructional Systems may supplement or provide a complete alternative to the formal lecture. They are educational programs designed to activate student thinking and performance processes, or simply tap into what people do quite well when they study on their own. IISs incorporate standards of operant conditioning by frequently assessing and reinforcing learned information. Conceptually, this translates into a systematic accumulation of knowledge providing evidence in favor of one instructional strategy or another. In terms of research, it means operationally defining constructs of teaching behavior and actually conducting experiments which collect verifiable data. For practical applications or potential implications, these systems are easy to comprehend and easy to implement in schools, if so desired. In many cases, students themselves develop mini-strategies within the instructional system to reward themselves for successful work or to discover new techniques should one previously chosen fail to bring about the desired outcome. Innovative systems empower students with a great deal of control over their own educational lives.

Four systems of instruction have been selected here for examination because they have already successfully elevated student achievement beyond what one would expect from a traditional class and because they contain all the necessary ingredients for conducting quantifiable and reliable empirical research. The

first strategy, *Personalized System of Instruction*, most closely follows the behaviorist tradition by designing content so students learn by approximations toward the goal of course completion. Along the way, they are reinforced for mastering units of information and they receive complete and immediate feedback from the results of their testing. *Feedback Lecture* marks the middle ground between formal lecturing and innovative instruction. Though students are presented with material in the traditional manner, they form small work groups for the purpose of discussing and responding to learning objectives based on the lecture they just listened to. The instructor then receives feedback from the students, may alter or shape her/his next lecture based on this new information, and respond in turn to the students' comments. *Guided Design for Cooperative Learning* expands behaviorist principles of reinforcement and self-paced learning to include group decision making tasks. Students are presented with small or large-scale projects and required to follow or be "guided" by a standardized problem-solving technique. Each step is analyzed for group and instructor feedback so students can learn not only how well they are accomplishing their task, but also how well they can work on their own as well as with others. The fourth and final innovative system, *Microteaching*, is designed to provide the specialized student, the novice teacher, with specific behavioral feedback on her/his pedagogical skills. Abridged, but complete "micro-lessons" contain all of the essential elements trainees need in which to review and analyze their video-taped behavior in an experimentally controlled, non-threatening atmosphere.

Innovative instructional strategies are not a learning panacea by any means. They will neither automatically nor miraculously obliterate the obstacles to student motivation and achievement that presently plague American classrooms. Many problems attributed to the failure of public education actually arise from deeper, more fundamentally flawed structures in the social and moral fabric of

the national psyche that extend far beyond the school. Then too, students who are used to an educational system which makes few demands of their talents and asks little of their independent and critical analytic skills in class will initially have some difficulty adjusting to an innovative system. Lecturing will continue to perform the necessary function of delivering information to the many in a most expedient way. However, the instructional systems discussed here are viable alternatives because they offer the student a supportive learning environment in which they are eager to participate, a chance to develop cognitive faculties often denied (e.g., problem solving), meaningful interaction amongst their peers, and early exposure to independent thought, individual or group control, and personal responsibility. To the instructor, IISs may be preferable because they grant more time to devote to teaching course content rather than text reiteration and more ongoing knowledge of student achievement and consequently teacher success. To a school or sponsoring organization, IISs provide an objective evaluation for determining successful and unsuccessful teaching strategies, a database for further scientific and public scrutiny, and better use of school facilities.

Structure of Each Instructional Innovation Strategy Chapter

Each chapter of this paper follows a specific structure. Instructional strategy background information, including early development and fundamental components, is covered as well as sections pertaining to the role of technology and application for military needs in education. Providing a similar textual framework in the paper should ease comprehension and encourage comparision of information from one IIS chapter to another. An analysis comparing and contrasting each chapter subheading immediately follows in a separate section. Below is a brief introduction to each chapter's structure.

What is the Innovative Instructional Strategy?

This subtopic describes main goals and basic elements of each innovative instructional strategy. A description of how the strategy is actually implemented is included along with key personnel who conduct any supportive activities.

A Brief History

Each IIS is a relative newcomer to education research, so historical accounts are relatively short. Nevertheless, some important trends in educational research emerge in terms of origins of the innovative strategy, how it has changed (if at all), and who was chiefly responsible for fueling interest and producing ground-breaking research.

What Are Its Advantages?

The thrust of the paper is to demonstrate the utility and efficiency of using IISs. There is a danger of detracting too much from the traditional lecture format: it has its place and fuction for delivering the most information to the largest possible audience in the shortest period of time. However, many, if not most, teaching environments lend themselves to the small group or individualized delivery system that are hallmarks of innovative strategies. Hence, the unique aspects of these teaching methods are underscored.

What Does the Research Have to Say?

Another important distinction between innovative and traditional education delivery systems is the former's reliance on objective, empirically derived data. Laboratory and field tested hypotheses are systematically examined. Investigators can either accrue evidence in favor of those strategies that have demonstrated efficacy or collect information that indicates limited usage of one instructional system or another. Establishing a body of scientific knowledge in

this area also leads to further inquiry, most necessary given the relatively short history of innovative strategy research.

The Contribution of Advanced Technologies

Advanced technologies have been crucial to the behaviorist tradition of education and instruction. A chief characteristic of behavior modification programs in education is the technology they bring to bear upon a student's ability to learn and the transfer of knowledge from one domain to another. Reduced cost, increased access, and use of machines for assessment and feedback have allowed teachers simultaneously to reach more students and give them more individual attention. Students who can concentrate their efforts on relevant on-going behaviors in class are more likely to excel and in turn be available to tutor or otherwise help their classmates.

An educational technology is not limited to applications of hardware like computers and audio-visual equipment, but also includes new designs of paper and pencil tests and rigorous monitoring of scholastic behavior. These add an element of reliability by providing hard, behavioral data to teachers that is usually missing in traditional methods of instruction. Consequently, each advanced technology that underlies an innovative instructional strategy contributes: (1) to the student, novel and interesting ways of digesting course material or feedback of their own behavior that increases their attentiveness in class and is more likely to engage their joint participation; (2) to the instructor, systematic recording of verifiable data on student progress and maximizing time spent on substantive course content by deligating many routinized instructional procedures to student control; and (3) to the sponsoring organization, standardized evidence for monitoring both student and instructor achievement levels across same-discipline classrooms in a cost-effective manner.

What Are the Implications for the Army?

Each specific innovative instructional strategy is discussed in terms of its implications for research sponsored by the Army Research Institute and in terms of potential application to training Army personnel and educating Department of Defense school personnel. First, other armed forces' research programs have had occasion to support an IIS on a temporary interventionist basis, but no programmatic plan for collecting and examining empirical data has yet been attempted. Second, employing innovative methods for delivering technical and managerial courses to soldiers both in the U.S. and abroad can minimize costs, maximize learning, and positively impact upon rates of retention and retraining. Lastly, innovative systems hold promise for students enrolled in DoD schools. Because these students are somewhat removed from mainstream American education they may be thought of as dependent "extention" students. As such, they study at remote sites, and like their military counterparts, can benefit from distance education by adapting innovative strategies to their particular needs.

References

Each chapter, including the "Comparison" chapter, comes with a separate reference section designed to ease efficient referral back and forth between sources and location in the text.

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Personalized System of Instruction

What is the Personalized System of Instruction?

To many, the most popular and promising teaching innovations of recent years are the individualized teaching methods. The Personalized System of Instruction, or PSI (Keller, 1968, 1985a; Johnson & Ruskin, 1977; Sherman & Ruskin, 1978) is such a method and is based on behavioral learning principles that require students to master each unit of content on their own or with the assistance of a proctor before proceeding at their own pace to other units. Research on PSI affirms its effectiveness as a means of conveying information (Kulik, et al., 1979; Koen, 1985) and enhancing student satisfaction (Keller, 1985b).

The five essential elements of PSI include:

(1) Student Self-Pacing

Students are allowed, within reasonable bounds, to pace themselves through the course materials. In PSI, there is recognition of the importance of individual differences in learning and communication skills such that courses can be designed in a way that allows individual adaptation to the material. Some students study and learn information more quickly than others. A course which takes this into account encourages efficient use of class time and provides students with opportunties to hone their own study skills. Students do not have to take a test until they feel they are ready to do so. Self-pacing, therefore, promotes student self-control while minimizing the discomfort often associated with test-taking at the instructor's discretion.

(2) Unit-Perfection Requirement

PSI instructors subdivide course content into sequential self-contained sections or "units" of equitable size and importance. While there is no hard and fast rule for determining the number of units for a given course, a typical

curriculum will include at least one unit per week. The student must demonstrate mastery of one learning unit before proceeding to the next. There is no penalty for failing to master a unit: the student discusses his or her misconceptions with the proctor, restudies the material, and takes another version of the test. This sort of remediation continues until mastery of the unit is achieved.

(3) Use of Lectures as Motivators

Traditional classes rely on lectures as the major, if not sole, disseminators of information vital to student success in the course. In this scenario, students play passive, detached roles in the educational process and often have a great deal of difficulty attending to the instructor. Here, there is little opportunity for the student either to demonstrate actual learning taking place or to receive feedback on whether the information they are processing is correct or incorrect. In short, the traditional lecture ignores basic principles of behavioral training; the teacher sets the pace of instruction, not the learner. In a personalized system of instruction, lectures are used for motivation and as student-centered sessions rather than to convey comprehensive information. The lectures offer the opportunity for the entire class to get together and for the instructor to appear at his or her inspirational best. Lectures thus become enjoyable experiences for both parties, rather than a tedious rumination of text material.

(4) Emphasis upon the Written Word

The stress is primarily upon the written word as a vehicle of instruction with textbooks, readings, and study guides serving as the main instructional materials. Standardized texts are necessary in order to insure that students receive the same information and be subsequently tested in a reliable fashion. A key element of standardization entails the use of "behavioral objectives",

essential learning goals prescribed by the course of instruction. Many teachers build learning objectives into an entire class by combining texts with other supplementary materials to avoid dullness, banality and the omission of critical analysis of issues which often plague certain textbooks. In this way, the constant availablility of important information is assured and not left to the vagaries of note-taking and student attention spans.

(5) Use of Proctors

The use of proctors is considered to be one of the most important features of PSI. The proctors grade quizzes and answer students' questions, clearing up confusions as they do so. Students who are having difficulty with a unit or who pose questions which the proctor cannot answer are referred to the instructor. Proctors may be selected from a pool of qualified upperclass or graduate students who excel in knowledge and pedogogic skills germaine to course material. Usually, however, "internal" students who are further advanced in the course serve as peer tutors for those students who are less advanced. It is advantageous to choose proctors from this group because they are freshly acquainted with the material, they can easily be granted extra credit for their participation, any student who masters a given unit can proctor a classmate, compared to graduate students they are often more willing to admit gaps in knowledge or understanding to a teacher should the problem arise, and finally their rehearsal of course material as proctors translates into the direct benefit of long-term retention.

A Brief History

Fred Keller inaugurated PSI classes some twenty years ago. He and his colleagues, J.G. Sherman, Rodolfo Azzi, and Carolina Martuscelli Bori, met with success at Arizona State, Columbia and Brazilia. Early results in introductory

psychology classes of this method of teaching were extraordinarily positive. PSI received impressive kudos on three different measures of student learning, student motivation, and teacher satisfaction. Lectures had all but disappeared to be used only as sources of course enrichment. Teacher monitors or *proctors* provided face-to-face evaluation of students' test responses. This effort supplemented the instructor's interest in monitoring student understanding of course material and progress from one course unit to the next. Students were no longer ranked nor expected to compete against each other. Subsequently, those who completed all the sub-units of the course received "A's", for they had successfully mastered the material. Success of this method began in Freshman level curricula but soon spread to higher level courses (Keller, 1985).

Interest in PSI peaked in the late 1970's and has shown a mild decline since 1980 in terms of the number of published studies (Lamal, 1984). However, since PSI's inception, research demonstrating its utility continues to accrue (Koen, 1985). PSI significantly aids student learning in introductory psychology classes where it was first implemented (Keller, 1968), in upper level psychology courses (Keller 1985b), in physical science courses (Davis, et al., 1987), in mathematics and problem solving curricula (Canelos & Ozbeki, 1983), in applied/real world settings (Ford, 1983), and across different cultures (Lahdes, 1983).

What are the Advantages of PSI?

1. PSI is built upon a positive (rewarding) structure. Its basic elements and philosophy are consistent with the behavioral approach to instruction and education. Students learn best in an environment which is both supportive and reinforcing. When they are given clear feedback about the results of their

class performance, they can more easily associate their study skills with success on tests. Teaching and learning are, therefore, geared toward specific curriculum goals and based on highly reliable and valid testing methods (Sherman & Ruskin, 1978).

2. Students may go at their own pace. They neither study nor acquire information in the exact same way within the same time period. PSI promotes student-centered classes with stress placed on student responsibility and accountability.

3. Students "master" course materials incrementally and sequentially, learning simpler concepts first before proceeding to more complex information. They may repeat units and take different versions of unit quizzes until they master the material.

4. A personalized system of instruction environment usually produces better learning of course material compared to traditional, lecture approaches. Students also report more enjoyment and satisfaction after completing a PSI class (Gray, et al., 1986).

What Does the Research Say?

Partly through the process of modification and partly as a result of improper preparation, some concerns about PSI have emerged. For example, Friedman and his colleagues reported that the failure to train adequately staff and counsel administrators led to the downfall of PSI at the Massachusetts Institute of Technology (Friedman, et al., 1976). Keller suggests that some of the more pertinent questions that have to be addressed to overcome potential pitfalls come under the rubric of *how* teaching any subject should be implemented. If students do, indeed, receive individual treatment, what kind of physical

environment will encompass them? How would the commonplace duration of courses change as a result of PSI? Would a semester still be a viable concept? How would methods of evaluation award top students? How would other support services, like libraries or special education centers, be affected? In the face of traditional methods of classroom teaching, innovative techniques like PSI need to address these questions, or educators used to a particular pedagogery are unlikely to switch.

Caldwell (1985) identified two major issue issues which impact on PSI's effectiveness. First, PSI has been accused of neglecting higher order skills and course content in favor of testing expediency. Because instructors must know in advance what students themselves are expected to study, test questions are supposedly only mild variations of study questions. That being the case, students do not learn critical analyses of material, merely a series of lower-level objective "one-liners". There are at least two considerations here. Most large survey classes employ the "low-level" method of multiple-choice testing anyway. PSI successfully employs this measure and significantly improves student scores on it. More important, the claim is made that study question techniques do not lend themselves to objective methods of evaluation. According to this view, study questions skim very shallow intellectual waters netting trivial facts but failing to capture critical and deeper thought processes. Unfortunately, the most popular and available evaluation alternative is an essay-style exam fraught with concerns over the instructor's inaccurate and unreliable means of grading vague responses. PSI stresses the specificity of content objectives. Further, there is nothing that prevents instructors from constructing more probing and complex analyses of course content. In fact, undergraduates successfully improved their writing skills in a PSI course built around their submission of brief written reports in an English class (Allen, 1984).

Second, the fear of uninspired monitoring and outright cheating on the part of student proctors causes educators to shy away from implementation of PSI. Students may unknowingly encourage proctors to "cut them a break" or may deliberately shape their behavior in ways that increase their chances of obtaining a higher score on a unit quiz. However, this concern is probably unwarrented. Students often compete against each other and are tempted to cheat in all kinds of classes; PSI hardly is unique in this respect (Finn, 1983). Moreover, the assumption that student proctors are more likely to give in to their classmates' requests than are professors is questionable. Proctors are usually highly successful students who are hard workers and retain a strong sense of course integrity. In fact, some proctors may demand more of their peers and evaluate them more stringently than instructors.

Regardless of whether or not difficulties associated with PSI are well-founded, they can be alleviated if certain precautionary measures are enforced (Hobbs, 1987). Most instructors have found that modifications in course structure from the original Keller plan are somewhat necessary (Lloyd & Lloyd, 1986; Coldeway & Coldeway, 1987). Such variations can take the form of more complex study questions which treat analysis and synthesis of course material, but are broken down into more discrete components to facilitate the use of precise learning objectives. Students who are habitual exam procrastinators can be encouraged to keep up the pace when they are rewarded for doing so, when they are penalized for failing to pace themselves, and when they previously commit themselves to testing on certain days with the course instructor (Reiser, 1984; Lamwers, et al., 1985). Contingency contracting is one specific method successfully applied for short- or long-term contracts; withdrawal rates, number of absences, final exam scores, and student study habits have all been positively influenced using this approach in a PSI course (Brooke & Ruthven, 1984). Student cheating can be minimized by incorporating a comprehensive final exam after all units have

been completed and by using student tutors who grade and feedback exam results, but lack decision making power in altering grades themselves. Such preventive measures were instituted in a recent study with success (Caldwell, 1985). Finally, evidence contradicts those critics (e.g., Lockhart, et al., 1983) who claim that PSI is no more effective than traditional teaching in course content retention over time. In fact, on a six-week "make-or-break" progress report, a PSI remedial chemistry class significantly improved students' course and ACT scores compared to a traditional remedial class (Freeman, 1984).

Unlike many instructional systems, PSI requires precise and extensive record keeping. But PSI instructors realize that the teaching profession incorporates many skills and abilities beyond delivering traditional lectures: student test data must be recorded accurately; classroom time must be carefully balanced between examination periods and presentations to avoid too much emphasis placed on student evaluation; and proctors need motivational reinforcement as much as students to guard against the former's absenteeism and promote their diligence in class (Couch, et al., 1984). It is the educator's duty to get the job done; that is, find the best way to promote student achievement. If one of the skills that a teacher must possess includes keeping and carefully maintaining a system of files for each student, so much the better that that system also enhances a student's learning potential.

A crucial element for the success of PSI, however, is more substantive. PSI focuses education on the consumer, the student. Students pursue course material at their own pace, take exams when they feel ready, continue studying and re-testing until they have mastered the information, and even become a part of the evaluation of their peers. Students consistently report overall higher levels of satisfaction with course content, lower levels of communication apprehension, longer duration of course content retention, and higher levels of

perceived learning (Lamal, 1983; Thompson, 1985; Gray, et al., 1986; Rosenkoetter, 1984). This is a method which engages the student and encourages student responsibility, self-discipline, and the importance of helping fellow classmates in the process.

The Contribution of Advanced Technologies

Successful completion of each sequential unit of study is the key element of the technology which supports a personalized system of instruction. Known as "mastery learning", this technology is based upon the behavioral principles and programmed learning techniques of B.F. Skinner. There is a plethora of research which supports the effectiveness and utility of this approach in learning (Bloom, 1984b; Cohen, 1977; Burns, 1987; and Mevarech, 1986). Students progress through the curriculum at their own pace. Each is reinforced for mastering a unit of study by passing an examination on the relevant material, usually scoring a minimum of 80%. While the basic technology is not exactly new (Skinner, 1954; 1968), applying mastery learning to a PSI class does constitute an important advancement.

Mastery learning classes significantly differ from their traditional counterparts. The amount of time spent on preparation and test-taking varies unlike traditional classes where everyone takes an exam at the same time. Mastery learning proponents argue that high achieving students are not held back by the extra time that would have to be devoted to low achievers as in traditional classes. Nevertheless, a very recent critique of the mastery learning literature questions the claims for "extraordinarily positive effects" by its adherents (Slavin, 1987). First, Slavin cites evidence that mastery students spend more total time learning material but retain less per hour of instruction. This is a peripheral point. Time spent in instruction is not a

vital element of mastery learning compared to the students' own devotion to extra preparation outside of class (Guskey, 1987).

Second, through a data manipulation technique ("best-evidence synthesis") which combines meta-analysis with discussions of key issues raised by standard literature reviews, Slavin (1987) argues that mastery learning research is methodologically flawed because it employs invalid outcome measures and misuses instructional time. But these criticisms can equally be directed toward traditional instructional use of testing and study time (Anderson & Burns, 1987). Slavin's final request that researchers conduct more precise methods of testing the effectiveness of mastery learning is echoed by supporters and opponents alike.

Advancements in mastery learning technology are taking PSI courses even beyond what their creators might have imagined. While behavior analysis has emphasized accuracy and precision by reinforcing student learning on a unit-by-unit basis (Couch, 1986), patterns and interrelationships among learning units are being identified and integrated into systems and cybernetic theories (Coldeway, 1987). On a more applied note, Kinser & Pear (1988) describe a computer-aided personalized system of instruction and how it can be implemented through electronic mail and other means for standard classrooms and remote sites.

What are the Implications for the Army?

The Personalized System of Instruction, with its emphasis on behavioral analysis and largely successful track record, deserves another look. The U.S. Army Research Institute for the Behavioral and Social Sciences is in a position to support the basic fundamental research effort necessary to investigate those outstanding questions of PSI that Keller posed nearly a generation ago. Moreover, ARI can commit the kind of resources it takes to examine PSI's

usefullness outside of the traditional classroom and in military learning environments.

There is no question that PSI works, not only in the classroom, but in applied settings as well (Ford, 1983). What's more, the Army offers an ideal laboratory environment for both identifying the variations that prove most effective and implementing those changes. Workstations which reinforce individualized instruction are more commonplace than ever in the Army. Use of the PLATO computer system for curriculum development and evaluation, computer graphics, and game-based learning has been available for a number of years (Simutis & Barsam, 1983).

In order for the Army to insure successful implementation of PSI, civilian and military educators need to be committed to behavioral principles and need to receive support from commanders and service school commandants. This is the case for conducting PSI classes for military personnel as well as dependent school children. PSI is a highly adaptable instructional system. The special technique of its advanced technology, mastery learning, has proven effective at all age levels. What this means for the Army is that its education centers can provide logistical and supply support for PSI implementation among soldiers and in the Department of Defense's dependent school system in locations within the U.S. as well as other bases located around the world.

Other sectors of the armed forces have already tested some applications of PSI. The Navy sponsored a modest PSI research project in the early 1980s (Lockhart, 1983). More recently, the Air Force successfully conducted a PSI course in physical chemistry at its academy in Colorado Springs (Davis, et al., 1987). Curriculum specialists recognized that a PSI-based course would let cadets participate in a host of academic and military activities without missing important instructional material. Student evaluations were determined by

mastery of learning units, three scheduled tests, and a final examimation. Results were positive. While less than 80% of all quiz attempts resulted in mastery (mainly due to students attempting quizzes without proper preparation), final exam scores were significantly higher than twelve previous classes. Moreover, in a survey delivered to PSI students during the middle and again at the end of course, 87% retained a very positive attitude toward the class style while 93% reported that what they liked most about the course was student independence. This Air Force PSI project produced cadets who not only knew their course material as well or better than their traditional class counterparts, but who also demonstrated independent action and independent thinking under conditions fostering responsibility (Davis, et al., 1987).

The Army seeks soldiers who can meet basic knowledge requirements and can think on their feet. PSI is one method that addresses both of these needs. Other sectors of the Armed Forces are already discovering the versatility and success of PSI. The time has come for the Army Research Institute to support basic and applied research for adaptation of PSI courses where feasible and desireable.

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Feedback Lecture

What is the Feedback Lecture?

The Feedback Lecture addresses the need for a more systematic approach for teaching large lecture classes by organizing the content of the presentation, actively involving students in discussion, and reinforcing students for participating and responding to the material. The Feedback Lecture can be seen as a compromise between the traditional lecture format and some of the newer instructional innovations.

The four chief characteristics of the Feedback Lecture include:

(1) Guidance

Students are guided through a lecture prior to, during, and after the lecture by the Feedback Lecture study guides. The study guides contain visual stimulation, concepts, objectives, introduction to the lecture, how to study section, prerequisite readings, guided notes, discussions, and individual activities for outside of class.

(2) Instructor Diversification

The instructor's role is diversified: lecturer, discussion leader, colleague, consultant, manager, and evaluator. During the discussion period, the instructor circulates through the audience, provides feedback, and assists students in answering discussion questions based on the lecture.

(3) Student Diversification

The different learning styles that students bring with them to class are met with activities designed to expose them to other students' learning preferences.

(4) Feedback

Feedback comes immediately and directly from the study guide, from the instructor circulating around the student discussion groups, prompt answers to the pre- and post-tests, in class, and prior to and after class.

The lecture itself is designed in two parts to accommodate the discussion period and provide students with an opportunity to talk with each other about the presentation. Each lecture is organized into a specific content area which builds on previously lectured topics. The second half of the lecture should build on the information presented in the first section and feedback from discussion periods. The students are again guided by notes and an outline from the study guide. Study guides provide the connection between lectures which motivates students to apply information in new directions.

Osterman (1980, 1984) recommends a point system for grading student performance wherein class points (500 maximum) are distributed between tests (205), homework assignments (195), responses to the Feedback Lecture discussion questions (50), and one paper (50). Extra credit points can be used for reinforcement and earned by participation and discussion.

The basic philosophy underlying the Feedback Lecture design is activity, involvement, and interaction. Students become involved in the material before the class even starts, and are encouraged to interact with each other and the professor in discussions of the material during class time. It is an attempt to refine the traditional lecture method of instruction to suit various learning styles.

Getting to know the different approaches by which students process course material can significantly contribute to presentation and explanation of the material. Providing alternative reading lists based on these approaches can

also help to individualize the course for students, and allow them to choose the material which most clearly matches their interests. Giving this kind of freedom to students, especially at the college level, is profitable for student and instructor.

A Brief History

The Feedback Lecture was first developed and implemented by Dean N. Osterman at Oregon State University in 1974. It is an approach that combines teaching and learning styles (reaching the four different learning preferences) with the lecture format. Osterman originially modeled this technique after programmed instruction which includes the elements of self-pacing, immediate feedback, small instructional units and instructional materials which students can use to teach themselves. Osterman's original intent was to retain the lecture format and extend it to include the personalized format of programmed instruction.

What are the Advantages of the Feedback Lecture?

1. Students' learning experiences are guided for each lecture. This means that they must purchase study guides prior to class and be provided with an orientation session to brief them on the use of these guides. Despite the extra cost incurred, extensive use of the guides clearly justifies their expense.

2. The instructor retains the lecturer role. Those traditionally trained in this manner of imparting course content do not have to radically alter the style of presentation. Students used to this method of teaching can also retain a sense of comfort and security toward a classroom instruction and singular lecturer for which they are accustomed. Moreover, classes with large numbers of students can still be accommodated with relative ease.

3. The Feedback Lecture provides an alternative for the conventional lecture. With that comes increased responsibility on the part of the instructor in so far as s/he must cover the material designated on the outline. This is ultimately an advantage because the student receives a well thought-out organized system of instruction in which the lecture and the students' responsiveness to it are integral parts of the course design. By the same token, different learning styles can now be accommodated in a single classroom during the feedback sessions.

4. Students rate this experience very favorably (Osterman, 1982). Their direct involvement can increase the level of volume during small group discussions, but such activity usually leads to positive, engaged rather than negative, withdrawn activities.

What Does the Research Say?

Feedback Lecture research has been minimal. Reasons for this lack of analysis are not clear though some instructional strategies embody many similar guiding principles or pedagogical techniques (Couch, 1983). However, none manage to combine the strength of lecture presentations with frequent feedback as the Feedback Lecture does. Moreover, a very significant dynamic process occurs. Students are given the opportunity to learn how well they comprehend lecture material and are then assessed. The results of their achievement are fed back to the instructor who can then further polish and refine her or his lecture accordingly. This secondary feedback process allows lecturers to become more active (a) in direct presentation and (b) in the construction of future classroom assignments (Osterman, 1982).

A recent innovation of Feedback Lecture is the recognition of its usefullness for audiences with little free time and who need to know how well they are

processing and remembering material presented to them. Educators at the Oregon State University Extension Service Home Economics Program have adopted Feedback Lecture for this type of student by training volunteers to deliver course content to the non-traditional adult student. These volunteer-trainees operate vis-a-vis a nine-step process in which they (1) determine the students' level of knowledge by asking a series of prepared questions relative to the subject; (2) provide a sequential order in which the lesson is to be presented, checking to see if students understand the order; (3) provide a list of tasks to be learned, clarifying any uncertainties; (4) provide a general overview of the material to be presented; (5) conduct actual lectures; (6) involve the student in synthesizing and evaluating the newly acquired information in light of their own life experiences; (7) formally assess the students' comprehension of the newly disseminated information; (8) provide feedback, including a listing of new terms introduced in the lesson and their definitions, in printed form for the purpose of reinforcement; and (9) conduct the students' evaluation of the instructional process and materials (Williams, 1986).

The Contribution of Advanced Technologies

One of the primary advantages of the Feedback Lecture system is that it retains the role of teacher as lecturer. It structures the presentation of information to maximize student involvement so that the interaction between student and instructor becomes an integral part of the lecture process. One of the ways this is accomplished is by using study guides which organize and introduce the lecture information for the student prior to the actual lecture. The study guides give detailed behavioral objectives of the lesson which inform the student ahead of time what the purpose of the instructional unit is and what will be needed to achieve mastery of the material. They also introduce the topic to the students and help them to get a head start on working through new

concepts. Study guides for a Feedback Lecture include an introductory passage written by the professor, an objectives page, a pretest, suggested procedures for studying, an outline of the lecture topic, visuals, a detailed reading list, and an advanced terminology description. The study guide is an integral part of the Feedback Lecture system and is designed to motivate as well as inform the student.

Osterman designed this program based on psychological analyses of various learner "types" or different ways in which students approach instructional material. As such, it is recommended that materials contained in the study guides allow students the flexibility to assimilate the information in a variety of ways. The study guides, combined with discussion questions and feedback sheets are some specific ways in which teachers can personalize the information delivered to students.

An important difference from traditional lecture techniques is that the Feedback Lecture incorporates a discussion period at the midpoint of each lecture. This provides students with an opportunity to discuss and assimilate the information presented in the first half of the class period. Discussion questions are provided in the study guide so that students can begin to formulate ideas before class. During the discussion period, students (ideally three) work in small groups exchanging ideas and discussing the information presented in the first half of the period. The instructor circulates among the groups of students to give individual attention and feedback to students. Before the beginning of the second half of the lecture, students write down their responses to the discussion questions and are given a feedback sheet on which the instructor has responded. The discussion period provides a chance for students to become involved and participate in class. This time also provides the instructor with a way of individualizing the lecture. As students gather in discussion groups,

the instructor circulates among the groups listening and learning about the various learning styles of the students. Students also have the opportunity to express concerns or discuss questions with the professor on a one-to-one basis during this time. This form of small group work is designed to guide student work and train students in decision-making through application of the concepts learned via the lecture.

What are the Implications for the Army?

For large group sessions which are used for basic orientation to Army regulations, introductions, and informational assembly, this alternative to the traditional lecture approach is applicable. Films, slide-tape programs, videotape playbacks, and other audiovisual materials should be used along with verbal descriptions during the lecture. Lecturing remains a good way to give a lot of information in a relatively short period of time. It is particularly well-suited for providing broad overviews and presenting the newest Army developments in the field.

Lecturing in and of itself, however, does not allow students to develop concepts or problem-solving skills. If an instructor has a goal of having students learn these skills, use of feedback during class or group discussions may be more appropriate for at least some class sessions. The Army's typical soldier is an adult who can readily benefit from the Feedback Lecture's commitment to both frequent assessment and reinforcement of classroom learning. The Army Research Institute can and should institute a research program designed to ascertain the conditions under which Feedback Lectures successfully surpass traditional lecture delivery systems for recruits, enlisted veterans and officers.

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Guided Design

What is Guided Design?

Guided Design (GD) is an instructional system aimed at teaching critical thinking skills and enhancing decision making capabilities of students in small groups. Traditionally, students are used to sitting in classrooms and passively absorbing material presented to them. Guided Design alters this learning process by temporarily reversing the roles of teachers and students. For their part, students learn to work cooperatively in small groups, analyze problems, and devise solutions rather than memorize masses of cold information. Their efforts often result in the generation of ideas and thinking strategies. Teachers, on the other hand, select problem topics, prepare materials necessary for the conduct of problem solving, and act as group facilitators and "guides". Their participation is limited to encourage students to do most of the work and pool individual student knowledge and skills for the success of the group. The direction of learning thus shifts from the traditional, teacher-based or "top-down" source of education delivery to a student-centered or "bottom-up" approach. Guided Design is based on the conviction that students can be brought to acquire whatever factual or technical knowledge they need as they work their way through an ascending order of well-designed problems. The central idea behind this is that the student who actively seeks solutions to problems in a cooperative group setting emerges far stronger intellectually, organizationally, and socially.

Key components of Guided Design methodology (White & Coscarelli, 1986) are:

(1) Independent Study

Students spend most of their time studying and preparing from course material outside of class. Materials may include audio-visual aids, written

instructional guides, and related ancillary texts. Students are not left to fend for themselves because specific performance objectives cover every lesson.

(2) Small Groups

In the real world, many decisions are made by groups of people. Students should and need to learn these kind of skills to be highly adpative when they leave the academic environment. They are organized into small groups and given specific problems to solve. The problems are broken down into clearly marked sequential steps. They are designed to tap into students' emerging thinking, organizing, and interpersonal skills - all of which are required for successful group decision making. Students spend most of their class time working on these problems.

(3) Guided Design Projects

A specific project (there are usually more than one for a given course curriculum) comes complete with the basic problem to be resolved and the various auxillary materials that help guide, but do not spoonfeed students. Course content is directly applied in these projects. Students also receive feedback and knowledge for each step of the problem-solving process. They get to find out how an expert decision maker would decided to work out a given step or sub-goal of the project. The completed project is presented in oral and/or written form and constitutes a major evaluated portion of the course.

(4) Instructor as Model and Mentor

Since traditional lecturing is minimal, if non-existent, the teacher becomes a facilitator and helper. Often acting as a resource expert, the instructor can guide, make suggestions, answer questions, offer support, but never direct the students toward a solution to a problem. The teacher becomes a conduit for real world decision making and the students can count on him or her for

conducting the project in such a professional manner that one would expect to find in an organization.

(5) Competency-based Testing

Any testing that is done generally follows basic learning or behaviorist principles. That means that questions which form the basis of an examination are drawn from the performance objectives of the projects. This way, students receive very specific feedback on their ability to understand and apply the decision making principles beyond the classroom.

(6) Grading

Course evaluations are based on a combination of test scores and work on projects. While students may be tested on any aspect of course material, the decision making skills they learn and practice in their small groups and for their projects form the basis of most methods of evaluation.

DECISION MAKING AND PROBLEM SOLVING STAGES

The manner in which students deal with the problem is carefully programmed. Each problem is broken down into sequenced stages or steps. Students must deal with each stage in sequence and are not permitted to progress to a new stage until they have adequately considered and dealt with the preceding stages (Wales & Nardi, 1984). The stages follow a problem-solving process well-documented in cognitive science and perfectly applicable to the group method:

(1) Define the Situation

Ad-hoc and informal groups often begin a decision process by considering a range of potential solutions. This is putting the cart before the horse. By not starting with a clear definition of the problem and its context, groups may waste time solving a problem that is irrelevant or doesn't even exist. There

are basic questions of the problem that need to be addressed: "Who is involved? What is involved? What happened? How did it happen? When did it happen? How serious was it?" These questions help students explore the parameters of the situation and begin to think about the tools they will need to solve the problem. To this extent, then, group members are explorers, or adventurers, in search of more and better questions to pose.

Groups should also be examining the cause and effect relationships that impact on problems. Observable symptoms may reflect a more rudimentary or fundamental dilemma hidden from view. Any preliminary decisions made at this early stage are not set in stone, however. Group members' perception of a problem and its attributes can and usually do change over the course of the decision making process. If in subsequent stages someone raises a valid point or thinks of another variable, it should help shape the definition of the situation. Once the context of the problem is fairly well established, the group can generally proceed to the next stage.

(2) State the Goal

Knowing the causes and symptoms of a problem is not enough for resolution. The identification of cause and effect relationships now requires group members to act and think like philosophers. That is, the group must decide what its purpose is: Should the cause be directly addressed or must it wait until immediate symptoms are handled? Thus, having determined what the problem scenario looks like, the group needs to identify its objective(s). Setting goals is a group effort. If members cannot agree on what the goal is, they can not be expected to work as a team toward achieving it. Goals should also be clearly stated. The inability to achieve an overall goal, like losing a relay race, can occur if the group fails to recognize the specific sequential behaviors necessary for success. The tendency is to concentrate on the "How?"

questions (e.g., "How could we have lost?"). The group needs to focus on what will work, not what went wrong after the fact.

Goals must also be measureable. To that extent, the group will probably have to create testable sub-goals (e.g., each racer has to be trained to pass the baton off at peak speed). These can include the identification of information or facts that are known to be relevant and meaningful for the major objective. Additionally, broad limits and restrictions need to be listed and they are distinguishable from facts. For example, if the general problem concerns identifying ways of expediting the transfer of supplies from one Army installation to another, it is important to know what and how many materials are to be moved. This is an immediate and quantifiable objective. It also helps to know if certain size trucks are not now and will not ever be available. Elaborate discussion of the best vehicles on the market is tantamount to beating a dead horse. It is irrelevant and constitutes a constraint on the group's time and energy. Certainly, then, without a measureable goal, no one in the group will really understand or know if the objective was reached.

If the group has difficulty producing an overall goal, then the behavior that guides the group in the right direction is planning. Members can ask more "Why?" questions (e.g., "Why are we doing this?). As an added bonus, "Why" questions also provide group members with information that reinforces cohesiveness and increases the likelihood that an optimal goal will be agreed upon. When information is unavailable, the group may have to make certain assumptions about what will or what will not impact upon the problem. The number of assumptions probably correlates with the vagueness of the problem. Nevertheless, it is very important for the group to list formally the relevant assumptions that have been raised regardless of the nature of the problem.

(3) Generate Ideas

Laboratory and field research in decision making has already demonstrated that successful problem solving is maximized when the group allots special time and energy for the generation of ideas. It is when students play the role of the scientist that they conceptualize ways and means of attacking the "Why?" queries of the philosopher. This is a stage that has a tendency to be glossed over; vital, even negative information shapes sub-goal development and is dismissed too quickly when the group focuses on final outcomes and ignores the logical and procedural progression required to reach a consensus. Students should be prepared to pose many "change" questions: "What will happen if we change this?" This is one precedure where group members are encouraged to borrow and build, piggy-back style, on each others' ideas.

There are many techniques available to generate ideas, the most popular of which is "brainstorming". Most idea production processes, like brainstorming, emphasize quantity over quality and variability in problem solutions even to the extreme. Group members are discouraged from censoring their own thoughts or criticizing the contributions of others. Like the inclusion of "Why?" questions in the goal establishment stage, brainstorming serves a secondary function of increasing the level of interest among group participants and reinforcing the building of interdependent give-and-take interactions, both of which forge an "esprit de corps".

(4) Prepare the Plan

When the basic goal is laid out and group produces a sufficient number of good ideas toward goal implementation, it is time to plan. The nuts and bolts of Guided Design activity occur at this stage as students behave like designers. They seek out and organize specific and crucial components that will aid their planning. But it would be premature to select a single solution even at this

point in the decision making process. For instance, before a roll call can commence, the group needs to evaluate solutions. Ranking ideas to arrive at the best means for accomplishing the task occurs at this stage. How should ideas be compared? There are specific criteria the group can adopt to increase the likelihood that the plan chosen is, indeed, the best. First is viability. What are the facts that support implementation of a plan and what are constraints that limit its usefullness? Second is resources. How much will the plan cost the group? Is the manpower and materiel available? Third is ethics. Is the plan legitimate? Does it follow the basic legal and moral rules which make up a part of the original problem situation? Different group members may be assigned specific tasks and job assignments toward ranking plans on these criteria and these tasks may be prioritized in and of themselves. Ultimately, an optimal solution is hammered out–the group poses and answers the question, "What is the best plan?"

(5) Take Action

Students now become builders as the Guided Design decision procedure enters its most constructive phase. What was an abstract problem, what were stated goals and ideas, and what theoretical plan was originally conceived have now become reality. The decision making action is a five-step process. First, groups usually set up groundrules governing the final decision. How will the decision be determined? Will group members vote democratically? In a hierarchically structured group where ranks and status differences are recognized, will the group rely on a formula for distributed decision making, giving greater weight to people in loftier positions of power? Agreement by consensus is usually the most successful final decision procedure, one that lays the foundation for future decision processes by an on-going group. Concensus minimizes power struggles and maximizes in-group attachments and support both during and after the decision is reached.

Second, last minute details are worked out even after a solution has been chosen. Specific elements of the plan are carefully analyzed to ensure that the group has accounted for as many varied consequences as possible. Yet, group members should not feel that their final decision is cast in stone. Further, once minute aspects of the solution are clarified, they must be integrated into the final decision.

Third, superior decision makers monitor the solution while it is carried out. This may mean selecting one or two group members to oversee the task. For this purpose, seasoned problem solvers may collect empirical data measuring the group's ability to implement the solution. Ideally, one of the group members can be assigned the role of secretary at the very beginning of the decision making process. This, however, is not always possible due to time constraints and precious use of participants' availability. Monitoring is a peripheral, but useful element of Guided Design. It is a powerful adjunct and can provide a very robust tool in which to collect group process information leading to later verifiability and to remind students that their efforts and responsiblities do not simply end with the production of a single decision.

Fourth, compilation of monitored data leads to evaluation of the plan. Was the plan successful? What kind of errors occurred, factual or procedural? Evaluation of the action is important because it provides the group with systematic, objective data allowing groups to accept or reject their decision with confidence. The evaluation materials may be further refined if the data appear irrelevant or do not address the essence of the decision.

Fifth and last, analyzed data is diagnosed, summarized, and fedback to all group members. The original student-philospher's dream has come full circle. Group members examine the results of the decision plan to see how it fares against their early conception. This feedback procedure is essential. It provides

students with an opportunity to review their decision efforts, observe what went right and what failed to materialize, and what steps need to be taken to correct faults. On-going task groups benefit greatly from the feedback mechanism. It reinforces recognition of group continuity and group cohesion.

WORKING IN A GROUP

Most students lack the experience required to make a group decision making effort a successful venture. Students are accustomed either to meeting in each others' homes with plenty of entertainment at hand or working over the telephone and assuming all who are part of a project are doing their part. Neither of these actions lends itself to producing superior decisions. Guided Design provides groups with basic rules and principles.

1. Students should work together in groups of four to seven members to formulate plans for tackling each stage. They should sit, rather formally, in a circle or preferably at a round table so each participant has an equal opportunity to contribute and respond to the comments of others. The location they choose should be one conducive to work: quiet, distraction-free, studious, but offering a reasonably stimulating environment with sufficient light and necessary materials for taking notes.

2. Each student should be assigned a specific task from the very beginning of the problem solving procedure by the group itself. All participants should feel not only that they are part of making the decisions, but also that they are getting their feet wet from the "ground floor". This does not mean that students must stick to the same job. Monotony can lead to unsatisfactory work. Rotating jobs is one possibility, but some sort of happy medium will have to resolved between boring work and creating specialists in each sub-task who can expedite the process. No doubt everyone will have to kick in when tedious and mundane work is necessary.

3. Meetings should be held relatively frequently, certainly in the early stages of large group projects, but must be substantive-getting together for the sole purpose of knocking ideas around is fine at the inception, but not when the group is well underway.

4. Group members need to be reminded about completing outstanding assignments and need to be reassured and reinforced for the work that they do. Completion dates teach responsibility and make students aware of the interactive nature of all who must pitch in and make their objectives by an agreed upon time. Point systems, schedules, reciprocal pats on the back can be soothing, but should also be used to motivate group members to press on and even reach beyond the stated goals. Satisfactory results are acceptable, but excellence requires the extra effort.

5. Make sure students comply with self and peer evalutions throught the decision making procedure. They are entitled to know what behaviors have changed, been improved, and what still needs to be worked on. Evaluation data should be summarized succinctly and presented in a manner that is easy for students to comprehend.

THE GROUP PROCESS

Though the group exists because the instructor or supervisor has created it out of necessity to solve a given problem, it is wise to recognize the fact that this social unit now carries with it force and direction. Group members are real people who will now engage in behaviors that will be new to them and they will welcome guidance accordingly. These new behaviors, however, do follow many fundamental principles that reflect the common conditions of all group processes (White & Coscarelli, 1986).

When group members begin their activities, they will play host to learning what the boundaries of acceptable and unacceptable behavior are. "Why?" questions are so important here, because each individual member poses this question to himself or herself: Why am I participating in this group? "What" questions are sure to follow: What will I receive if I contribute to the group effort? What is expected of me and others? This is the stage where the instructor must lay out the rules.

Initial interactions soon encourage the exposure of individual pursuits. Disagreement is likely to follow, but cannot be allowed to dissuade or stifle the group from its objectives. Though some students may become defensive when their ideas are questioned by their colleagues, the principle of job and role rotation may help to stem the worst of the conflicts (e.g., "When am I going to get a chance to lead the group?). On the other hand, overt conflict is a yardstick for group progress and it doesn't pay to restrict heated discussions too much. Opinions must be public for all to see and respond to. Guided Design recognizes the occasional necessity for individual and/or group counseling to keep the group goal in sight.

Coalitions of two or three students are likely to emerge, but if these are kept positive, rather than destructive and cliquish, they will serve the group well. In fact, small sub-groups can compliment this acceptance stage as the large group becomes a true working unit. As specific tasks are carried out, the group discovers and allocates appropriate workloads to those individuals and pairs or coalitions most capable. The only real danger in this early group integration phase is that a kind of "groupthink" or conforming tendency will stifle creativity. Peer evaluations can be used to "reshuffle" the group's thinking process.

The final phase occurs when groups have learned to overcome petty individual differences and integrate the various assigned members into a single working unit.

When the group has decided upon its action for the stage of the problem under consideration, it is given written feedback materials prepared in advance by the instructor. These materials discuss a number of possible decisions the group may have reached at this point in its problem-solving, elaborating upon the strengths and weaknesses of each decision. The students compare the pros and cons of their decision with those of other decisions before they are allowed to advance to the next stage of the problem. They may also receive follow-up or homework assignments eminating from the in-class Guided Design procedure.

A Brief History

As a young educator, Charles Wales noted that student achievement and effort did not meet standards that he felt would help youthful minds cope with everyday challenges of life. His students often missed critical points of certain lectures, failed to transfer analytic techniques from classroom problems to real-world dilemmas, and exhibited a general lack of enthusiasm and motivation for schoolwork. He created the Guided Design approach intending to help his pupils become more creative, more adaptive, and more autonomous. Lofty and idealistic as these goals were, sound technical and analytical skills would need to be developed to meet these objectives. Students would have to study harder to obtain the cold facts and learn how to process this information for making appropriate decisions. The key transfer mechanism in guarenteeing adaptive critical thinking was incorportating the value of small group decision making, a practice that is commonly found in families, organizations, and other cultural institutions.

After publishing some of his rationale and empirical support for Guided Design (Wales, 1979; Wales & Staiger, 1977), Wales established the Center for Guided Design at West Virginia University in 1980. He edits the Center For Guided Design Newsletter which is published twice yearly. In it are recent reports of the latest Guided Design research, instructional system conferences which coordinate GD efforts with related innovative pedogogic techniques, calls for papers, and descriptions of various GD projects implemented around the world.

What are the Advantages of Guided Design?

1. Guided Design brings knowledge alive as the tool of an active mind seeking orderly solutions to complex problems. It is exemplary of a student-centered approach to learning and instruction. It reinforces independent thought for each individual and interdependent thought for cooperative work among peers.

2. This approach uses real-life experiences and students can easily transfer the learning to vocations. *Guided Design contributes* to a school's success by representing it to students as an institution that facilitates the growth and transfer of information from home or work to school and back again. Too often a school conjures up an oppressive image, one that holds student creativity in check and inhibits learning.

3. Students interact with peers and successfully implement group decision making. This means that they explore issues using different opinions, inputs, values, and recommendations in the decision making process. A vital element in the success of Guided Design is that students learn to be interdependent; while their individual contributions are welcomed and rewarded, they find out what it's like to become team players in the classroom. The group problem solving scenario also aids slower students who would normally have difficulty with a traditional classroom environment. With their peers, they can feel more

relaxed and more willing to be tutored by their fellow group members. Simultaneously, students-turned-tutors gain a valuable teaching experience unavailable in typical classes.

4. Teachers spend less time lecturing and more time facilitating, coordinating, and supporting student critical thinking. Guided Design cannot entirely eliminate, but can significantly reduce the time and effort devoted to recapitulating concepts better processed in small groups. This frees up instructor time for monitoring and evaluating individual and group performance.

What Does the Research Say?

Research studies reported in the Guided Design literature usually reflect one of two types. A few attempt identification and systematic manipulation of relevant variables, but the bulk are anecdotal in nature. For instance, course instructors who seek out new ways to reach their students publish the results of "one-shot" design experiments. Willey (1987) discovered that pupils in his chemical engineering class had difficulty solving distillation problems. After attending a Guided Design workshop, he restructured his course to focus his efforts toward teaching decision making techniques. This included paring down from three to two lectures per week and requiring a term project built upon Guided Design principles of group problem solving. Students' ability to solve distillation problems was significantly better than in his previous classes. Borschadt (1984; 1986) adapted decision making guidelines from published works by Wales and his colleagues (1977; 1986) for a course in theatre education. Here, students applied thinking skills and exchanged knowledge in small groups to cover the literature genre of comedy, ancient and modern. Guided design instructional systems have been implemented in other curricula as well including courses in petroleum technology (Zacharakis, 1984), mechanical

design (Allen, 1984), German history (Mork, 1982), nursing education (Selby, 1985; Selby & Tuttle, 1987), and educational troubleshooting for teachers (Tillman & Pajak, 1984). Creating new Guided Design projects poses no special *difficulty and the response has been enthusiastic.*

Of those that attempt systematic collection of empirical data and controlled manipulation of relevant variables, a few stand out. Duane Miller and his colleagues (1981, 1983) examined student experiences in Guided Design activities. As expected, students in these projects reported higher levels of satisfaction and interest compared to those who solved problems in more traditional ways. Recently, an attempt has been made to look at individual differences among students by the effect certain personality dispositions may have on their likelihood to benefit from Guided Design. Staiger (1987), expanding Miller's earlier work, developed a self-report questionnaire which tapped eight "experiential norms" of problem solving including interpersonal engaging, intrapersonal engaging, describing, associating, conceptualizing, valuing, processing, and closuring. These descriptors are based on the Jungian/Myers-Brigg formulation for the four pairs of bi-polar personality types: extroversion-introversion, sensation-intuition, thinking-feeling, and judging-perception. For example, "working alone" is intrapersonal engaging and comes from Jung's introversion pole. Though the methodology is still at an exploratory stage, Staiger concluded that each stage of the Guided Design process requires a concentration of certain personality types. Earlier stages stress extroversion because sociable students help get the group started, break the ice, encourage group connectedness and dialogue. Other decision making phases are successful when they allow individuals to focus on the gathering of facts (sensing). A "thinking" preference is most evident in later stages when cause and effect relationships of the problem predominate in group effort.

Teachers and researchers who develop, deploy, and evaluate Guided Design procedures identify some limits to its use. First, it becomes difficult to handle classes larger than 35-40 students. One instructor cannot organize many student groups without administrative backing. Second, certain facilities do not allow students to form small groups. Some chairs and desks are affixed items of furniture and do not lend themselves to group activities. Then too, large scale student projects may require department or school-wide support on an official basis. Third, students have a difficult time returning to traditionally taught courses. When students are rewarded for thinking on their own and working together to solve problems, it is unrealistic to expect them to easily return to passive, unrewarding system of learning. Fourth, instructors must be good writers to produce the materials. Parenthetically, a great deal of forethought and organization are manditory–this is particularly true for novices who lack problem solving experience. They will need direction and they will look to written materials for help. Finally, students and instructors will need a transition to this approach. Allen (1984) discovered that despite the success of a Guided Design program and the genuine interest and appreciation it created among all participants, there remained a residue of slovinliness: many students still wanted to be "spoon-fed".

The Contribution of Advanced Technologies

Guided Design is a vanguard of innovative instructional strategies because it incorporates and fuses the combined forces of two technologies, decision making and interactive cooperative learning, each of which is receiving a fresh look by educational researchers. Much has already been said of the structure and process of decision making. Cooperative learning, on the other hand, deserves a closer examination. It is not that interactive group instruction is highly unusual, though it is implemented relatively infrequently in most schools

compared to formal lecture presentations. It is because scientists have begun testing a whole new training device for cooperative learning, computer support technology, that the results may have far reaching implications for Guided Design and adaptative use in organizations like the Army.

Guided Design works so well because it is founded upon the premise that people are gregarious and can, in spite of their individual or cultural differences, learn to work together to achieve a common goal (Schniedewind & Salend, 1987). It is unfortunate that most school systems and organizations relunctantly adopt cooperative learning techniques (Slavin, 1985). It is not difficult to institute cooperative learning research in classroom settings, if teachers are encouraged and rewarded to see themselves as active educational researchers (Johnson & Johnson, 1987).

Results of cooperative learning research are formidable. Students can achieve more if they are rewarded for group efforts (Brophy, 1987; Stevens, et al., 1987). They will be more motivated to work if they are evaluated by their peers or in a "buddy" system (Fader, 1976). They can also learn from others of different cultural, ethnic and economic backgrounds if they work together cooperatively (Wilcox, et al., 1987). The Office of Basic Research at ARI has supported the cooperative learning research of Donald Dansereau and his collegues for a number of years (Dansereau, 1989; Lambiotte, et al., 1987; O'Donnell, et al., 1987). His specific cooperative scripts, in which subjects play interactive roles of student and instructor, have been used to enhance performance on technical equipment and encourage participants' distributed planning and decision making.

A very exciting and innovative approach to cooperative learning combines group work and computer-assisted instruction (CAI). Research on the utility and effectiveness for individual computer-assisted learning aids is well established

and need not be reviewed here. However, advances in computer technology and information systems now allow educators, psychologists, and engineers to look at ways in which computers can foster collaborative work. For example, at a recent conference in Portland, Oregon, a number of papers discussed key issues and actual technological advances in computer-supported cooperative work. Some of the highlights included demonstrations of: 1) a tool which allows users to "socially browse" other people in a virtual environment on a computer screen or examine the various channels and levels of communication available to people who use computers for organizing data and sorting electronic messages (Root, 1988; Reder & Schwab, 1988; Hiltz, 1988; Mackay, 1988; Eveland & Bikson, 1988; Borenstein & Thyberg, 1988); 2) a group decision support system which, through computer communicative control, manages group conflict and equitably distributes perceived power by deemphasizing face-to-face personal relations and emphasizing written over spoken communication to encourage freer ideational expression (Poole, et al., 1988; Greenbaum, 1988; Whiteside & Wixon, 1988); and 3) a hypertext environment which offers users a myriad of simultaneous information filing, communicating, and organizing systems (Trigg, 1988).

On a small scale, limited use of computer-assisted instruction could enhance a well-structured decision making procedure like Guided Design in the areas of idea generation and plan preparation. In groups within larger organizations, adapting computer aids for cooperative learning environments can be very seductive. Nevertheless, some consideration should be given to the cost of hard and software, the time necessary for retraining, and the very real possibility of the redistribution of control and power withing certain organizational components.

What are the Implications for the Army?

According to the authors of a recently published text on the history and research contributions of the Army Research Institute, future determinants of battlefield readiness will include distributed decision making across geographical regions and departments within the organizational hierarchy, inclusion into the force of nontraditional and unusually skilled representatives of the U.S. population (older workers, e.g.), and assessment of group cohesion and effectiveness (Zeidner & Drucker, 1988). Guided Design directly addresses all three of these issues. Solving problems at vast differences among a stratified sample of soldiers at various ranks will become commonplace as computers simultaneously assist group communication and the display of information. Guided Design will encourage further creation of simulations that allow decision makers to test their ideas either in accelerated, real or decelerated time. The steps that people usually take to make minor decisions along the way will also be catalogued and evaluated. Determining the relative contributions of persons with different levels of knowledge and abilities is already a part of the Guided Design process. Perhaps most poignantly, whether computer assistance is invoked or deferred, Guided Design presents decision makers with real problems, not contrived ones. It allows people to meet on common ground, merge their individual skills into a single, unified effort, or to work through conflicts that erupt at the front or across conference tables in a safe and supportive atmosphere. Guided Design can help even the most experienced planner make better decisions.

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Microteaching

What is Microteaching?

Microteaching differs from the other student-centered innovative instructional strategies covered in this paper in that it is designed for teachers to enhance their teaching skills and self-awareness through audio-visual feedback. It condenses class presentations into one or two lessons in a controlled, laboratory setting. It is a scaled-down version of teaching in terms of class size, lesson length and lesson complexity (Perrot, 1976). This kind of miniature teaching environment maximizes immediate individual attention for each trainee.

The rationale behind Microteaching is to reduce the complexity of traditional classroom teaching and to allow for concentrated attention on specific aspects of the lesson. In order to accomplish these objectives, microteaching trainers seek the following prescription (adopted from Allen & Ryan, 1969):

1. Make initial decisions about a Microteaching clinic's chief purposes. Decide if the clinic will stress training or research. Consider how the Microteaching process will augment other formal instructional aids. Decide how the trainees will receive instruction and evaluation in the clinic. Spell out the detailed decisions regarding the number of students attending the "micro-lesson", the length of a lesson, how videotaped monitoring will be used, and other related concerns.

2. Formalize the structure of the Microteaching clinic within the confines of the educational institution. The Microteaching staff should be privy to the operation as a whole. Administrators should factor in the trainees' course load, other duties and responsibilities of the microteaching supervisors, and the availability of students. Thus careful scheduling of facilities, equipment, and human resources is essential.

3. Pattern and organize actual Microteaching activities that are conducive to the clinic's goals. These activities fall into one of three patterns:

- a) *the micro-lesson*: a five-minute lesson designed to teach, critique, plan, reteach, and recritique a single skill or concept. The trainee observes a live or taped demonstration lesson and then proceeds to teach that lesson to a small group of students. The lesson is rated or videotaped under the supervisor's direction and the information is fed back to the trainee in the form of a critique. After planning changes to improve her/his teaching, the trainee reteaches the session and receives still another critique. This process, though quite brief, is repeated until mastery of a lesson is obtained.
- *b) the micro-class*: whereby three or four trainees are grouped together to teach an entire unit of instruction in their subject field by combining their previous micro-lesson experience with team unit design, critiquing, and practicing. Here, trainees learn cooperative group work, increase their awareness of their own teaching strengths and weaknesses, and may develop the equivalent of a teacher "esprit de corps".
- c) *the research clinical session*: a highly controlled laboratory environment designed to concentrate teacher training in a specific skill for two or more hours at a time. In particular, the research session provides a conduit for diagnostic testing of any variable deemed relevant to the trainees' teaching repetoire.

Thus, the Microteaching lesson begins by redefining a teaching skill in terms of the overall pattern of teacher behavior and objectives to which that behavior is aimed. The focus is on conveying specific behaviors and singular concepts. Further, students are less threatened by an approach which stresses skill learning rather than evaluation under pressure. Microteaching provides a relatively anxiety-free environment in which to practice new teaching skills.

4. Provide the Microteaching supervisor with the support necessary to help the trainee perform teaching skills and understand when that skill should be applied. Select supervisors from a pool of university teaching and research assistants who have had previous classroom experience. Assign no more than ten trainees to each supervisor. Train supervisors to develop skills which will help them recognize trainee behavioral deficits in teaching and help them give apppropriate positive feedback to trainees.

5. Recruit and select those students who will help evaluate the trainee in the Microteaching environment. Pay students for the service they perform, but in exchange, outline their responsibilities to the trainee and the supervisor. Choose students based upon a representative cross-section which trainees would be most likely to teach in schools. Choose students based upon a match between their age or level of understanding and the micro-lesson itself.

Microteaching can be distinguished from other non-traditional instructional systems in six important respects:

(1) Real Teaching

Microteaching is real teaching; the teacher and the students work together in a practice situation. Though not in the classroom itself, the setting is as natural as it can be. Since the focus is on the development of specific instructional skills, the setting and the teacher-student interaction lend themselves to optimizing this focus. Moreover, Microteaching offers a new way of looking at supervision. Instead of stressing evalution, supervisors concentrate on examining the actual, applied skills of the trainee in as realistic a setting as possible. This reinforces the Microteaching clinic as a relatively comfortable, relaxed, neutral zone. In this atmosphere, both trainees and supervisors are free to experiment with new teaching techniques.

(2) Classroom Environment

Microteaching lessens the complexities of normal classroom teaching, but retains the essential elements of what constitutes a virtual classroom environment. While class size, scope of content, and time are all reduced, they represent some of the key variables educational researchers need to examine. The Microteaching structure thus lends itself to experimental research.

(3) Specific Skills Training

Teaching is not merely a vague art or style that instructors adopt while in the process of conveying information to their students. A successful teacher employs many specific behaviors (aka "component skills") to engage students including question posing, lecturing, organizing, probing, reciting, nonverbal communicating, reinforcing, and others. Microteaching focuses on teacher training for the accomplishment of specific issues; these tasks may be the practice of instructional skills, the practice of techniques of teaching, the mastery of certain curricular materials, or the demonstration of teaching methods.

(4) Increased Control of Practice

Microteaching allows for the increased control of practice; in the practice setting of microteaching, time, students, methods of feedback and supervision, and many other factors can be manipulated; as a result, a high degree of control can be built into the training program. Increased control of practice also lends itself to safe practice. Trainees are more willing to take chances and risks experimenting with different delivery techniques in a supportive, non-threatening environment. These are activities and behaviors that would be extremely difficult to procure if teachers' sole training were on-the-job training.

(5) Feedback

Microteaching greatly expands the normal knowledge-of-results or feedback dimension in teaching; immediately after teaching a brief micro-lesson, the trainee engages in a critique of his or her performance; this feedback can be immediately translated into practice when the trainee reteaches shortly after the critique conferenece. The use of feedback need not be a once-in-a-lifetime lesson. Teachers recognize that as time passes, they may become used to a particular style of instruction even though their students may require

different delivery methods. Combined with new knowledge that accumulates in their field, teachers need some means of continuing to assess and improve their skills in the classroom. Feedback in the Microteaching clinic is an ideal vehicle for this purpose.

(6) Structure

The structure of Microteaching encompasses three sections for a given "class": (1) modeling, (2) feedback and (3) practice. The first section of class is devoted to training a new skill and is a much shorter session than in other teacher-training techniques – usually lasting four to 20 minutes. In the second session, students make presentations using the new skill and receive immediate suggestions on how to improve their skills. In the remainder of the class period, the students incorporate these suggestions and recommendations into a second presentation. The idea behind this training cycle is to maximize student participation in the lesson itself.

A major component of this approach is based on the psychological principle of modeling, in which knowledge and specific skills are translated into a behavioral repertoire. Modeling provides explanation and goal specification which allows the student to focus on the behavior itself rather than on the context (Perrot, 1976). The teacher trainee is shown live, taped or written models of the skill and then attempts to emulate the example. Trainees receive positive reinforcement when the behavior is achieved or suggestions for change for the sake of improvement when it is not achieved.

Modeling

The modeling sequence involves: a) acquiring the behavior, b) performing the behavior, c) practicing old and new skills, and d) transferring new skills to new environments and situations. Throughout this sequence, the teacher provides a "model" of the behavior to be learned. It is important to note, however, that

the objective is to master the teaching model – not simply model the "master" teacher (Stones & Morris, 1972).

Feedback

The consultation or feedback session should focus on the reinforcing aspects of student performance, and self-analysis is encouraged along with peer group discussion. Although the length of the feedback phase will depend on the content of the lesson and the number of students, it is recommended that it be limited to 5-10 minutes. Not only can helpful feedback reinforce and improve student performance, but it can also help to boost such abilities as self-evaluation, self-awareness and self-confidence, all of which are essential to effective teaching at any level.

One of the chief reasons that Microteaching is a unique innovative instructional strategy is that the type of feedback employed is one in which student-teacher trainees must directly confront their own behavior (Fuller & Manning, 1973). This method of "self-confrontation" initially increases the trainees' level of arousal, but research demonstrates that a number of potentially positive behaviors follow: self-realism, openness and insight increase. Nevertheless, trainees must be prepared to handle and improve upon their performance because if they see themselves in an unsavory light, or if they already harbor a dogmatic, rigid profile of themselves and others, they will feel badly. The teacher most likely to benefit from self-confrontation is the YAVIS type: young, attractive, verbal, intelligent, and successful; least likely to benefit is the HOUND type: homely, old, unattractive, nonverbal, and dumb (Garfield, 1971). Different types of self-confrontation are available to the practitioner including: mirror (show the teacher what he did), focused (use specific instructions), and cross-confrontation (have two or more trainees view and comment on each other's performance). Audio self-confrontation appears to be

less threatening than visual, though the feedback dynamics may be too discrepant to compare in a valid way. Lastly, change in a trainee's performance through self-confrontation usually occurs in the following stage order: arousal, awareness, goal setting, discrepancy reduction, behavior reassembly and task concerns. Behavior change as a result of self-confrontation has been likened to Lewin's unfreeze-change-refreeze process (Fuller & Manning, 1973).

Practice

It is recommended by Turney (1973) that students' practice sessions be videotaped to maximize learning. Videotaped lessons are used primarily because this instructional technique focuses equally on non-verbal and verbal cues given by the teacher. Videotaped sessions enable students to analyze maximally and evaluate their own skills while learning to align these skills with the practical as well as the conceptual aspects of teaching (McIntyre, et al., 1977). Videotaping also helps to provide immediate feedback during class.

Many teacher educators agree that there are at least nine areas of teaching behavior in which student teachers need to acquire and practice new skills. These are: questioning, classroom management and discipline, reinforcement, explaining, introductory procedures, small group teaching, developing thinking, and individualizing instruction (Turney, et al., 1973). Microteaching can be particularly effective for training in areas such as these because it is not discipline-specific and teaches universal skills. For example, one can improve the effectiveness of teacher questioning using skills-analysis in Microteaching. This approach breaks down a complex behavior such as directive questioning into its subcomponent behaviors. In each class, students practice these subcomponent behaviors, perform and master the skills necessary for effective questioning, and can then use them within their specific discipline.

A Brief History

The conceptual basis for Microteaching arose out of the attempt to provide a systematic framework for training specific teaching skills. Analysis of teacher education programs revealed that there was very little training of the behavioral aspects of teaching. Rather, most teacher training programs focused on the theoretical aspects of teaching coupled with brief periods of apprenticeship in the classroom. Microteaching, however, is specifically designed to train teachers in the most effective ways of communicating information. Since its inception at Stanford University in 1963, Microteaching has gained popularity in a variety of teacher-training disciplines. In fact, in a national survey of student teaching programs, it was found that 44 percent of all teacher education programs used some form of Microteaching (Cooper & Allen, 1971).

Much of this early success can probably be attributed to the production and access of video equipment. Videotaping gave educators a means by which teaching behaviors could be recorded, analyzed and fedback to the teachers themselves almost immediately. Patterns of verbal and nonverbal actions could be discerned through slow motion playback, split-screen recording of simultaneous student behaviors, and magnification of particular teaching segments.

What are the Advantages of Microteaching?

1. Students receive immediate feedback on teaching behaviors. The feedback can be in videotape form, behavior checklists, or other appropriately standardized paper and pencil measures. It is important that students receive feedback immediately following the microlesson while their behavior remains fresh in their minds.

2. Groups can provide positive suggestions and specific information to improve teaching. Because the feedback setting is deliberately constructed to minimize evaluation apprehension, students are comforted by knowing that the criticism which follows their microlesson is substantively positive and supportive. They can make mistakes in front of their peers without recrimination. Students realize that they and their peers are all "in the same boat".

3. Many people enjoy viewing themselves on videotape. Some may alter their behavior when initially placed in front of a camera, but after a series of microlessons, the vast majority of trainees soon forget that their gestures and actions are being recorded. As their teaching becomes less tainted by the novel televised experience and more natural behaviors emerge, they do begin to enjoy seeing themselves as others see them.

4. Theory and practice combine in the application of Microteaching experiences. What is true of most, if not all, operant-based instructional systems is particularly evident in Microteaching: that instruction combines theoretical basis of reinforcement and programmed learning with actual application in a learning environment. Whatever a student learns in a microlesson, designed to model a general or domain-specific teaching environment, can be transfered almost immediately to the real classroom.

What Does the Research Say?

When first conceptualized and operationalized in the early 1960s, Kevin Ryan and his associates chose to implement Microteaching efforts before empirical research had begun. Because early results in their own clinic were so impressive, they decided that the best crucible for testing Microteaching efficacy was in the field; i.e., the classroom itself. Nevertheless, it was clear from the start that systematic testing and examination of relevant

teaching behaviors in a controlled laboratory setting (e.g., the Microteaching clinic) would eventually be conducted.

A cursory review of recent literature reveals that Microteaching has been: 1) established as an innovative technique that is here to stay (Kasambira, 1984); 2) open to modifications in research (Klinzing, et al., 1984); and 3) a method destined to be intertwined with new and emerging educational technologies (Perlberg, 1988; Brown, 1986). First, the Microteaching process has become well-infused in education centers around the country and abroad. The newest innovation in this direction is the Microcourse: a thorough and, in some cases, semester-long instruction in Microteaching techniques and execution (Jerich, 1987; Kasambira, 1984). In another direction, Ford (1983) developed a four-lesson Microteaching program for those institutions with limited time and resources for teacher training. Gregory (1986) recommends that Microteaching can successfully be exported for use in the third world, even to the extent that training and feedback are delivered through instructional television systems at remote sites.

Second, Microteaching continues to evolve as research teases out the effects of one essential variable from another. For instance, Lockledge & Ray (1986) found that despite the relaxed atmosphere of the Microteaching clinic, supervisory evaluations produced undue apprehension among teacher-trainees. Subesequently, a method of self and peer evalution criteria were developed leading to a significant increase in positive attitude toward peers and Microteaching. Klinzing and his colleagues (1984) studied the effects of nonverbal teacher training during Microteaching. Results showed that trainees could improve their assertiveness and persuasiveness solely based upon noverbal behaviors including gesturing, eye contact, and vocal delivery.

Third, Microteaching's structure and delivery have proven to be quite adaptable to the challenge of new technologies in education. In telecommunications, Microteaching techniques, particularly those that employ videotape feedback, provide useful teaching techniques that are easily delivered to remote locations. Transfer of information and learning techniques from a Microteaching clinic to a television studio is not that complicated (Brown, 1986). Moreover, the success that Microteaching has enjoyed over the past generation brings into focus the re-conceptualization of how to train teachers. In this light, pedagogery becomes operant behavior and the classroom changes into a learning laboratory where trainees can experiment with new information delivery modes and optimize their level of teaching excellence (Perlberg, 1988). Gebhard and his colleagues (1987) have gone so far as to construct a multipurpose clinic which includes the production of self-investigative research by trainees.

The Contribution of Advanced Technologies

When videotaping was first employed in Microteaching environments, it was seen as an interesting, adjunct tool for use feedback, but ultimately a "frill" (Allen & Ryan, 1969). Today, video technology is recognized in some quarters as an integral part of the Microteaching program. Videotapes are flexible components: they allow the trainee, at will, to examine microscopic behavioral details of a teaching lesson plan, or expand the analysis to a wide angle display of macro behaviors and the surrounding environment. In the area of motivation, videotaping has enhanced trainee effectiveness in adopting new leadership syles (Kozcowski, et al., 1978). Classroom vignettes successfully increase a teaching faculty's willingness to participate during inservice meetings (Menges, 1979). One study reported higher levels of self-confidence as a result of a trainee group receiving video demonstrations in the field, not in the laboratory (McConnell & Fages, 1980).

Research on the success of videotaping encompasses all three phases of Microteaching. In the case of the first, i.e., modeling, Orme et al. (1966) found that teacher trainees performed better under conditions of video modeling compared to structuring their behavior after a written model. However, teaching effectiveness was maximized when both the video and written model were combined. In conjunction with social learning theory, Allen (1967) found that trainees performed better after viewing only positive vis-a-vis negative models.

Studies related to the second stage, feedback, show that trainees learn more if they are success-oriented, expect no "quick fixes" for altering deeply ingrained teaching styles, and receive specific goal-oriented feedback (Fuller & Manning, 1973). Moreover, trainees benefit when their own in-vitro supervisors model key behaviors for videotaping (Orme et al., 1966).

Third, trainees improve their non-verbal skills when they practice a lesson that is classroom-based in the original video presentation; if the lesson is non-specific, trainees are more likely to focus on improving their verbal capabilities (Young, 1969). Trainees learn to disciminate among different types of teacher interactions when they have practiced viewing relevant videos (Nias, 1974). In fact, after training with video recordings, novice teachers scored a model's performance almost as accurately as a group of master teachers would rate it (Legge & Asper, 1972). Reading comprehension scores are more likely to improve if trainees practice their reading skills with videotape support, rather than with role-play scenarios (Anderson, et al., 1982). Split-screen (separate cameras on teacher and students) analysis gives teachers a chance to observe the effects of their behavior upon their audience; consequently, it led to more positive verbal and non-verbal behavior between teacher and student (Mertz, 1972).

What are the Implications for the Army?

Microteaching holds two key areas of promise for the Army. The first is the actual conduct of research. Whereas the real classroom does not easily lend itself to manipulation of teacher-based variables, much less situational factors, ARI maintains potential testbeds of databases in field units which could very well lend themselves to Microteaching research centers. The Microteaching setting is useful for examining optimal teacher performance, for analyzing more global learning and performance relationships, and for analyzing functional behaviors between teachers and students (Allen & Ryan, 1969).

1. There are many trainee research questions yet to be clearly addressed: Is there an optimal time duration for a microlesson? How many students should participate? Beyond the self-confrontational literature, which trainee demographic factors reveal the most and least likely to benefit from Microteaching? Are some skills more readily teachable in a microlesson? We know a little about appropriate feedback and who should deliver it to the trainee, but we need to learn more about when feedback should be given during the Microteaching format.

2. Other questions dealing with general learning-performance relationships may be considered within the Microteaching setting: What kind of model optimizes trainee performance? Does the type of skill being taught to trainees make a difference? What other kinds of processes or sub-routines may yet be uncovered in modelling behavior? Studies of the contribution of supervision to trainee performance can provide greater understanding of the specific supervisory techniques used, verbal vs. nonverbal reinforcers, and identifying the optimal method for matching the right supervisor with the right trainee.

3. Microteaching illustrates a social psychological process in action between student and teacher. Data can be made readily available (e.g., split video screen) to address such issues as: where the teacher is in the classroom and how the student responds, turn-taking behavior between teacher and student, and the effect of a teacher's voice or gesture and student response (and teacher response, in turn). One recent study showed that Microteaching is effective in minimizing bias against females in classroom-type training sessions (NETWORK, 1984). Other related processes which could be studied include the step-by-step analysis and development of whole units of curricula or alternate forms of teaching and learning within the Microteaching setting (e.g., cooperative learning and small group discussions).

Secondly, because the Microteaching technique focuses on behavioral aspects of the education process, it is readily transferable to almost any military teacher training curriculum. Indeed, in related research sponsored by the Armed Forces self-confrontation was found to be superior to verbal coaching in teaching subtle interaction skills to males in military service (Haines & Eachus, 1965).

Given the Army's reliance on supervisory skills, the additional contribution of video technology holds promise. Army personnel can set clear goals and subgoals for teaching improvement on the basis of specific video presentations. Portable videos allow easy access to minute changes in teaching environments thereby increasing potential transfer of new behaviors. Adaptation of these technologies to other Microteaching extentions may just be on the horizon: specific domains may require honed techniques, hypervideo systems can expand the possibilities of dovetailing video pictures with database information, and cable networks offer microteaching possibilities at great distances.

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Comparison of the Four Innovative Instructional Strategies

The preceeding chapters presented and examined four instructional strategies noted for their innovative educational appoaches. It was seen that they differ from traditional lecture formats in terms of their essential elements, how they are implemented, and the unique contributions of their advanced technologies. Each delivery system offers students special opportunities to excel in a curriculum and each has met with some measure of success.

What follows is a direct comparison of each of the innovative instructional strategies on each major chapter sub-heading. Table 1, on page 78, lists some of the more important behavioral attributes upon which academic excellence may be gauged for each IIS. It may therefore serve as a guide for instructors who hope to implement one of these strategies but cannot decide which is most appropriate for a given classroom situation. The list may also act as a conduit to aid scientists and inspire future research queries: To what extent are these strategies interchangeable? Will they seek the same solutions or accomplish similar goals in classroom teaching? How easily can students shift their attention and activities to accommodate or transfer from one innovative pedagogical technique to another?

A more extensive comparison, based on the structure of each innovative instructional strategy chapter, follows.

Table 1: Innovative Instuctional Strategy Comparison Matrix
(Adopted from Osterman, 1980)

Attributes	Lecture	PSI	Feedback Lecture	Guided Design	Micro-Teaching
1. Student-centered	low	high	mod	high	high
2. Teacher-centered	high	low	mod	low-mod	low-mod
3. Transfer to real world	low	low	low	high	high
4. Student thinking	low	low	mod	high	low-mod
5. Scheduled activities	low	high	low	low	mod-high
6. Student involvement	low	high	mod-high	high	high
7. Instructor skills	mod	low	high	high	low-mod
8. Instructional support	low	low	low-mod	low	high
9. Cost-effectiveness	high	low-mod	high	high	mod-high
10. Resource constraints	little	much	little	much	some
11. Extrovert instructor	yes	no	yes	yes	yes
12. Introvert instructor	no	yes	yes/no	yes	yes/no
13. Student needs assessed	no	yes	yes	yes	yes
14. Preparation time	little	much	some-much	much	much
15. Decision making	low	mod	low-mod	high	low-mod
16. Feedback to students	little	high	mod	high	high
17. OK for all disciplines	high	mod	high	mod	high
18. Problem solving	little	mod	mod	high	low
19. Individual instruction	no	yes	no	no	no
20. Small group instruction	no	no	yes	yes	yes/no
21. Large group instruction	yes	no	yes	no	no
22. Student concept retention	little	low-mod	low-mod	high	high
23. Funding sources available	no	no	no	Exxon	no
24. Storage space necessary	none	low	none	low	high
25. Generates ideas	low	low	mod	high	low-mod
26. Instructional development	little	high	mod	high	mod
27. Stimulates research	little	high	mod	high	mod
28. Popularity in higher ed	high	low	low	low	mod
29. Helping students at risk	little	mod	mod	high	mod

Main Goals and Basic Elements

Neither a student nor an educator would have any difficulty distinguishing a traditional lecture class from any of these innovative programs. This is true from the very first moment one enters the classroom. There is a different "feel" or climate which permeates the learning process. Chairs and tables may be arranged in circles for small group activities, or singular stalls for individual work and tutoring may dominate the physical landscape. Students can often be seen helping, and being helped by, other students. Teachers are as

much facilitators as they are lecturers; more likely than not they can be observed aiding students individually or guiding a group discussion. They also spend a good deal of time preparing ancillary materials or evaluating data collected from student behavior.

This is a far cry from the traditional, ritualized and often mysterious atmosphere that accompanies teaching. Here, the instructor enters the premises expecting students to meekly and passively absorb information that is delivered. Students are occasionally called upon to respond to questions that have only one correct answer and that only the teacher possesses. The few major exams that are given are designed to measure how much a student does not know or has not learned and are usually conducted in an oppressive, anxiety-provoking manner. A student's ongoing learning is monitored infrequently, if at all, and feedback from examinations rarely helps a student improve performance or prepare for the next test.

There are modifications, within this apparently rigid context of traditional education, worth noting. The instructor may invoke an informal style of teaching whereby dress is more causal, gestures and body postures appear fluid (e.g., sitting on the desk), and students are encouraged to ask questions. Then again, some form of lecturing will always be necessary. Large classes require an inexpensive and relatively efficient means for delivering information. But the symbols of authority, control, power and educational responsibility rest with the teacher. Even where the teacher conducts a lecture peppered with humor and entertainment in the hopes of motivating listeners, the emphasis is still on her or his ability to "turn on" students, presumedly because they don't have the capacity or desire to learn on their own. In this context, students generallly lack opportunities for self-discovery, independent and critical thinking, and meaningful group interaction.

The four innovative instructional strategies outlined in this paper speak to these very issues that traditional approaches largely ignore. Innovative systems focus attention on what the student does: classes become centers where students learn, not where teachers drone. Students are understood to possess active, inquiring minds (Schomberg, 1986). Virtually all enter the school environment with an extensive reinforcement history for seeking information and learning tacit, or practical knowledge in their homes, at play, at work, or other relevant situations (Sternberg, 1988). To this end, non-traditional instruction focuses directly on how the student actually behaves and what the student can ultimately accomplish. PSI and Guided Design stress independent learning, the former for pacing students individually so each sequentially masters a unit of study at her or his own pace, the latter for encouraging work and preparation outside of the classroom. Microteaching requires more direction and control on the part of the instructor; however, as noted previously, trainees do increase their control, independence and willingness to perform new teaching behaviors as they practice their teaching skills over time. To that extent, Microteaching encourages the development of student-centered activities. Feedback Lecture is the least student-based of the four instructional strategies. Yet even within its more structured format, students behave more independently than they might in the traditional classroom through initial preparation before feedback class sessions and in the course of their small group discussions. Summing up, these innovative strategies support the proposition that students, not teachers, are the building blocks of achieving excellence in education.

A second proposition which underwrites an innovative orientation in learning is the particular attention paid to any and all behaviors that increase the likelihood that students will excel. In other words, these strategies adhere to the principles of behaviorism in the psychology of education. "Precision

Teaching", as it is also known (Couch, 1986), defines specific behavioral cause and effect relationships in learning, uses behavior rather than cognitive or attitudinal response rates as dependent measures, functionally analyzes behavior change by charting continuous student performance, and focuses on the utility as well as the accuracy of correct responses.

Demonstrable applications of operant analysis began with Skinner's programmed learning machines in the 1950s, and soon expanded with the advent of individualized computer-assisted instruction. These innovative instructional strategies represent futher developments along the same behavioral theme by encouraging, incorporating and increasing student interaction and student control over the learning process. Indeed, those pupils who, for various socio-economic and interpersonal reasons, lack control over their academic lives (i.e., are "at risk") are the first to benefit from the application of behaviorist learning techniques.

Third, and perhaps somewhat ironic considering the historical and underlying behaviorist foundation, innovative strategies pursue a rigorous program of testing performance measures many of which may be categorized under the psychological subdiscipline of "cognitive skills". On a relatively simple level, evidence has accrued indicating better and more durable concept retention for the innovative strategies than traditional classes. But cognitive skills also include higher-order thinking. PSI encourages students to become active in monitoring, controlling and planning their learning behavior which, some psychologists would suggest, requires high-level "metacognitive" abilities. Guided Design greatly, and Feedback Lecture to some extent, exhort student use of problem solving and decision making faculties. Microteaching relies heavily on a student's willingness and skill to confront her or his own teaching activities and modify them through a combination of behavior and attitude

change. One might summarize the cognitive requirements and admonitions of these strategies in two ways: 1) Students can increase their awareness of what it takes to think through decisions and solve problems and; 2) Students can prime themselves for engaging in those behaviors which improve academic performance.

Fourth and last, innovative instructional strategies look beyond the classroom itself to see if the techniques employed will generalize to other students, other schools and other learning environments. This means supporting scientific research and investigation of the conditions under which the strategies are most effective. The only meaningful avenue open to measuring teaching effectiveness of a typical lecture is the examination, a test which under most circumstances is often conducted quite some time after material is presented and lacks a control condition for valid comparison. PSI and Guided Design, on the other hand, have been especially concerned with sponsoring and stimulating research in teacher and student performance. Microteaching presents a slightly different picture of research support. The clinical session creates controlled laboratory conditions conducive to experimentation. However, since Microteaching is a method for improving teacher and student-training and is not a strategy that deals directly with the delivery of information in the classroom, it received a rating of "moderate" under the attribute of "stimulates research" in Table 1. Feedback Lecture is a more narrowly defined classroom technique which does not lend itself, as readily, to systematic study. This is not to say that valid and relevant data can neither be collected nor analyzed. Instructor-based variables (e.g., gender, style, nature of teacher instuctions), student-based variables (e.g., group and leader behavior, member attitudes and relations, prior homework preparation time), and classroom-based variables (e.g., size of class, type of class, feedback materials) can provide a wealth of information as to the quality and effectiveness of specific lectures.

Brief Histories

The development of the four innovative instructional strategies documents a relatively recent affair in the history of American educational psychology. To date, much of the empirical research only scratches the surface of potentially mediating variables in these instructional systems, so a review of their development over time is limited. However, the innovative strategies do share some common factors affecting their emergence and growth.

1. Each is based, to one degree or another, on the pragmatic philosophy of operant conditioning principles that have become a mainstay of the American classroom environment since emerging earlier this century. Though "innovative", they are actually truer to a "pure" branch of behaviorism in education than most reward structures typically implemented in schools. This is because many reinforcing strategies are combined with inappropriate forms of punishment or various ineffective punitive measures, diluting the strength of operant techniques and confusing or obscuring the role of the instructor in the process. Not so with the innovative strategies.

2. Parenthetically, the behaviorist school is staunchly empiricist by design; innovative educators trained in rigourous scientific inquiry expect their classes to become living laboratories where experimental research is the touchstone for progressive student achievement. The development and growth of innovative instructional strategy research is the story of humble beginnings in a single class. With experimental success verified, resources were added to test more classes, different disciplines, and covary potentially mediating variables.

3. Each strategy draws its strength from the knowledge, skill and imagination of a single innovative educator. Fred Keller's success in PSI did not occur over

night; in a recent biographical sketch, he described his early efforts in animal operant behavior which eventually convinced him of the possibilities for increased human control over external reinforcers in classroom environments (Keller, 1985). Similarly, Drs. Osterman (Feedback Lecture), Wales (Guided Design), and Allen (Microteaching) each discovered as teachers that students in their respective classes were either turned off by dull lectures and factual regurgitation or failed to achieve the knowledge and grades of which they were thought capable. Recognizing that students could succeed if only they were given the opportunity to master and reinforce their own behavior, fueled a concerted effort for finding a teaching strategy which could translate increased student input into hard academic success.

4. A stronger national commitment to academic excellence began at the close of World War II and created a bonanza. Improvements in classroom technology went hand-in-hand with more money for funding basic research and supplying loans to students now plentiful as either experimental subjects or prospective educators in their own right. Efforts in these four innovative strategies have probably decelerated since the 1970s, not so much because enthusiasm has waned, but more likely due to the decrease in financial support and resource allocation. Nevertheless, the best evidence to date suggests that innovative instructional research is thriving.

Advantages

The "advantages" section of each chapter displayed some of the chief attributes of the respective innovative strategies. At a glance, they compare rather favorably, but two broad elements stand out. If one had to choose the first and most important behaviorist principle that these strategies share, it would have to be positive reinforcement. The Personalized System of Instruction encourages students to work at a level and speed at which they feel comfortable.

This is particularly advantageous if, in a given class, student intellect varies widely. Such is often the case when teaching or training adults such as Army recruits. PSI testing procedures reinforce successful learning in incremental chunks allowing the best students a chance to finish early while not squandering their time, offering slower students relief from undue stress and unnecessary competition, and providing all students immediate feedback on what they learned. Guided Design operates similarly: first, by establishing the supportive, problem solving environment where students can feel comfortable as they contribute to the decision making process and; second, by providing the necessary feedback materials to group members so they can evaluate the results of their decision and identify relevant strengths and weaknesses of the decision making strategy they chose. Microteaching employs immediate feedback, either through videotape or rating schemes, to let prospective student teachers monitor their own progress and hone their teaching skills. Feedback Lecture tries to create a middle ground between the necessity of providing instruction to typically large lecture classes and tapping into each individual student's ability to incorporate what is presented. Students shouldn't be expected to comprehend an unwieldy mass of information in a full-length lecture for the sole purpose of later regurgitation on an exam. Feedback Lecture chops up a course curriculum in smaller learning units, immediately reinforces concepts presented in lecture through small group interaction, and prevents boredom from setting in by having students review the concepts during the lecture. Like the other strategies, the thrust is toward successful learning. Students can master learning behaviors in a non-stressful, supportive environment. Such is the goal of positive reinforcement in these instructional systems.

The second advantage is the creation of a classroom environment in which student behavior is paramount. The focus and ultimate responsibilty of learning is

placed on the student. PSI, for example, is a self-paced program and the most "individualized" of the four strategies. Except for the occasional brief lecture or small group demonstration, it is up to the student to maintain a rigorous study schedule. Not eveyone has the kind of self-motivation needed to succeed in this program and students should receive clear instructions describing the nature of the instructional strategy from the first day of class. Guided Design builds decision making by utilizing problems that often emerge from the students' real life experiences. Here, the student's active contribution to the problem solving scenario is highly regarded and rewarded. Microteaching is somewhat less student-centered, certainly for the novice during initial teaching behavior training sessions. However, with increased self-review of videotaped behavior and actual practice, the student gains more self-confidence and takes greater control over the course and direction of the training program. Feedback Lecture minimally shifts learning activity away from the instructor and toward the student. To this extent, study guides prepare students for response to lecture material on their own before they walk into class. Often, small groups are organized to encourage sharing of information among students, but their utility is as much a part of trying to evaluate student mastery of concepts presented in lecture as it is genuinely promoting interactive skills. Still, a great deal of instructional cost in time and energy is rendered unnecessary.

The innovative instructional strategies offer other advantages over traditional delivery systems (Couch, 1983). Grading schemes are more equitable because they depend upon smaller and more accurate selections of a student's substantive learning. Class sizes are generally smaller; even for those that are not, students receive far more attention and performance appraisal either individually or in small groups. Students in special categories, like those at risk or those returning to school after a long absence, are more likely to have their needs met by instructional strategies that increase their sense of control

and respect the unique characteristics or extra knowledge and experience they have to offer (Slavin & Madden, 1987). Finally, all of the innovative strategies generalize across many disciplines, whether in "soft" educational fields (e.g., history and literature), or "hard" technical areas (e.g., engineering and science).

Research

Waddell (1983) raised a poignant concern, one which directly affects the utility of IIS research. Can observed successes in IIS outcome studies be attributed to real differences between the instuctional systems and traditional formats or are they more dependent upon the individual needs of the student and the individual capabilities of the teacher? A meta-analysis which statistically combines relevant results is one method of resolving this question. Until such a study is undertaken, a qualitative review of the research must suffice.

Waddell's point is appropriate in two respects. First, it would seem intuitively that students differ on their need or preference for directive, controlled instruction from a teacher. One study previously described (Stagier, 1987) suggested that certain personality types will emerge during a given stage of the Guided Design decision making process. An early criticism of innovative strategies was that they catered to the bright, articulate student. Those who already excel in school were likely to do even better in programs that do not restrict their learning potential. However, the research presented here does not generally support this premise. The vast majority of students who attend these classes, regardless of their academic standing, report significantly higher levels of satisfaction compared to traditional lectures. This discovery includes students used to a highly organized curriculum in technology and in the military. It also includes students who come to school from a disadvantaged

background and generally lack opportunities to show how they can master learning behaviors.

Why is this the case? Traditional education systems are not designed to accommodate students with different learning needs. They present course material for the masses. Their goal is a kind of conformity in learning. They therefore attempt to minimize, but cannot eradicate, those ideological and cultural perspectives which shadow student participation in school activities. Innovative strategies, to the contrary, thrive on student diversity. They rely on behaviorist techniques which advantageously use those ideological and cultural perspectives which shadow student participation in school activities (Lawless, 1986; Smith, 1986).

For example, Feedback Lecture has been found to be especially useful to adult students. Guided Design is adaptable among many different disciplines and successfully builds problem solving scenarios among pupils of different races, genders and ethnic origins. By giving individual students a chance to excel and "show their stuff" either on their own or in small groups, regardless of the home or community environment from which they come, IISs actually reach more students, an accomplishment that is supposed to be one of the traditional format's strengths. Still, more research is needed to identify those students who might achieve more with one innovative strategy versus another.

Waddell's second concern has to do with the individual abilities of teachers. It is possible, if not likely, that some instructors speak better than others, relate to students better than others, construct exams better than others, and so on. However, individual differences alone cannot account for improved student scores across all IISs. Moreover, it is also true that some instructors prefer a student-centered to a teacher-centered class. Like student needs, however, this can better be explained by differences in motive and experience.

Consider a traditional lecture. An independent accounting of how well a lecturer speaks and disseminates information is obtainable through the Lecture Feedback system. The lecturer gets results back from student learning in quantitative form. S/he can then moderate her or his teaching style to according to the needs of the class, not merely her or his own whim. Thus the teacher *learns*, just as the student does. Innovative instructional strategies may emphasize a student-based perspective, but they concurrently focus on the student-teacher "fit". This is not the same as individual ability. A single strategy may not suit everyone. More to the point, this relationship exists because the educational process is interactive and dynamic; it requires the contributions of both the expert and the novice. The fact that it is also measureable lends further credence to its verifiability over traditional formats. What is now needed is a further delineation of the student-teacher relationship vis-a-vis innovative systems and the conditions under which it flourishes or falters.

Two other criticisms of research findings need to be addressed. The first takes issue with IISs' choices of dependent measures. On one hand, innovative strategies could be accused of selecting test variables that are too esoteric and too far afield from a traditional curriculum. Recent trends in education reflect a general yearning for the return to teaching the "3 r's" in American schools: reading, riting, and 'rithmetic. New educational strategies like PSI, however, are very much concerned with these basic goals and, in fact, probably make even greater demands (and offer more appropriately designed rewards) on students than the typical method of teaching. The kind of dependent variables that make up Guided Design and Microteaching studies are specifically based on student behavior, whether in the classroom or applied to real world situations. The charge of vague, pedogogic measures, therefore, does not hold up under

careful scrutiny.

On the other hand, instructional systems like PSI have been criticized for ignoring higher level cognitive functions that analyze and synthesize information in favor of simpler bits of unrelated facts. This issue appears unfounded. First, there are safeguards and modifications available for ensuring PSI's inclusion of these more complex processes, like giving a final exam or constructing test items that cover these concepts. Second, condemning an entire class of instructional aids merely because the potential for one system has not been fully explored seems unreasonable. Third, other IISs like Guided Design exist because of this very omission in traditional instructional systems.

The second issue in this vein has to do with information retention over time. IIS detractors argue that these innovative techniques may be all well and good for the immediate lesson, but beyond the initial exposure to a novel and exciting teaching method, the effects found do not endure. Again, the data, though not extensive, suggest otherwise. PSI students do better than their matched controls both at the beginning and at follow-up observations sometime later (Freeman, 1984). Numerous studies in the cooperative learning literature point to the lasting influence of Guided Design-like aids (Putnam, 1985; Talmage, 1984). Concept retention remains a fairly unexplored territory in innovative educational systems research and should provide prospective investigators with a rich domain for future inquiry.

Finally, it should be pointed out that each of these innovative instructional strategies lend support actual on-going research under their auspices with the exception of Feedback Lecture. Even still, this particular IIS contains all the ingredients of a research support center. Besides a ready-made classroom laboratory, written materials, "captive" subject sample, and lecturer as

experimenter, there remains a fruitful set of feedback data waiting to be collected and analyzed. Microteaching, of course, owes part of its very nature, either as a series of functional analytic lessons or as a complete course, to scientific experimentation. Explication of nonverbal behaviors that impact upon the learner's teaching efforts is indicative of Microteaching's strong contribution to important basic instructional research. Both PSI and Guided Design have a short, but meaningful history in support of innovative research previously discussed in greater detail.

Advanced Technologies

Four advanced technologies have been presented. Each contributes its own unique aspects to the development of non-traditional education. The Personalized System of Instruction succeeds where traditional classroom instructional techniques fail because it sets a standards of excellence which every student is capable of meeting incrementally, given sufficient time and practice. Dubbed "mastery learning", the technology not only carves out digestable chunks of information so students are not overwhelmed, it also provides tremendous knowledge of results for students based on their modular quiz performances, giving them the opportunity to adjust their study habits if need be. Feedback Lecture provides more programmed direction in the form of "study guides." These are designed to walk students through a lecture. Just as important, and unique, is the fact that the feedback procedure is conducted during the lecture, not after. Guided Design's technology is a well-researched, verifiable technique in the form of cooperative learning with a new wrinkle, computer assistance. Students may either organize in small groups for or they may communicate and work interactively through computer networks. Perhaps most versatile about CAI with respect to Guided Design is that group interaction need not occur in real time; hypertext and other information support systems allow

users to call up simultaneously and overlay one or more fellow group member's files on their display, input ideas or make further problem solving suggestions, and then save the changes. This gives other group members an opportunity to respond in kind according to a flexible work schedule adopted by the group. Microteaching employs the advanced technology of videotaping. There is probably no other simgle, more powerful instructional technology that offers the capacity of storing a record of one's actual, continuous behavior and retrieving it a later time for critical review.

Army Implications

The teaching and learning approaches described in this paper have direct application to the needs of the U.S. Army's training and educational programs. The following areas illustrate the usefulness of these strategies to trainers seeking appropriate and effective teaching systems and may aid them in selecting the best innovative instructional stratetgy, or combination of stratgies, for their needs.

1. Knowledge Level and Basic Information: The Lecture and Feedback Lecture

For large group sessions which are used for basic orientation to Army regulations, introductions, and assemblies, the lecture approach is applicable. Films, slide-tape programs, videotape playbacks, and other audiovisual materials should be used along with verbal descriptions during the lecture. Lecturing is a good way to give a lot of information in a relatively short period of time. It is particularly well-suited for providing broad overviews and presenting the newest Army developments in the field. It should be kept in mind, however, that lecturing, in and of itself, does not guarentee, that information will be learned and remembered. If this is an important goal of the instructor, than Feedback Lecture offers a reasonable compromise between delivering a lot of information to a large audience in a relatively short period of time and

seeing to it that those listeners actually got the message intended for them.

Lectures also do not allow students or audiences to develop concepts or problem-solving skills. If an instructor has a goal of having students learn these skills, class or group discussions may be more appropriate for at least some class sessions. In this case, lesson objectives should be specifically directed toward what can be accomplilshed by the learner during the lecture session itself. Again, Feedback Lecture can be modified to aid the instructor's objectives. Otherwise, information delivered in a three-hour presentation will most likely be lost in three days.

2. Specific Application and Comprehension: PSI and Feedback Lecture

For large groups and individual sessions, students can be instructed by PSI or Feedback Lecture. With PSI, the information can be presented individually at the learner's own pace. Students can be provided with immediate feedback to check their comprehension of the materials. There is a decisive advantage in using this instructional strategy for soldiers under unusual work schedules, out in the field, or in remote locations that aren't normally suited to the traditional classroom. Computer-Assisted Instruction is a potentially important adjunct to PSI because in place of an instructor it gives students individual, self-paced practice with an electronic tutor. CAI can also monitor a student's thinking and logical skills, evaluated her or his performance, and feed test results immediately back to the student. The Feedback Lecture can be used in large or small group sessions, utilizing the resources of members of the group to give the students an opportunity to formulate applications of abstract principles.

These approaches are specifically guided for the students in terms of objectives, learning outcomes, and study procedures. Students can retrace their course material preparation steps and learn subject matter in smaller,

more digestable chunks of information rather than overwhelming dumping class sessions. Students get a chance to monitor their own study behavior and course progress in the form of pre- and post-test assessments. They are provided with stimulation and motivation for learning concepts and details. These approaches, then, successfully combine theory and practice and incorporate them into their instructional design.

3. Presentation Skills and Delivery Enhancement: Microteaching

Microteaching is directly applicable to improving presentation skills and enhancing lecture, demonstration, discussion, leadership and delivery-of-information skills. The Army can use the skills of consultants to work closely with presenters to improve the quality of presentations: delivery flow, use of wait time, board work, use of questions, assessing an audience, checking information acquisition, motivating students, and handling difficult students or participants. Videotaping is a more retrievable form of classroom observation and will provide "live" data for later analysis by both the instructor and the consultant. Like one or more classroom observations, the class or classes to be taped should be as representative as possible of the instructor's teaching or of particular problem areas about which s/he is concerned. As with the classroom observations, it is useful, if time allows, to complete a second videotaping. Close attention must be given to each individual in viewing the tapes, providing suggestions for improvements, recognizing the positive attributes of the trainee, and monitoring their progress.

4. Simulation, Roleplaying, and Problem-Solving: Guided Design

Guided Design creates the environment for students to test concepts and ideas in small group decision making sessions. Students can simulate real experiences and roleplay events while they are guided through problem-solving activities. The Army's use of and interest in simulated training can be partially met with

Guided Design in two ways. First, soldiers in combat and support services face issues and tackle problems–prejudice, cowardice, altruism–that cannot be resolved simply by lecturing or reading impersonal and generic manuals. They need tools, like Guided Design, to let each of them, especially within their respective units, address the real challenges in military situations. Second, Army personnel can enhance their decision making skills by using Guided Design as a process–the process by which people deal with problems. "Decisions," per se, take place when a goal is specified, when information is gathered and judged, when values are used to choose the best solution, and when detailed plans are made and evaluated. Each "decision," plus the knowledge and values applied along the way, helps to define the final result. Understanding how all these pieces fit together and how to use a systematic approach to problems should help even those who already know how to make decisions do an even better job of Army decisions.

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