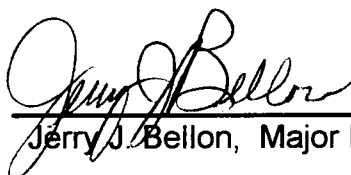


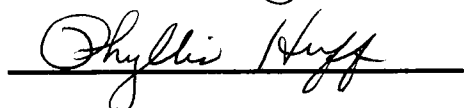
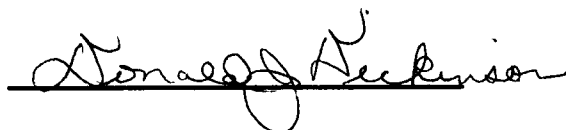
To the Graduate Council:

I am submitting herewith a dissertation written by Roger Blough entitled "The Effects of Using Student Response Keypads on Student Motivation and Achievement in High School Biology Classes. A Time Series Design." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Education, with a major in Curriculum and Instruction.



Jerry J. Bellon, Major Professor

We have read this dissertation
and recommend its acceptance:



Accepted for the Council:



Associate Vice Chancellor and
Dean of The Graduate School

The Effects of Using Student Response Keypads
on Student Motivation and Achievement in
High School Biology Classes.
A Time Series Design

A Dissertation Presented for
the Doctor of Education Degree
The University of Tennessee, Knoxville

Roger Blough
December 1996

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ABSTRACT

This study investigated the effects of using student response keypads as a tool to provide the critical factors necessary for student motivation. Keypads provided students with a means to actively participate in instruction and receive immediate feedback and reinforcement. They also provided systematic and useful feedback for the teacher, so that student misunderstandings or errors in the lesson could be corrected before they accumulated.

Using a time-series research design, student motivation was evaluated in terms of student achievement levels on daily classwork, unit tests, and a comprehensive final exam. A questionnaire was used to evaluate student self-efficacy and goal setting. The effects of treatment were determined by evaluating the patterns in the data collected for nine weeks before treatment and during the nine weeks treatment period. Eighty nine students in five preexisting Biology classes (three college prep and two general level classes) from a north Georgia county high school participated in the research.

During the treatment period, student motivation increased to the point where students studied more than twice as many chapters and did twice as many classwork assignments. At the same time that students were studying substantially more, they were also earning higher grades. Grades for classwork went from a mean of 71% to 92%; unit test grades went from 60% to 84%, and the final exam grade went from 55% to 92%. The students and the class teacher expressed amazement at the amount of work students were doing and how easy it was for them to learn. Student self-efficacy ratings increased 20.3% and personal goal setting increased 26.5%. As grade means increased, the gap between the lower level students and the upper level students decreased substantially.

The significance of this research is that it demonstrates how to do what, research says, educators should be doing. It demonstrates that the tools are presently available and applicable in a natural classroom setting to substantially and significantly improve the quality of instruction; thus, improving student motivation and academic achievement, while at the same time promoting a sense of worth and well-being for students.

*How to do
what should be done.*

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CHAPTER I

INTRODUCTION

The prosperity of a nation is inherently linked to the motivation of its people (Richards, 1977). Nations that fail to provide a climate that frees human motivation languish in poverty regardless of a wealth of other natural resources. Motivation does not arise from poverty nor from prosperity. It is neither poverty nor prosperity that motivates people. It is motivated people that create and recreate both "deserts and treasures" into national prosperity. Even the richest of nations will decay, if its people become lethargic (Gardner, 1981).

Successful businesses are ones that promote the motivation of their employees and customers. They promote in their employees a perception that personal effort will result in a desirable outcome. And their customers perceive them as providing a desirable product obtainable with a minimum of effort.

Like businesses, social institutions such as schools are successful when they are able to motivate teachers and students. Gardner (1981) said that "motivation isn't a fuel that gets injected into the system" (p. 18). Motivation is an attribute that resides within the individual. The institution provides the structure that supports and encourages personal effort in the attainment of desired outcomes.

In educational settings motivation is critical. "Students learn by doing" (Anderson & Faust, 1973, p. 200); and they do what ever they are motivated to do. Learning requires a desire or willingness on the part of the learner. Students have to be willing to spend the time and the effort to learn. While the degree of involvement may differ from student to student, the instructional process has a direct relationship to student motivation (Bellon, Bellon & Blank, 1992).

"You can lead a horse to water but the only water that gets into his stomach is what he drinks."... In most instructional situations, what is learned depends largely on the activities of the student. It therefore behooves those interested in the scientific study of instruction to examine these learning activities, i.e., the "drinking habits" of students (Rothkopf, 1970, p. 325).

For more than one hundred years psychology has been developing and expanding our understanding of teaching and how to motivate students in educational settings. The literature is quite specific and refined in explaining what works, under what conditions, and why it works. The findings come down to three fundamental components of teaching (1) presenting a task or materials, (2) providing for student response, and (3) giving reinforcement and feedback (Anderson & Faust, 1973; Bloom, 1976; Simpson, Koballa, Jr., Oliver & Crawley, III, 1994). The third component contains the motivating factors.

STATEMENT OF THE PROBLEM

Different people generally see and express the problem of student achievement from slightly different perspectives. National and local political leaders are concerned about the low level of student performance on achievement tests. Parents and students are concerned about high student dropout rates and low grades. Teachers are concerned with low levels of achievement but they express their concerns in terms of student motivation. One of the common statements made by teachers about student motivation is, "if he would only complete his assignments, stop daydreaming, and pay attention, I know he could succeed" (Anderson & Faust, 1973, p. 259). Educational researchers that study motivation, such as Bandura, Locke and Corno, view the problem in terms of self-efficacy and goal setting.

If a persons self-efficacy is low, he/she tends to set lower goals and give up sooner than people with a higher self-efficacy. But in turn, self-efficacy is a result of past success and failure experiences. If student success rates and therefore self-efficacy are to be improved then the quality of instruction must be improved.

When researchers study the quality of instruction, they find that the problem is a lack of student involvement, inadequate feedback for both students and teachers, and low levels of reinforcement (Bloom, 1976). In an attempt to get

teachers to use effective feedback, Elawar and Corno (1985), taught eighteen elementary school teachers to give written feedback on math homework. After the teachers agreed that the feedback was effective at improving both student achievement and attitude, none would agree to continue the feedback even for three days a week.

The problem of providing quality instruction exists because teachers simply do not have the time to give adequate feedback to all the students. Teachers are overburdened with more than 30 students at a time (Lepper, 1983). Some of the classrooms are filled with disrupting and non achieving students. Teachers have too much responsibility and no tools to provide the amount of feedback and reinforcement that is needed for quality instruction. The problem is not one of knowing what to do but of knowing how to do it in an actual classroom (Bishop, 1989).

PURPOSE OF THE STUDY

The purpose of this study was to investigate the effects of using student response keypads to provide students with a means to actively participate in instruction and receive immediate feedback and reinforcement. This study evaluated student self-efficacy, goal setting, and achievement levels.

This study was designed to answer three questions:

1. Will the use of student response keypads to provide immediate feedback and reinforcement improve student achievement levels?
2. Will students have a higher perception of self-efficacy and set higher personal goals relative to achievement levels?
3. Will students in general level Biology classes reach achievement levels obtained by students in college preparatory classes?

SIGNIFICANCE OF THE STUDY

If a comprehensive and efficient technological tool can be found that will: (1) provide a means for all students to participate in the instructional process, (2) provide ongoing feedback for both teacher and student, and (3) provide immediate reinforcement for students' correct responses, then the quality of instruction can be improved. When the quality of instruction is sufficiently enhanced student success rates will improve. When student success rates improve, student goal setting, self-efficacy, and motivation will also improve.

This study was intended to show just how important providing an ongoing means for student response, feedback, and reinforcement are as motivational factors. It demonstrates how student motivation can be enhanced and when motivation is improved student achievement rates increase. In this regard, this research will provide important collaborating information for existing research.

But the significance of this research is not only collaboration, it is primarily transformation, that is, it transforms knowledge into practice. This research combines a growing body of knowledge on instruction, learning, and motivational principles into a comprehensive schema and applies it in a natural setting. It will provide information to show that both the knowledge and the tools are presently available and applicable to improve the quality of instruction and therefore student motivation and academic achievement, while at the same time promoting a sense of worth and well-being for students.

ASSUMPTIONS

The assumptions on which this study was based are as follows.

1. Teachers can influence student motivation
2. Students view grades as a measure of school success and that higher grades are equivalent to higher success rates.

3. Students value success experiences.
4. Feedback is necessary for perceptions of success and future goal setting.
5. All students can and will learn to the extent that they are motivated to learn.
6. Students will feel good about their work when they receive feedback and reinforcement for what they do.
7. Motivation, self-efficacy and achievement can be evaluated.
8. Data in this study are from random samples across time.

DESIGN AND PROCEDURES OF THE STUDY

This study uses a time-series design with nine weeks of baseline and nine weeks of treatment. Five intact groups for within subject comparisons are composed of subjects from existing Biology classes. The existing classes are 1st and 3rd period general Biology classes, 2nd, 5th, and 6th period college preparatory classes, 4th period is the teacher planning period. Two groups for between subject comparisons are general classes and college preparatory classes. All classes were repeatedly tested on the dependent variables for nine weeks then treatment began and testing on the same variables continued for nine more weeks.

A Wood and Locke (1987) Academic Self-Efficacy (ASE) questionnaire (see Appendix A) for evaluating self-efficacy, and goal-setting was given at the end of the first nine weeks, at four and a half weeks into the treatment period, and again at the end of the nine weeks treatment period. Tests were given at the end of each unit of study. A comprehensive exam was given at the end of the first and second nine weeks. Classwork was graded as a percentage of the correct answers.

Before the experiment began student permission forms (Appendix B) were handed out by the classroom teacher in class, read and discussed with the students. Students were asked to take the form home for a parent or guardian signature and return it the next class period.

Prior to beginning the treatment phase students were given one day of instruction on using the keypads. During baseline, the classroom teacher taught all classes in his usual manner. During the treatment period the researcher was present with the teacher to assist students in operating the keypad equipment.

Subjects for this study were ninety tenth through twelfth grade Biology students at Lafayette High School in Walker County, Georgia. Subjects were from existing Biology classes. They were assigned to these classes before anyone knew that they would be involved in this research. The student population was composed of approximately 10% African Americans and 90% Caucasian students. Students came from suburban and rural families. They ranged in age from 15 to 18.

The first question to be answered was on academic achievement. To answer this question, academic achievement was evaluated using daily grades on classwork, unit test grades and a nine weeks cumulative exam. Classwork and test grades were determined on a percent correct basis.

To answer the second question, self-efficacy and goal setting were evaluated with a pre treatment, midterm, and post treatment questionnaire. Wood and Locke (1987) Academic Self-Efficacy (ASE) questionnaire was used (see Appendix A).

EQUIPMENT

Student Response Keypad is a 20-key multifunction terminal with an LCD display connected to an IBM compatible computer. Keypads (one per student) and an external link interface are manufactured by Audience Response Systems in Evansville, Indiana. The link interface is connected to an IBM compatible microcomputer through a standard RS232 cable. The keypads are connected in series, with regular telephone plugs to a link interface. The keypads are polled by the software at a rate of 200 to 300 keypads per second. Students may log onto the system at any time during the class. The system uses a Truevision Targa+ board that allows the capture and manipulation of video images and graphics displays with text overlay. Images and graphics can be stored in the computer and displayed on an external monitor for student viewing.



There are four different modes of operation: open forum mode, quiz mode, exam mode and inquiry. In open forum students respond to impromptu questions from the instructor and get an immediate response on the viewing window of the keypad as to whether they are correct. These responses are not recorded in a permanent file but are displayed on the VGA monitor for the instructor and can be displayed on the class monitor so the students can discuss and evaluate their responses. In Quiz mode a series of questions are preprogrammed into the class computer for presentation one at a time. These questions can be presented in any order so that if the majority of the class gets a question incorrect, further explanation can be given and the question asked again (only the last set of scores is recorded). If the class appears to understand the subject matter in a given area, the instructor can skip to a new section of questions to present and test for student understanding. New questions that have not been

preprogrammed can be asked in quiz mode by entering an unused question number with appropriate number of choices. A question is given and each student enters a multiple choice answer into the keypad, which immediately tells the student whether the answer is correct or not. The percent of each response is displayed in graph form for the instructor and can be displayed on the classroom monitor. The instructor can display each student's response on the VGA monitor.

In exam mode students use a paper test based on teacher prepared questions. Alternate forms of the test may be used. Students can answer questions in any order that they wish and the computer will keep track of the answers. Students can also go back to a previously answered question and change it if desired. When they have reached the last question, they are given another opportunity to review their answers and make any changes. When they end the exam their LCD display will tell them their grade and the correct answers to any questions that they missed.

In inquiry mode either a cooperative learning format or a game format can be used. In cooperative learning format students are assigned to teams. Each student answers questions; and scores are accumulated for the team and for the individual. The game format is similar except that the teams wager a percent of their grade on each question. If they are correct they are awarded the additional points and if they are incorrect the points are subtracted from their overall score.

LIMITATIONS AND DELIMITATIONS

The author of this study has piloted the use of student response keypads in a high school tenth grade Biology class for six semesters. In this study he developed the instructional material and operated the keypad system in the classroom during the instructional process. This research was intended to see if

student motivation could be increased and was not concerned with the quality of what was learned.

Because of the short term nature of this study (nine weeks treatment period), the effects of long term or broad general use of the system could not be determined.

DEFINITIONS

For this study the following definitions were used.

1. SELF-EFFICACY may be operationally defined as a personal belief that one is or is not capable of performing a specific task in a particular situation.
2. GOAL: A goal is a particular level of outcome (a grade) that one is trying to obtain, not the intention to engage in a specific task.
3. IMMEDIATE FEEDBACK is knowledge of results both qualitative and informational about incorrect responses at the completion of a particular task.
4. REINFORCEMENT is an event that increases or reduces the frequency of the act from which the event was a consequence.
5. MOTIVATION is self-determined movement. It is a cognitive control process that one engages in to initiate and sustain behavior directed at obtaining whatever goal one wants at any given time.
6. ACHIEVEMENT LEVELS are measures of quality (% correct) on classwork, quizzes, and tests and quantity of classwork completed and chapters studied.
7. OUTCOME "An outcome is the consequence of an act, not the act itself...An act must be defined by the criteria that state what it is" (Bandura, 1986, p. 311).

ORGANIZATION OF THE STUDY

- Chapter I contains the: statement of the problem, purpose of the study and research questions to be answered; significance of the study; assumptions; design for the study; limitations; and definition of terms.
- Chapter II consists of a review of self-efficacy theory of motivation and related research literature which forms the basis for the study.
- Chapter III presents the methods and procedures used in the study including the equipment.
- Chapter IV includes the presentation and analysis of the data.
- Chapter V contains a summary, findings, conclusions, guidelines, and recommendations for further study.

CHAPTER II

REVIEW OF RELATED LITERATURE

INTRODUCTION

To be successful, governments, businesses, social institutions, and educators must have an understanding of and be able to apply principles of motivation. In every field, those who are responsible for the activities of others attempt to create conditions that will elicit certain types of behavior.

The principles of motivation are the same in every aspect of life. It is the application of the principles that is different under different circumstances.

To understand motivation we should first look at the theories of motivation and develop an understanding of the underlying principles. To apply the principles to educational settings we need to know how motivation directly and indirectly affects learning, what is unique about educational settings, and the role that feedback and reinforcement play in motivation.

THEORY OF MOTIVATION

Using Bandura's (1986) social cognitive theory of motivation it can be illustrated how people control their actions through cognitive processes. People use past and present experiences to predict and control their future behavior and the environment. Through their thoughtful control of behavior people arrange as well as respond to their environment.

Assuming that we have the knowledge to engage in a particular act, we still have to decide whether we want to respond or not. One area of cognitive consideration is, whether we have the ability necessary to complete a particular task (Feather, 1982). Judgments of this nature are termed "self-efficacy". The other area of personal consideration is the desirability of the outcome which is in turn influenced by self-efficacy.

By studying self-efficacy we can better understand what the different cognitive factors are that motivate behavior and differentiate successful and unsuccessful behavior.

Developing self-efficacy

In the very early years children rely on the opinions of other people for information about their performance instead of objective feedback from the task outcome. Social comparison in the form of normative grades was found to affect kindergartners' but not fourth graders' performance predictions and self-evaluations (Stipek & Daniels, 1988). As children grow older they increasingly base future performance-predictions on previous-performance feedback.

Effort and ability are not clear concepts to young children. The younger children are, the less likely they are to attribute success or failure to their ability (Stipek, 1984). In the first few years of school children view effort as a cause of success. Some children view ability as acquirable by gaining knowledge and skills (Bandura, 1993). Studies have found that students, in the fourth or fifth grade, who attributed failure to a lack of ability continued to do so the next year (Mason & Stipek, 1989).

By the sixth grade comparison with peers becomes more important, and ability becomes a more stable concept. Children begin to attribute performance to things other than effort such as their ability and external causes (Stipek, 1984).

Once formed, efficacy perceptions were found to be stable (McAuley, Duncan, & McElroy, 1989) for up to two years regardless of what the actual performance was (Mason & Stipek, 1989). There seems to be a natural tendency to maintain the self-efficacy status quo (Alden, 1986). This tendency toward stability has been termed "self-serving effect". Students with a higher academic self-concept and judged to be more able by their teachers and peers exhibited a higher self-serving effect (Marsh, 1986). In a study of self-serving effect, people with a higher self-concept tended to attribute successes to either effort or ability more

than external causes. Failure was attributed more to external causes regardless of the actual cause (Marsh, 1986). Results from this and other studies suggest that efficacy formation is the result of consistent behavior over time, and that efficacy-perceptions affect the way people view the causes of their future success or failure experiences (McAuley, Duncan, & McElroy, 1989).

Causal Attributions of Success and Failure

Bandura (1986) and McAuley (1989) found that a person's previously perceived self-efficacy causes different attributions for success or failure in an activity regardless of the actual circumstances. They have identified two distinctly different causal attribution patterns that are correlated with success and failure.

Students with low self-efficacy perceptions (associated with negative motivation) attribute failure to fixed and uncontrollable causes such as lack of ability, lack of skills or difficult tasks. They attribute success to luck, an easy task or the generosity of the teacher (Covington, 1984).

Students with high self-efficacy perceptions (associated with positive motivation) develop ability perceptions by attributing failure to a lack of effort and success to ability (Eccles & Wigfield, 1985; Ames & Archer, 1988; Mason & Stipek, 1989; Whitley, Jr & Frieze, 1985). For these students the self-serving effect seems to be operative in minimizing the role of effort when they are successful by attributing success to ability (Covington, 1984).

Success Experiences that Build Self-Efficacy

Success is critical. But success for its own sake or the sake of someone else is counterproductive. The attributes that success engenders must reside within the student. John Dewey (1916) said that "making the individual a sharer or partner in the associated activity so that he feels its success as his success, its failure as his failure, is the completing step" (p. 14).

Contriving success experiences for children who expect to fail is not in the interest of the child. Only after children were given actual experiences in which they were taught and shown that effort would result in success were they likely to persist at difficult tasks (Janott-Bulman & Brickman, 1982).

One type of contrived success experience that schools have used is social promotion. In a study comparing socially promoted and retained students, the retained students performed as well as their matched-ability promoted students and better than the socially-promoted students two or more years later (Pierson & Connell, 1992).

Studies of students high in achievement motivation found that if they are not personally responsible for the outcome then they are not likely to get any satisfaction from doing the work better (McClelland & Koestner, 1992). Studies done with conduct-disordered students have also found that when students perceived that effort resulted in success they had a higher belief in their ability to perform future tasks correctly, they persisted longer when failure continued to occur, and success led to improved self-efficacy perceptions (Lyman, Prentice-Dunn, Wilson, & Bonfilio, 1984). As students develop a greater sense of control over outcomes they raise their self-efficacy (Schunk & Rice, 1991).

Successes built on effort promote high self-efficacy, produce more enjoyment, and more effort. Further, students that experienced more successes attempted to do even more difficult work (McAuley, Duncan, & McElroy, 1989).

If we view success as a rewarding experience, then it should be clear why the experience of success should result directly from individual effort. If the effort-outcome linkage is unambiguous then effort will be rewarded by success (Chance, 1992). But if there is no success then there is no reward. And if there is success without the linkage to personal effort, then something or someone else is rewarded, not personal effort.

Self-efficacy and Motivation

People engage in activities if they expect to be successful. The expectancy of success is believed to be a primary factor in achievement strivings (Weiner, 1982). People do not even attempt to perform activities if they perceive a lack of ability. If they perceive self-doubts about their ability, they tend to engage in activities with a reduced amount of effort and in the face of difficulty they give up and fail. A person's perceptions of their ability serves as a part of their self-referent thought processes before engaging in an activity (Bandura, 1986).

Ability perceptions become particularly important in school, where the culture is based on academic achievement. Success or failure in school is equated with ability and becomes a part of the student's self-worth motive (Covington, 1984).

Low-efficacy subjects are more likely to attribute outcomes to a high or low level of task difficulty (Alden, 1986) or to other external causes. When low-efficacy subjects attribute failure to ability, they are left with "feelings of guilt, resignation, and regret" (Eccles & Wigfield, 1985, p. 189). Because ability is perceived as a stable trait and not under an individual's control (Weiner, 1982), when they attribute their success to ability they are still not likely to see outcomes as a result of their effort (Janott-Bulman & Brickman, 1982). And even if they begin to work on tasks, they do not persist in the face of difficulty.

On the other hand, high self-efficacy subjects that attribute failure to a lack of effort and success to ability exert an even higher degree of effort and persist longer at difficult tasks (Bandura, 1992). When they perceive that they have the ability to complete tasks successfully, they enjoy tasks with a degree of challenge and they are more likely to persist until they are successful (McAuley, Duncan, & McElroy, 1989). When students perceive success as possible without excessive effort, they change their attention from a focus on failure-avoiding to one of how to obtain the best possible performance (Covington, 1984).

A perception of efficacy is a personal judgment that develops over time. It is a way of thinking that regulates our motivating capability to organize social,

environmental, and behavioral events for anticipated outcomes (Bandura, 1986). Psychologists have found that changes in perceptions of self-efficacy cause changes in motivation (Eccles & Wigfield, 1985; Feather, 1982; Lyman, Prentice-Dunn, Wilson, & Bonfilio, 1984), performance, (Pintrich & De Groot, 1990; Meece, Wigfield, & Eccles, 1990), achievement levels (Chapman, 1988), and anxiety (Meece, Wigfield, & Eccles, 1990).

Self-efficacy and Learning

Not only does self-efficacy affect whether a person engages in a task or not, it also, has been found to directly and strongly affect performance while involved in a task (Meece, Wigfield, & Eccles, 1990). Self-efficacy affects learning by promoting a higher level of active engagement in learning tasks. The instrumental mode through which self-efficacy operates on learning is called self-regulated learning (SRL). SRL is an enactment process. It is a process that students use to maximize cognitive engagement. It is controlled by student intentions to associate with and gain control over tasks while involved in learning (Corno & Rohrkemper, 1985). Its primary function is maintaining attention after engagement occurs.

The meta-cognitive processes of SRL serve the function of screening competing stimuli so that concentration is maintained as the task is ongoing. Before SRL can be effective other motivational factors must come into play to begin the activity (Corno, 1986).

Students with a low sense of self-efficacy tend to focus their cognitive effort inwardly on their personal shortcoming rather than on solving the problem. People who expect to fail show impaired performance even before they know how they are doing. When they are successful, there is still a tendency to give up if they have doubts about their ability to continue to be successful in the future (Janott-Bulman & Brickman, 1982; Covington, 1984).

Students with high self-efficacy focus their attention on the task and use more cognitive strategies (Pintrich & De Groot, 1990) and analytical skills to solve problems (Bandura & Jourden, 1991). Meta-cognitive processing is a necessary component of learning, but alone it is not enough to engage a learning task.

Motivation is widely accepted as a key factor in performance achievement (Covington & Omelich, 1984). And perceptions of self-efficacy are an essential part of motivation. It is also known that achievement affects self-efficacy (Eccles & Wigfield, 1985). Self-efficacy strongly influences SRL by promoting interest in a task. SRL strongly influences performance by promoting cognitive strategy use (Pintrich & De Groot, 1990).

MOTIVATION MISUNDERSTANDINGS

Motivation and Fun Activities

The view that learning should be fun has a lot of appeal but no research support. In fact the opposite is true. In a research study in which the investigators hypothesized that some nonacademic activities would enhance student interest and motivation in learning, no nonacademic activities were found that had a positive correlation with reading or math achievement (Rosenshine, 1979).

If students are engaged in task structures or activities that are not relevant it may interfere with learning that is relevant (Anderson & Faust, 1973). Relevant overt responses are more effective because students are actively involved in the learning. Providing more relevant information and feedback, and less extraneous information will result in more learning (Sturges, 1972b). When motivational problems appear, classwork becomes drudgery, and that is often misinterpreted as being due to a lack of fun activities (Good & Brophy, 1987). Classroom activities should be meaningful and worthwhile, but not fun as such.

Discrepancy Theory Motivation

All motivational theories entail some aspects of discrepancy theory. This theory is built on failure avoiding rather than success-anticipation. Humans have the drive and capacity to go beyond just avoiding failure (Bandura, 1986).

In many classrooms the unspoken motivational environment is structured around discrepancy. Failure avoiding motivation has a negative effect on goal setting and directly affects learning processes through anxiety arousal.

Teachers who try to motivate their students with fear of failure give excessive amounts of work, and keep standards and objectives ambiguous. This makes school so difficult that students are constantly afraid of failure. When students are failing, teachers shift the responsibility onto the student: "if he would only complete his assignments, stop daydreaming, and pay attention, I know he could succeed" (Anderson & Faust, 1973, p. 259).

In schools, students set their own personal goal levels. Research on goal-setting has found that social comparative information has an even stronger effect on personal goals than assigned goals do (Meyer, 1988). When class averages are kept low even self-efficacious students set low performance levels. High-ability students that set low goals are assured of obtaining their goal, which makes the goal lose its value and the students lose motivation (Lahaderne, 1968).

Failure motivation is especially counterproductive for students with low efficacy. They envision failure and develop corresponding anxiety reactions. They act out their frustration, cheat, or give up (Bandura & Jourden, 1991). If students can't avoid failure by taking an easier class they may shift failure to external causes and avoid any display of inability by increasing absenteeism, inattention, or simply not doing classwork. In this way failure cannot be tied to a lack of ability and any feelings of shame are diminished because personal responsibility can be shifted to other factors (Covington, 1984).

Failure motivation promotes anxiety that affects one's perception of self-efficacy (Alden, 1986). Anxiety activates a state of high arousal that causes a perception of threat, which narrows one's mental focus to self-thoughts of possible harm, thereby distracting thought from the learning task (Brophy, 1983).

Motivation should foster a state of mind that is optimal for learning, more like a "mellow state of flow" than a high state of arousal. In a flow state people are open to mastery of the material, they feel a sense of control, and are involved in an ongoing process of receiving feedback from the engagement process with the task (Brophy, 1983).

In a study on student absenteeism the authors found that it was the lower-achieving students that have high rates of absenteeism. And when fear-of-failure motivation was tried by warning students at midterm that they were going to fail because their absenteeism was causing low grades, absenteeism increased even more (deJung & Duckworth, 1986).

One of the assumptions that underlies the "scarcity-of-grades" means of motivation is a belief that if good grades were not scarce they would lose value and students would not have any reason to keep working. But research has found that, when success is all but assured, student competition and focus changes from avoiding failure to trying to get the highest grade possible (Covington, 1984).

FEEDBACK

The Effects of Feedback on Motivation

In order for learning activities to be motivational, informative and evaluative feedback about outcomes and/or goals must be produced by teachers. When students complete a learning task, if there is no feedback students are left in a frustrating and arbitrary position (Butler & Mordecai, 1986). They have completed a task that has no known results. In effect, if there is no feedback

there is either no outcome or the outcome has to be cognitively generated (Bandura, 1986). If there is no acknowledgment of their effort, students soon learn that what they do has very little value and they lose interest (Stevenson, 1992).

In most tasks feedback is a natural, inseparable consequence of the task. You bake a cake and you can see it, you can smell it, you can taste it, and so can others. From feedback you develop a perception of the outcome. From past outcome perceptions cognitive representations are generated and people anticipate the outcome of their future actions, which activates emotions. In this way "people motivate themselves" (Bandura, 1986, p. 19).

The Teacher's Role in Feedback

In educational settings perceptions of success or failure do not necessarily follow as an actual occurrence of outcomes. A student's perception of an outcome is controlled and communicated through the environmental structuring strategies of the teacher. Teachers are the source of authority on the material and formally or informally they evaluate students' effort and progress (Marshall & Weinstein, 1984)

The salience of feedback is controlled by the teacher, either directly through evaluation or through the task structure. Day-in and day-out students must depend on the teacher to evaluate their work (Marshall & Weinstein, 1984). A student's academic ability formation depends on teacher evaluations and feedback. Teacher structuring of feedback is as important for ability perceptions, if not more important, than student behavior (Rosenholtz & Simpson, 1984). In educational settings students have no independent objective means to evaluate their individual performance (Bandura & Jourden, 1991).

The Effects of Feedback on Perception of Outcomes

Feedback is no more than information. How information is perceived and appraised will determine how it is used (Locke & Latham, 1990). After completing a task, perception of an outcome will depend on the feedback that is received. The way that performance success is attributed, and therefore its' effects on self-efficacy, will depend primarily on the classroom reward structure and information feedback. Results of this study support the idea that the effects of particular performance outcomes are determined by the structuring of feedback rather than by their absolute properties (Bandura & Jourden, 1991). Students that do not receive feedback attribute their success to irrelevant factors (Butler & Mordecai, 1986).

In determining perception, feedback is nine tenths of reality. Regardless of what the performance outcome actually is, the outcome will be perceived as more positive if feedback is "more frequent, immediate, contingent, informative, encouraging, and provided in a natural context that displays performance recognition by a source the student respects" (Corno & Rohrkemper, 1985, p. 81).

Whenever grades are given out, the source of the information is always suspect. The strength of perception will vary with the credibility of the source. This study found that when the same performance feedback was given by a computer rather than from a teacher, students perceived it to be more credible. If the feedback comes as a direct result of an activity students are involved in it is more likely to be accepted as is (Alden, 1986).

Frequent Feedback

Any feedback is better than none. In a study comparing three feedback conditions with a no feedback condition, all three feedback conditions significantly improved student retention and final exam scores over the no feedback condition (Sassenrath & Garverick, 1965).

In many school settings students receive feedback 4 or 5 days after a test. Even the very minimum amount of feedback can improve learning. This study found that if correct answers are given after a test the same errors are not as likely to be repeated on subsequent tests (Karraker, 1967).

Post-test feedback alone, though helpful for some, is not very helpful for those who need it most. The effects of post-test feedback will vary with achievement-level perceptions. Researchers have found that after a test is taken, low-achieving students are not interested in feedback but high-achieving students like to get post-test feedback because they believe it will be helpful on future tasks (Bender & Standage, 1992). For students that succeed, post-test feedback is reinforcing. For students that do not succeed, feedback after the test is too late.

Brophy (1986) contends that feedback in the form of corrective information and evaluation for quality should be given at every step in the learning process. A general model of effective instruction developed from the research on information processing also supports the practice of giving students feedback all during the learning process (Rosenshine & Stevens, 1986). Bloom (1976) says that feedback-corrective procedures account for the major portion of the difference between high and low achievement levels.

Immediate Feedback

In a review of research on corrective feedback, Anderson (1973) concluded that knowledge of the correct response to incorrect answers was more effective than just telling students the answer was wrong. It was also concluded that feedback immediately after every response could interfere with learning, especially in programmed learning, where students can give any kind of a response and then have the correct answer provided.

Other studies, done to determine when feedback should be given, have found that when immediate feedback was given following each item the least amount of

long term retention occurred. This study found that retention improved when feedback was given at the end of the class period and improved even more when it was delayed for 24 hours (Sturges, 1972a). Research seems to be in agreement that feedback after every response does not improve learning and even seems to interfere with learning (McNaughton, 1981).

Sturges (1972a) concluded that the effects of feedback are related to the amount of attention the feedback encourages from the student. Consistent with this same idea, other researchers have found that rather than supplying students with correct answers it is more effective to provide a cue or prompt to assist the student in finding their own correct answers (Singh, 1985; Wheldall, 1987) or to structure the lesson so that students have the opportunity to self-correct errors (McNaughton, 1981).

In a study of achievement motivation, researchers found that students with high achievement motivation perform better if they can get immediate feedback at the end of each task that tells them how well they are doing (McClelland & Koestner, 1992). Others have found that knowledge-of-scores feedback is necessary at the end of a task in order for students to set goals on future tasks (Erez, 1977). Also, combining process goals with progress feedback at various stages of a task was found to have the greatest effect on achievement by raising perceived self-efficacy (Schunk & Swartz, 1993; Bloom, 1976).

Performance Recognition

When thinking of schools, grades usually come to mind. Grades raise anxiety for many people: teachers get depressed when they have to spend the time grading bad papers, students are frustrated after spending so much time and getting low grades, and parents feel helplessly disappointed. It soon becomes evident that the problem is not grades per se but bad grades. Glasser's (1971) opposition to grades and objective tests as "destroying students" is based on the assumption that students do not get good grades. Other researchers have

expressed the idea that students like to succeed and that positive feedback is probably the most powerful reinforcer available to teachers (Chance, 1992). Perceptions of competence on a task are important components of the intrinsic motivation to perform the task again (Arnold, 1976). Grades based on normative information undermines intrinsic motivation, whereas, grades based on task-related factors strengthen intrinsic motivation (Butler & Mordecai, 1986; Chance, 1992).

In fact, Medley (1979) found that grades are such powerful reinforcers that they determine what the functional class objectives will be, that is, if students are motivated to learn, they will learn whatever their grades depend on. Grades are a form of extrinsic reward. Once an extrinsic reward is received, if the person perceives that they can continue to receive the reward by their continued engagement in a similar future activity, increased task engagement will occur (Lepper, 1983).

The problem with grades in schools has two aspects. First, the grades need to be high enough to be reinforcing and not punishing, and second, the grades need to be given frequently during the learning task. Studies of reinforcement rates have concluded that when reinforcement rates are high, students "experience a minimum of adversity and actually enjoy learning" (Chance, 1992, p. 202). Social comparisons (in this case grades) affect the amount of satisfaction that students get from their work (Bandura, 1993).

Test Effects

Students who expect an external evaluation perform at a higher level than students not expecting an evaluation (Shalley, Oldham, & Porac, 1987). A study by Halpin (1982) found that students who have to study for a test score significantly higher than students studying for the fun of it. Comparisons of study time and testing showed that study alone was not as effective as the combination of study and testing. Testing also improved retention rates. Tests

are most effective when they are given as soon as possible after a lesson. And subjects that are given more tests do better on a final exam (Dempster, 1992). Dempster (1992), reporting on research findings, says that students prefer frequent testing.

One of the concerns with grades has been their effect on students that are high achieving. Studies have shown that high achieving students perform at a higher level after receiving normative grades than after receiving praise (Butler, 1987). High achieving students seem to be challenged more by the competitive nature of grades.

The Effects of Feedback on Task Involvement.

Another way that feedback seems to be effective is through its effect on task involvement. This study found that general feedback did very little at improving performance but if the feedback gave specific performance information it was used by the participants in thinking about their task. If feedback is structured properly it focuses a person's attention on relevant factors which otherwise would not have been considered important (Early, 1988). To maximize the benefits, feedback should require students to do more than rehearsal of the same cues or reinforcement of a previous response. Feedback needs to be structured in such a way that it requires the student to reinvest attention in the task; in other words, it should require the student to look up the correct answer rather than just being given the correct answer. In studies of three different feedback conditions the one that provided the most active participation and rehearsal of the task was the most effective (Sassenrath & Garverick, 1965).

In a study of feedback and retention, feedback was most effective when it was constructed in such a way that it required greater student involvement and reprocessing of all of the pertinent test-related information (Sturges, 1972a).

A similar study found that feedback about task-performance quality significantly affected future quality but not quantity when no feedback

concerning quantity was given (Erez & Arad, 1986). A study of feedback in the form of a daily report card (grade and informative comment) showed significant improvement in both quality and quantity of task performance (Evans, Bostow, Geiger, & Drash, 1982).

The Effects of Grading on Task Involvement

Frequent grading not only increases a students motivation to learn but, in doing so, it also increases the chances of student success at the learning task by promoting a high level of student involvement in the task operations. Rewards affect learning through their strong influence on getting people to accept goals and to maintain continued interest and relevant behavior in tasks (Locke & Latham, 1990). When grades promote a task orientation, thoughts concerning ability, that would otherwise interfere with learning, are temporarily suspended (Covington & Omelich, 1984).

Once task engagement begins, the grading which is apart of the task structure becomes an important factor in maintaining self-regulated learning (SRL) and contributing to outcomes. Grades and other social rewards aid in maintaining SRL volitional. Students may regain or maintain focus by recalling outcome expectations (Corno, 1986).

The Effects of Feedback for Effort Verses Feedback Concerning Ability

Grades represent both a social comparative evaluation, or extrinsic reward, and a personal developmental evaluation with intrinsically rewarding components (Tinto, 1975). Because grades contain both of these components, emphasis can be placed more on one or the other depending on how they are structured.

When comparisons are made between people, differences are attributed to a person's ability not to effort. A normative grading structure focuses student attention on comparison with other students, whereas a mastery grading system

focuses student attention more on the material to be learned (Marshall & Weinstein, 1984). Feedback in the form of normative grades which focuses student attention on ability is significantly less effective than feedback given in the form of praise and specific correcting information (Butler, 1987).

Task-referenced feedback draws attention to one's effort in relation to the task. Feedback should use a format that encourages student self-comparison of progress on a task by listing personal accomplishments (Bandura, 1993). It should focus attention on task mastery (percent of the task correct) rather than ability (Eccles & Wigfield, 1985). Since perceptions of competence on a task enhance intrinsic interest, rewards based on quality of performance rather than quantity will not decrease this aspect of future intrinsic interest (Lepper, 1983). Contingent rewards imply goals that guide the student's attention during the activity (Lepper, 1983). When student perceptions are on mastering a goal (accomplishing a level of quality on a task) rather than focusing on obtaining a high level of performance (doing more work), they report that they use more effective strategies, prefer challenging tasks, have a stronger belief in effort, and like the class better. Students that focus on doing more work rather than the quality of the work concentrate more on their personal ability (Ames & Archer, 1988).

Some teachers for whatever reason say that they are grading on effort when they give students a grade for turning in their work regardless of the quality of the work. Research findings have clearly demonstrated that when rewards are task-contingent (based on participating in a task), intrinsic motivation and interest in the task is destroyed (Lepper, 1983). Very little if anything is accomplished by grading on "effort" (the amount of work completed) rather than quality of performance (Anderson & Faust, 1973).

It has been demonstrated that when feedback makes the outcome-effort linkage unambiguous and direct then any failures that do occur will not discourage the student's will to learn. When individuals perceived that their

effort resulted in success, they took pride in their work (Covington, 1984) and increased their persistence toward a goal (Weiner, 1982).

FEEDBACK AND GOAL SETTING

Introduction

After one has decided to do something, performance on the task is affected by both self-efficacy and the level of personal goal (Locke & Latham, 1990). Although we may not always be conscious of it, we can name the goal of our actions when we are asked to. We naturally establish goals for specific tasks. The term goal as used by Locke (1990) refers to a "specific standard of proficiency on a given task" (p. 26). A goal is a particular level of an outcome that we are trying to obtain, not our intention to engage in a specific task.

Higher goals will lead to higher performance levels (Shalley, Oldham, & Porac, 1987). People that set higher goals exert more effort and persist longer because the degree of outcome-satisfaction depends on obtaining the goal (Locke & Latham, 1990). When people set goals they establish criteria for self-satisfaction which guide them in directing their behavior and provide a perceived incentive to persist until the goal is obtained (Bandura, 1993).

Choice and Participation

Very little choice or participation in goal setting is possible in school. Research on goal-setting has found that being allowed to choose one of three possible goals does not improve learning over being assigned a goal (Huber, 1985). Participating or not participating in goal-setting had no effect on performance of either boring or interesting tasks. For routine work, assigned goals had a more positive effect (Chang & Lorenzi, 1983), as did learning tasks in which an incentive was included (Huber, 1985).

Assigned Goals

When goals are assigned they affect self-efficacy, personal goals (Locke & Latham, 1990), and intrinsic motivation (Shalley, Oldham, & Porac, 1987). Assigned goals affect personal goals by providing an implied standard of acceptable performance and a level of performance that would result in a desirable outcome (Meyer, 1988).

In a study where group feedback was given without assigned goals, performance increased 50%. The increase was attributed to informal goal setting. When group goals were established, however, performance increased to 75% (Pritchard, Jones, Roth, Stuebing, & Ekeberg, 1988).

Social Standards

Feedback in the form of norm referenced information can override assigned goals. Feedback information in a normative form has a stronger ability to influence personal attainment standards than assigned goals do, especially when the assigned goal exceeds the performance norm (Meyer, 1988).

Social-comparative feedback functions in the same way as normative feedback. It makes the performance possibilities visible and desirable by establishing an acceptable standard. Studies have found that subjects set higher goals when they receive comparative information (Bandura & Jourden, 1991). For example, publicly posting individual feedback and goal setting about "hit rate" for a university hockey team, significantly increased the "hit rate" (Anderson, Crowell, Doman, & Howard, 1988).

Feedback Goal Setting linkage.

In a study that allowed individuals to set their own goals, feedback that provided knowledge of scores from past performance was found to be necessary to establish a higher level of goal-setting and performance. Knowledge of scores increased student intentions, which in turn increased goal-setting and

performance (Erez, 1977). Thus, knowledge-of-scores feedback enhances performance through its effect on goals. Feedback provides the information that people use to establish their goals and it encourages spontaneous goal-setting. However, other studies have found just the opposite effect. In studies done with multiple goals and feedback, it was the goal that determined what feedback information would be considered important for improving performance (Locke & Latham, 1990).

Feedback is not just important to goal-setting, it is critical. Success in obtaining a goal is directly dependent on feedback. When information about the results of an activity (KR, knowledge of results) was withheld, goal-setting had little effect on performance (Locke & Latham, 1990). In a study comparing two different goal-conditions without feedback (one of learning a strategy to improve reading comprehension and the other of answering questions after reading material) and one goal condition with feedback (of learning the strategy), the only goal-condition that improved reading comprehension skill was the one with feedback. The goal-condition with feedback was also the only one that improved self-efficacy (Schunk & Rice, 1991; Schunk & Swartz, 1993).

Neither feedback alone nor goals alone are very effective at improving performance. But the combination of both a goal and feedback does improve performance (Locke & Latham, 1990). In a study of goal-attainment and the task process, it was found that establishing several sequenced goals where there are many opportunities for reinforcement, feedback, and closure improved performance (Frost & Mahoney, 1976).

SUMMARY

Bandura's (1986) theory of self-efficacy provides a basis for considering how student perceptions of success impact the motivational aspects of learning. In this schema, individual effort plays a central role in both the perception of success and in actually making outcomes successful.

In educational settings standards for success are not naturally inherent in outcomes. Task contingent feedback and reinforcement are necessary for the development of perceptions of success and for goal-setting (Locke & Latham, 1990).

Success and Self-efficacy

Self-efficacy formation is the result of previous success or failure experiences. Efficacy perceptions develop over time, and affect the way people view their chances for future success or failure experiences (Bandura, 1986). Success is critical. But success for its own sake or the sake of someone else is counterproductive. Success needs to come from personal effort in order to promote higher self-efficacy (Janott-Bulman & Brinkman, 1982). And in turn, higher self-efficacy will produce more enjoyment and more effort.

People engage in activities if they expect to be successful. The expectancy of success is believed to be a primary factor in achievement strivings (Weiner, 1982). People do not even attempt to perform activities if they perceive a lack of ability.

Self-efficacy strongly influences self-regulated learning (SRL) by promoting initial interest in a task. SRL, in turn, strongly influences performance by promoting cognitive strategy use (Corno & Rohrkemper, 1985).

When students focus on trying to avoid failure they set low standards and anxiety, which interferes with learning, increases. When success is all but

assured, student competition and focus changes from avoiding failure to trying to get the highest grade possible (Covington, 1984).

Feedback About the Outcome of a Task.

Feedback-corrective procedures can account for the major portion of the difference between high and low achievement levels (Bloom, 1981). General feedback does very little to improve performance but if the feedback gives specific performance information it will be used in thinking about the task. Feedback after every response is not necessary and even seems to interfere with learning. Feedback at the end of a task provides the information that people need to establish goals and it even encourages spontaneous goal-setting (Locke & Latham, 1990).

Feedback is an Important Part of Goal Setting.

Knowledge-of-scores feedback is necessary at the end of a task in order for students to set goals on future tasks. Students need comparative information in order to set higher goals (Locke & Latham, 1990).

Being allowed to choose one of three possible goals does not improve learning over being assigned a goal. Assigned goals affect personal goals by providing an implied standard of acceptable performance and a level of performance that would result in a desirable outcome (Meyer, 1988).

Grades are a Necessary Form of Feedback.

In educational settings students have no independent objective means to evaluate their individual performance (Bandura & Jourden, 1991). If there is no acknowledgment of their effort, students soon learn that what they do has very little value and they lose interest.

Grades need to be high enough to be reinforcing and not punishing, and they need to be given frequently during the learning task (Chance, 1992). Students

who have to study for a grade, score significantly higher than students studying for the fun of it (Halpin, 1982). Grades promote a task orientation and thoughts concerning ability, that would otherwise interfere with learning, are temporarily suspended. A normative grading structure focuses student attention on comparison with other students, whereas a percent correct grading structure focuses student attention more on the material to be learned (Marshall & Weinstein, 1984). Very little if anything is accomplished by grading on "effort" (the amount of work completed) rather than quality of performance (Anderson & Faust, 1973).

Teacher Feedback

Teachers need immediate feedback from student work in order to structure the next days lesson. Teachers who receive accurate and timely feedback directly from student efforts use the information to improve the quality of future instruction. As teacher errors and ambiguity decrease, the degree of student success increases (Bloom, 1976).

CHAPTER III

METHODS AND PROCEDURES

INTRODUCTION

This study investigated the use of student response keypads as a tool to improve student motivation. Keypads allow the teacher to provide a structured learning environment giving all students the opportunity to be involved in the lesson and receive immediate individual feedback from their responses. This approach aims to remove impediments to individual motivational factors inherent in the traditional classroom, primarily the lack of feedback and reinforcement based on individual effort.

In particular, this study measured achievement levels, self-efficacy, and grade goals as indicators of motivation. Self-efficacy and goal setting were measured by student responses on a self-efficacy and goal-setting questionnaire (Wood & Locke, 1987). Achievement levels were measured using percentage grades on various forms of student work.

DATA SOURCES

Biology teachers in Walker County, Georgia, were asked if they would be willing to take part in a research project that would involve their classes. A high school teacher with thirty years experience volunteered to participate in the project. The teacher, principal, and superintendent signed a school permission form like the one included in Appendix C. A student consent form (Appendix B) was developed. The human subjects approval form A was obtained from the University of Tennessee, Knoxville.

Two weeks before the end of the first nine weeks, students were read a letter from the principal by the classroom teacher. The letter in Appendix B, addressed to students' parents regarding the research project, was to be taken home along

with the attached consent form. After the teacher answered any student questions, students were asked to get the letter signed and return it as soon as possible. Students were told that if they did not want to participate in the research they did not need to get the form signed. Of the ninety consent forms sent home, eighty nine were returned signed.

Rationale for the Data Sources

This study uses a time-series design in existing biology classes. The design can be represented as (O O O O X O O O O) where O is an observation and X is the beginning of treatment. A time-series design requires the collection of data for a period of time prior to the beginning of treatment. The period before treatment, sometimes called baseline, is a period that should demonstrate the subject's "natural behavior without experimental intervention" (Borg & Gall, 1986, p. 713). The next period, called the treatment period, begins when the treatment is administered.

The effects of the treatment are indicated by the difference in the data collected before and after treatment (Ary, Jacobs & Razavieh, 1972). Determining the value of the treatment is basically an evaluation of the pattern of scores. Time-series designs are statistically analyzed using "one-way repeated-measures analysis of variance" (Freed, Ryan & Hess, 1991, p. 21).

In reference to time-series designs, Campbell and Stanley (1963) state that "this design is particularly appropriate to those institutional settings in which records are regularly kept and thus constitute a natural part of the environment", and where more rigorous experimental control is not possible. This research is designed for a natural class setting, not a laboratory-type controlled setting. This research uses student grades and the number of chapters studied as measures of achievement. Grades are a natural part of classrooms and therefore are an available data source without the bias causing intrusiveness that other measures might present. The perceptive value of grades remains constant for students

throughout the study. Regardless of whether it is a baseline or treatment period, students have a personal stake in grades.

To evaluate self-efficacy and personal goal setting a Wood and Locke Academic Self-Efficacy (ASE) Questionnaire was used (Wood & Locke, 1987). In education research, questionnaires are an appropriate means for studying opinions and attitudes (Galfo, 1975) such as self-efficacy and personal goals. The questionnaire helps ensure a response to the same item from all respondents, which tends to standardize and objectify the observations of the responses. Standardized data collection allows for the quantification and statistical analysis of the data.

Grades During Baseline

The first nine weeks of the second semester served as a baseline period for the study. During the baseline period all the classes were taught by the regular Biology teacher. The study involved students in five Biology classes: two general classes and three college preparatory classes (CP). There were 38 students in the general classes and 52 students in the CP classes.

NUMBER of DATA SOURCES for STUDENT ACHIEVEMENT DURING
BASELINE

	Number of classwork assignments		Number of unit tests		Number of chapters completed	
Baseline (1st 9wks)	General classes 9	college prep classes 20	General classes 1	college prep classes 13	General classes 2	college prep classes 4

Grades During Treatment

The second nine weeks were used as a treatment period. The classroom setting was not changed except for the addition of keypads to student tables and one computer next to the teacher's desk at the front of the room. The classroom teacher was in charge of instruction, discipline, seating charts, and attendance.

The research investigator installed the keypad system and established the task structure to meet the objectives of the teacher. Each day the teacher outlined what he wanted students to know and the research investigator made out a set of questions and answers to aid students in learning. Correct answers were then entered into the computer keypad system for the next day's lesson. The task structure during the treatment phase was kept the same for all students. All classes used the college preparatory text book and materials.

NUMBER of DATA SOURCES for STUDENT ACHIEVEMENT DURING TREATMENT

	Number of classwork assignments	Number of unit tests	Number of chapters completed
Treatment (2nd 9wks)	40 all classes	11 all classes	9 all classes

The Wood and Locke Questionnaire

Most self-efficacy questionnaires are made to fit the particular circumstances under consideration. However, "the predictive validity of the overall scale" of the Wood and Locke Academic Self-Efficacy (ASE) Questionnaire used in this study "should replicate across courses and students" (Appendix A) (Wood & Locke, 1987). The self-efficacy portion of the questionnaire contains 7 categories with a total of 29 sublevels in each area and a confidence scale for rating in each area from 0-10. The grades or goal-setting section contains four sublevels for confidence ratings.

At the end of the first nine weeks, a self-efficacy and goal-setting questionnaire was completed to obtain baseline data before beginning the treatment period. During the treatment phase the self-efficacy and goal setting questionnaire was given twice: once at mid-point of the treatment and again at the end of treatment. Students were given a brief reminder of how to complete the questionnaire. The number of students completing the questionnaire at four and a half weeks and nine weeks was 75. Because of absences they were not

necessarily the same 75 students both times. Students who were absent on the day the questionnaire was filled out did not have time to fill it out the next day due to classwork.

TECHNIQUES FOR DATA COLLECTION

Achievement

Student achievement was evaluated in terms of student grades. Grades for the baseline and treatment periods, the first and second nine weeks, were categorized as either classwork or unit tests and a summative 9 week exam. Any work in which students were allowed to use some means, other than from memory, to complete the assignment was considered classwork. Any work that students had to complete from memory, such as chapter tests and quizzes, which were actually short tests, were categorized as unit tests. A comprehensive exam was given at the end of each 9 week period.

During the baseline and treatment phases, all grades used as a data source were determined on a percent correct basis. No weighting, curbing or other such grade manipulating techniques were used for the research data. However, because these were actual ongoing school classes as well as research classes, it was necessary for school purposes to determine the students' semester average. To determine a student's semester average, classwork was weighted at approximately 40%, unit tests at 40%, and the final 9 week exam at 20%, in accord with school-wide policy.

Although grade weighting has motivational implications, weighting was eliminated for the research data. Research data used the actual percentage grades (carried out two decimal places) for each area of instruction such as classwork, unit tests, and the final 9 week exam.

Classwork.

All classwork was done in class and taken up at the end of each period. This was done to ensure that all students did their own work and had the opportunity to obtain teacher assistance when they needed it. If a student worked the entire class period but did not finish the assignment, he/she was allowed to take a book and the assignment home to finish and turn in the next day. If students felt they needed help they were encouraged to ask the instructor.

The only time students had homework was to make up work missed due to an absence. If students were in class but did not do the classwork or did it at a 30% or less correct level, they received a grade of zero. This procedure was used to discourage students from just randomly choosing any answer.

The number of questions per assignment was low at first to help ensure student success immediately. Adjustments in the length of the task were an ongoing balancing act to meet the needs of both the slower students and the faster students.

Most of the classwork, approximately 85%, consisted of seat-work in which the students' worked independently, used their text book and wrote out the answers to questions. As students entered the classroom they picked up a text book and the questions for the day's lesson. Some students started to work immediately, while others waited until the tardy bell to begin. When the bell rang for class to begin, the teacher gave a brief introduction of what was going to be learned that period, and any changes in the daily routine were explained. Students were told they could begin work, and the teacher took attendance and completed other administrative duties such as excessive absentee or tardy notices. Students who were absent the previous day or days were given their missed assignments to complete as soon as possible.

Questions were put in order according to where the answer was in the book. Questions were of the short answer type and not multiple choice (Appendix D). Each question was numbered with the corresponding page number.

After each student completed the written assignment, he/she received a similar worksheet with the same questions in a randomized order (Appendix D). Each question contained four multiple choice answers. Using their hand written classwork, students chose an appropriate answer for each question and entered their choice in the keypad. If they felt their answer was incorrect they could go back to the book and look up the answer again. At any point in their work students could go back and change a previous answer.

When students were finished answering all the questions they received a grade through the LCD display on the keypad. Once a score was obtained, students could not go back and change any answers. Students could review any incorrect responses to see the correct answer.

Every Monday, an accumulative grade report was given to students (Appendix F). The grade report included an accumulated listing of all the work done and not done. It contained two grade averages: one for the actual work done and one that included a zero grade for the work not done.

About 15% of the classwork consisted of students answering questions during a short lecture discussion. During this phase students were shown pictures stored in the computer and displayed on a monitor. The pictures contained numbers that were relevant to the teaching objectives. Each picture was displayed and discussed then, students were asked to respond to questions about the picture. Students entered a number from the picture into the keypad. The instructor watched student responses on the computer monitor. If a question received too many incorrect responses the instructor retaught and then repeated the question. After each response students were told, on the keypad LCD display, if they were correct or incorrect. At the end of the lesson they received a percentage grade.

Unit Tests

Unit tests (Appendix E) were given after three or four lessons, because frequent evaluations have "a positive effect on student achievement" (Bellon, Bellon & Blank, 1992). Before a test, each student's handwritten classwork, not the multiple choice sheet, was given back for study and students were told which questions would be on the next day's test. Tests usually consisted of thirty to forty questions chosen from the classwork. For school purposes, but not for research, tests counted 40% of the students overall grade average. Tests were administered in two alternate forms with the question order rearranged. At the end of the test students received a grade on the keypad and they could review any incorrect responses.

The Nine Weeks Final Exam

The nine weeks final exam contained 162 questions chosen from the previous classwork. All of the exam questions were reviewed, in the same manner as daily classwork assignments, prior to the exam. The school's exam schedule required the exam be given in two parts on consecutive days.

Administering the Wood and Locke Questionnaire

To protect the privacy of students, they were asked to use a four-number code as their personal identification number on all questionnaire forms. The teacher read page one of the instructions on the form and asked students questions regarding the interpretation of the confidence level scale, to be sure they all understood. Students were then asked to turn to page two and complete the sample page. After checking to be sure students knew how to complete the form, they were told to complete the next four pages and keep the form until everyone was finished. After every one was finished the forms were turned in. Eighty one forms were turned in. One student withdrew from school. The other eight

students were absent on that day. Also, on the last day of the first nine weeks, students were taught how to use the keypads with their personal ID number.

METHODS OF DATA ANALYSIS

Research Question 1: Will the use of student response keypads to provide immediate feedback and reinforcement improve student achievement levels?

To answer question one on academic achievement classwork, unit tests and nine week tests were compared between the treatment and baseline periods using the mean and standard deviation. Statistical significance was determined at the 0.05 level using univariate analysis of covariance. Data were presented in tables and graphs.

All items that required the students to answer questions from memory and that were graded on a percent correct basis were classified as tests. The nine weeks test was always called the nine Weeks Test. In general classes, during the baseline period, tests included unit and chapter tests. In college preparatory classes, tests included quizzes and unit tests. Work in which students were allowed to use the text book or other types of reference material was classified as classwork. During the baseline period, data for classwork grades in general classes included magazine reports, lab reports, notebook chapter reports, and reading reports. Data for classwork in college prep classes included lab reports, assignments, readings, and video reports.

When students were present in class but failed to do their work they received a grade of zero for the assignment. If students were absent and failed to make up work missed, either tests or classwork, the item was recorded as a missing item. The student grade report gave the students two grades: one grade was for the actual work done, and the other grade included missing work averaged as a zero. Grades were also evaluated both ways to answer research questions 1

and 3. For school purposes, any missing work was evaluated as a zero at the end of the 9 week period.

Research Question 2: Will students have a higher perception of self-efficacy and set higher personal goals relative to achievement levels?

To answer question two, Pearson product-moment correlation coefficients were obtained for correlation analysis between self-efficacy and goal setting, self-efficacy and achievement, and goal setting and achievement. Statistical significance was determined at the 0.05 level using multiple analysis of covariance for repeated measures.

To obtain a self-efficacy and goal setting score, the questionnaire was scored by adding the reported level of confidence for all of the sublevels in each of the seven categories to obtain one numerical value (see the following example).

EXAMPLE (The following category has four sublevels and a score of 28)

CLASS CONCENTRATION

The proportion of class periods for which you feel you are able to concentrate and stay fully focused on the material being presented

	CAN DO	CONFIDENCE
1. Concentrate for at least 50% of a class period	<u> y </u>	<u> 10 </u>
2. Concentrate for at least 70% of a class period	<u> y </u>	<u> 10 </u>
3. Concentrate for at least 90% of a class period	<u> y </u>	<u> 8 </u>
4. Concentrate for 100% of a class period	<u> no </u>	<u> 0 </u>

Scores were not used for subjects who failed to complete the questionnaire three times; once each at the end of baseline, after four and a half weeks of treatment, and at the end of treatment. The reason subjects did not complete one or more of the questionnaires was due to absence and the amount of time

needed to complete classwork during other class periods. Eighty two students filled out questionnaires. Twenty two students did not complete it all three times, and twenty three did not complete the goal-setting question all three times. Eight other students were also eliminated from research data; one did not turn in the assent form, three withdrew from the research and four withdrew from school.

Research Question 3: Will students in general level Biology classes reach achievement levels obtained by students in college preparatory classes?

To answer question three, the general classes were compared with the college preparatory classes on the basis of grades. The general students had a much higher absentee rate, which confuses the data when comparing grade means for the purpose of performance levels. In order to eliminate this confusion, zeros for work not done due to an absence were removed from all grade averages. Significance was determined at the 0.05 level.

SUMMARY

Data on achievement were collected using student grades on classwork, unit tests, and a nine Weeks Exam both during the baseline and treatment periods. Self-efficacy and goal-setting data were collected using a Wood and Locke (1987) questionnaire at the end of baseline, after four and a half weeks, and at the end of treatment.

Data were collected for 18 weeks from five existing Biology classes: two general and three college prep classes. The first nine weeks served as a baseline to compare achievement levels, self-efficacy, and goal setting. The second nine weeks served as a treatment period. Treatment was designed to increase student motivation by providing a means for all students to participate

in lessons and receive immediate feedback and reinforcement. Student Response Keypads were used as the tool to implement the treatment.

Data analysis consisted of collecting and grouping student grade averages into categories of classwork, unit tests, and a nine weeks exam. This procedure was used for the first nine weeks baseline period and again for the second nine weeks treatment period. Individual student grade averages were averaged to obtain one average under each category and time period for the general students and one for the college prep students. The effects of the treatment were demonstrated by the difference in the means before and after treatment. Statistical analysis consisted of one-way repeated-measures analysis of variance and Pearson correlations.

CHAPTER IV

ANALYSIS OF DATA

INTRODUCTION

When studying the quality of instruction, Bloom (1976) said that a large part of the variation in student achievement levels can be accounted for by a student's motivation to participate in the learning process. Motivation is affected by achievement rates and achievement rates are affected by the quality of instruction. Quality instruction requires adequate feedback for both students and teachers, and high levels of reinforcement (Bloom, 1976). However, the problem of quality instruction exists because many teachers do not have the tools to provide the amount of feedback and reinforcement that is needed.

This study identified operational factors in educational settings that inhibit motivation, and therefore interfere with achievement. The motivational factors identified as missing were a means for all students to participate in instruction, and receive immediate knowledge of results and reinforcement feedback. Classroom operations were developed to utilize student response keypads as a way for students to actively participate in instruction and receive immediate feedback and reinforcement.

Development of the Research Questions

In developing the research questions, a review of the literature identified three primary areas of motivation that are conceptually linked: (1) student success or achievement rates, (2) student self-efficacy, and (3) personal goal setting. These three areas are dynamically interconnected and culminate in a human response called motivation.

In a social environment success can be perceived as the actualization of a person's self-efficacy and goal-setting perceptions. Yet, it is self-efficacy and

goal-setting perceptions that develop from an individual's success experiences. Success experiences in social settings such as schools are socially contrived. Schools are the social institutions that are responsible for establishing the conditions and standards under which student success or failure is realized.

The questions developed for this study were intended to determine if student success rates, self-efficacy, and goal setting (indicators of motivation) could be improved in actual classrooms. Motivation is thought to be a critical component of learning. And the critical components of motivation are anticipating a desirable outcome, personal involvement, immediate feedback, and reinforcement. The tools used to provide for student success outcomes, participation, feedback and reinforcement were student response keypads.

The first question that had to be answered was: given the conditions of a school environment, could the use of keypads increase student achievement or success rates? Second, if success rates could be increased, would self-efficacy and goal setting also increase? Third, if motivation improved, could it be improved for both the general level students and the college prep students?

Data Collection

To evaluate achievement rates, data consisting of grades and the number of chapters studied were collected for a baseline and treatment period of nine weeks each. The baseline period was a pre-existing period in which the natural classroom procedures were used.

During the baseline period, grades were collected from nine classwork assignments, one unit test, and a final exam in the general classes. The general classes studied two chapters. In the college prep classes, grades were collected from twenty classwork assignments, thirteen unit tests, and a final exam. The college prep classes studied four chapters.

During the treatment period, grades were collected from forty classwork assignments, eleven unit tests, and a final exam in both the general and college prep classes. All the classes studied nine chapters during the treatment period.

To evaluate student perceptions of self-efficacy and levels of goal setting under classroom conditions, data were collected using a Wood and Locke (1987) self-efficacy and goal-setting questionnaire (Appendix A). For the baseline period, data were collected at the end of the first nine weeks. For the treatment period, data were collected after four and a half weeks of treatment and again at the end of nine weeks. The questionnaire contained seven self-efficacy categories, with a total of twenty nine sublevels. The questions asked students to rate their ability perceptions to perform various academic tasks such as reading, note taking, and memorization. Students rated their level of confidence from zero (totally unconfident) to ten (totally confident) to perform at various task levels. One category with four sublevels was used to rate personal goal setting. Students were asked to rate their confidence in obtaining various grades.

An Overview of Data Analysis

Data analysis for this time-series design involved a descriptive and statistical analysis of the data collected before and after treatment. Scores were accumulated and converted to means for grades on daily classwork, unit tests, and a final exam. Item ratings from a Wood and Locke self-efficacy and goal-setting questionnaire were converted to a mean score. Means were statistically compared with repeated measures analysis of variance. A general linear models procedure was used for one-way repeated measures. Mean score patterns before and after treatment were compared using tables and graphs.

RESEARCH QUESTION 1

Will the use of student response keypads to provide immediate feedback and reinforcement improve student achievement levels?

Student scores and the number of chapters completed were used as indicators of student achievement rates. Each students' percentage grades were compiled within three areas: classwork (CW), unit tests (UT), and a final exam (EX). All student grades were then combined based on the class period (1st period, 2nd period, etc.). The class periods were grouped as either General Biology classes or College Prep Classes. Grade means were obtained, for the two groups of classes and for all classes combined, during both the baseline and treatment periods. To compare the difference in achievement levels between baseline and treatment, data were displayed in Table 1. A statistical analysis of the means for grades was done using repeated measures analysis of variance. The number of observations in the data set was 83. Observations with missing values were excluded from analysis. Thus, only 82 observations were used in this analysis.

A Comparison of the Quality of Work

The use of student response keypads for instruction was found to substantially and significantly improve student achievement levels. Both general and college prep classes had significantly higher grades with the use of keypads ($p < .05$). In all areas and classes grade means showed substantial increases as displayed in Table 1. For the general classes, daily classwork grade means increased 24.9 percentage points, unit test grade means increased 24.2 percentage points, and the final exam increased 38.1 percentage points. For the college prep classes, classwork grade means increased 18.2 percentage points,

unit test grade means increased 23.7 percentage points, and the final exam grade mean increased 36.2 percentage points.

When grades were combined for all classes, grade means for classwork changed from a mean of 70.6 to 91.6, which was an increase of 21.0 percentage points. Unit test grade means changed from 60.1 to 84, which was an increase of 23.9 percentage points. And the final exam grade mean changed from 54.9 to 91.9, which was an increase of 37.0 percentage points.

Table 1.

Test Score Means During Baseline (first nine weeks) and Treatment (second nine weeks) and their Differences.**

	<u>Baseline Mean</u>	<u>Treatment Mean</u>	<u>Differences in the Means</u>
General Classes			
Classwork	63.7	88.6	24.9*
Unit Tests	53.6	77.8	24.2*
Final Exam	50.6	88.7	38.1*
College Prep Classes			
Classwork	75.3	93.5	18.2*
Unit Tests	64.5	88.2	23.7*
Final Exam	57.8	94.0	36.2*
COMBINED SCORES FOR ALL CLASSES			
Classwork	70.6 (SD 19.4)	91.6 (SD 6.6)	21.0*
Unit Tests	60.1 (SD 21.8)	84.0 (SD 13.6)	23.9*
Final Exam	54.9 (SD 15.3)	91.9 (SD 12.2)	37.0*

* ($p < .05$), ($n = 82$, $df = 1$) ** (Baseline was a pre-existing period of nine weeks prior to treatment.)

A Comparison of the Quantity of Work

The quantity of work is one of the indicators of motivation. In classrooms quantity can take two forms: the number of daily classwork assignments completed and the number of chapters studied from the text book. The amount of work that students accomplished is shown in Table 2. Not only did student grade means increase, but the amount of classwork that students did and the

number of chapters covered also increased. Students did substantially more and did better. The number of classwork assignments increased from 9 for general classes and 20 for college prep classes to 40 for all classes. The number of chapters studied went from 2 for the general classes and 4 for the college prep classes to 9 for all the classes.

Table 2. The Number of Classwork Assignments Completed and Chapters Studied for the Baseline and Treatment Periods.				
Baseline (1st 9wks)	Number of Classwork Assignments		Number of Chapters Studied	
	General Classes	College Prep Classes	General Classes	College Prep Classes
	9	20	2	4
Treatment (2nd 9wks)	40		9	

RESEARCH QUESTION 2

Will students have a higher perception of self-efficacy and set higher personal goals relative to achievement levels?

To answer this question, data were collected using a self-efficacy and goal-setting questionnaire. The Wood and Locke questionnaire was administered at the end of the 9 week baseline period, after four and a half weeks of treatment, and again at the end of the 9 week treatment period. Students rated, from 0 to 10, their confidence level by responding to a total of 29 questions on self-efficacy and 4 questions on goal setting. One mean score was obtained for all students at each time period. A comparison was made between the mean scores at baseline, four and a half weeks of treatment, and at the end of treatment. Any changes in the mean were determined. Statistical analysis of the means was

done using repeated measures analysis of variance. The number of observations in the data set was 83. Observations with any one of the three values (baseline, four and a half weeks, or nine weeks) missing were excluded from analysis. Thus, only 59 observations were used in this analysis of goals and 60 in the analysis of self-efficacy.

To evaluate the relationship between grades, self-efficacy, and goals it was necessary to change self-efficacy and goal means to a percentage score. Grades are scored as a percent of the total possible.

Correlation analysis was done using Pearson product-moment. Correlation coefficients (r) were obtained to evaluate the degree of relationship of self-efficacy and goals to grades during both baseline and treatment periods.

Means for Self-efficacy

Student self-efficacy means (see Table 3) increased significantly between baseline and the end of treatment ($p < .05$). Student ratings of their self-efficacy at baseline had a mean of 172.9 out of a possible 290. After four and a half weeks of treatment, using students response keypads, self-efficacy ratings increased to 210.5, an increase of 37.5. After using student response keypads for another four and a half weeks, student ratings continued to increase from a mean 210.5 to 231.7. This was an additional increase of 21.2 for a total increase of 58.7 for the 9 week treatment period. The mean increase of 37.5 between baseline and four and a half weeks was significant ($p < .05$). The mean increase between four and a half weeks and the end of treatment was also significant ($p < .05$).

Means for Goals

Student goal setting means (shown in Table 3) increased significantly between baseline and the end of treatment ($p < .05$). Student ratings for goal setting at baseline had a mean of 26.0 out of a possible 40. After four and a half weeks of treatment, using student response keypads, goal setting changed from 26.0 to 34.6, an increase of 8.6. During the next four and a half weeks of treatment, goals changed from a mean of 34.6 to 36.6, for a total increase of 10.6 during the treatment period. The mean increase between baseline and four and a half weeks was significant ($p < .05$). The mean increase between four and a half weeks and the end of treatment was also significant ($p < .05$).

Table 3. Mean and Standard Deviations of Self-efficacy and Goal Setting for Baseline, Four and a Half Weeks, and the End of Treatment.							
	<u>Baseline</u>		<u>4.5 Weeks</u>		<u>End of Treatment</u>		<u>Increase in</u>
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>Mean</u>
Self-efficacy	172.9*	63.2	210.5*	65.0	231.7*	63.0	58.8***
Goals	26.0**	11.7	34.6**	7.8	36.6**	6.0	10.6***

Raw Scores Maximum Possible Values (*290 **40) *** $p < .05$

Comparison of the Means as a Percentage of the Total Possible

Self-efficacy increased 13% between baseline and four and a half weeks of treatment. Goal setting increased 21.5% between baseline and four and a half weeks of treatment. From four and a half weeks of treatment to the end of treatment, self-efficacy increased another 7.3% and goal setting increased another 5%. For the entire treatment period of nine weeks, self-efficacy increased 20.3% , goal setting increased 26.5%, and grades increased 27.3% (shown in Table 4). All increases were significant at the $p < .05$ level.

Table 4.

Displays Means (of self-efficacy, goals, and grades) as a Percent of Total Possible at Three Different Times (baseline, four and a half weeks, and the end of treatment). This Table also Shows the Total Percent of Increase for Each Item (self-efficacy, goals, and grades) Between the End of Baseline and the End of Treatment.

	Baseline	4.5 Weeks (mid point)	End of Treatment	Total Percent of Increase in the Means
Self-efficacy	59.6	72.6	79.9	20.3*
Goal Setting	65.0	86.5	91.5	26.5*
Grades	61.9	(not available)	89.2	27.3*

* $p < .05$

Baseline Correlations

Pearson product-moment correlation coefficients were computed between baseline grades and baseline self-efficacy. When grades were low and had a high standard deviation, then self-efficacy ratings were also low and demonstrated a significant relationship ($r = .48$, $n = 75$, $p < .05$). Pearson product-moment correlation coefficients between baseline grades and baseline goals were computed. When grades were low and had a high standard deviation, goals were also low and demonstrated a significant relationship ($r = .40$, $n = 75$, $p < .05$).

Treatment Correlations

For the treatment period, Pearson product-moment correlation coefficients were computed between grades and self-efficacy. When grades were higher and the standard deviation was low, then self-efficacy ratings were higher and demonstrate a significant ($r = .28$, $n = 73$, $p < .05$) but smaller relationship.

Pearson product-moment correlation coefficients between grades and goals during treatment were computed. When grades were higher and the standard deviation lower, then students set higher goals, which is demonstrated by a

significant ($r = .31$, $n = 72$, $p < .05$) but smaller relationship. Baseline and treatment correlations are shown in Table 5.

Table 5.			
Percentage Scores for Self-efficacy and Goal Setting Correlated with Baseline and Treatment Period Grades.			
Baseline Period (end of the First nine weeks)			
		Grades	Correlation
<u>Self-efficacy</u>	<u>59.6</u>	61.9	.48*
<u>Goal</u>	<u>65.0</u>		.40*
Treatment Period (end of the Second nine weeks)			
		Grades	Correlation
<u>Self-efficacy</u>	<u>79.9</u>	89.2	.28*
<u>Goal</u>	<u>91.5</u>		.31*

* $p < .05$

RESEARCH QUESTION 3

Will students in general level Biology classes reach achievement levels obtained by students in college preparatory classes?

Previous grade means reported in this research included zeros that students had for being absent and not completing their work. Absences were higher in the general classes than in college prep classes, so this variable was removed in order not to confound grades for actual work done.

These data show the differences that existed between the college prep classes and the general classes during the treatment period only (see Table 6). During the treatment period, all students used the same college prep text, materials, and tests. Data are not reported for the baseline period. During the baseline period, general and college prep students did not use the same text, materials, or tests, which makes any comparison between the two groups inequitable.

Grade Comparisons for the General and College Prep Classes.

Using repeated measures analysis of variance, there were statistically significant differences between grade means on daily classwork for college prep and general students ($p < .05$). The mean classwork grade for the general students was 92%, and for college prep students it was 94.8%, a difference of 2.8% which was found to be significant ($n = 82$, $F = 7.05$, $p < .05$).

Unit test means for the general students were 86.4%, and for the college prep students they were 90.7%. These means have a significant difference of 4.2% ($n = 82$, $F = 5.52$, $p < .05$).

The final exam mean for the general students was 91.5% and for the college prep students it was 94.0%, a non significant difference of 2.6 % ($n = 81$, $F = 2.91$, $p = .09$).

Table 6.
A Comparison of the General and College Prep Classes on Three Achievement Measures (CW, UT, & EX) During the Treatment Period.

	General		College Prep		Difference of Means
	M	SD	M	SD	
Classwork	92.0	5.5	94.8	4.1	2.8*
Unit Tests	86.4	9.0	90.6	7.2	4.2**
Final Exam	91.5	7.1	94.0	6.3	2.6***

* $F = 7.01$, $p < .05$, $n = 82$. ** $F = 5.52$, $p < .05$, $n = 82$. *** $F = 2.91$, $p = .09$, $n = 81$

SUMMARY

In retrospect, the data analysis revealed that student success levels increased an average of 21 points on daily classwork. As would be expected, when daily classwork grades improve, unit test grades also improve. Unit test grades improved 23.9 percentage points. Consistent with other grade improvements, the final exam grade also improved 37.0 percentage points.

Once student success rates increased, then students were willing to do substantially more work. The number of classwork assignments completed increased from 9 to 40 for the general classes and from 20 to 40 for the college

prep classes. If students are motivated to learn, then both the quality and the quantity of student work should improve, and this happened.

It was anticipated that if success rates could be improved, then student self-reports of ability perceptions (self-efficacy) and goal setting should also increase, and they did. Self-efficacy ratings increased 20.3 percentage points between baseline and the end of treatment. During this same period students set even higher personal goals. Personal goals increased 26.5 percentage points. For the baseline period, self-efficacy was found to have a correlation coefficient of .48 with grades; and goal setting was found to have a correlation coefficient of .40 with grades. For the treatment period, self-efficacy was found to have a correlation coefficient of .28 with grades; and goal setting was found to have a correlation coefficient of .31 with grades. As was expected, when the range of scores was restricted by a decrease in standard deviation during the treatment period, the correlation coefficient decreases.

Comparing the grades of the general students and the college prep students, a statistically significant difference was found for classwork and the unit tests ($p < .05$). College prep classes had a slightly higher grade average than general classes. Classwork grades differed by 2.8 percentage points, unit test grades had a difference of 4.2 percentage points, and the final exam had a difference of 2.6 percentage points.

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, GUIDELINES, AND RECOMMENDATIONS FOR FURTHER STUDY

SUMMARY

“Students learn by doing” (Anderson & Faust, 1973, p. 200) and do whatever they are motivated to do. Learning depends “largely on the activities of the student” (Rothkopf, 1970, p. 325). Learning occurs when students are cognitively involved in the learning activities. In educational settings student involvement (motivation) is critical. “People who are involved become motivated; involvement is the basis of motivation” (Glasser, 1971, p. 10). “The degree to which students invest attention and effort in classroom activities depends on their motivation” (Good & Brophy, 1994, p. 209).

A review of the literature on motivation helps to explain some of the components that affect motivation. Motivation was found to be affected by individual perceptions of success (self-efficacy), feedback/correctives from a task, personal goal setting, and reinforcement from the task.

Bandura (1986) defines how efficacy perceptions develop over time, and affect the way people view their chances for future success or failure. A perception of efficacy is a personal judgment. It is a way of thinking that regulates our motivating capability to organize social, environmental, and behavioral events for anticipated outcomes. Other research findings confirm that past success experiences are critical to the development of a positive self-efficacy; but success for its own sake or the sake of someone else is counterproductive. Success needs to come from personal effort in order to promote higher self-efficacy (McAuley, Duncan, & McElroy, 1989; Schunk &

Rice, 1991; Lyman, Prentice-Dunn, Wilson, & Bonfilio, 1984; Janott-Bulman & Brickman, 1982; McClelland & Koestner, 1992; Chance, 1992).

People engage in activities if they expect to be successful. The expectancy of success is believed to be a primary factor in achievement strivings (Weiner, 1982; Eccles & Wigfield, 1985). "Students feel motivated when they experience success with what they perceive as reasonable effort" (Brophy, 1983, p. 203). People do not even attempt to perform activities if they perceive a lack of ability.

Student success rates are affected by feedback/corrective information. Brophy (1986) contends that feedback in the form of corrective information and evaluation for quality should be given throughout the learning process. A general model of effective instruction developed from the research on information processing also supports the practice of giving students feedback during the learning process (Rosenshine & Stevens, 1986). Bloom (1976) says that feedback/corrective procedures account for the major portion of the difference between high and low achievement levels. In a review of research on corrective feedback, Anderson (1973) concluded that knowledge of the correct response to incorrect answers was more effective than just telling students the answer was wrong.

After one has decided to engage in a task, performance on the task is affected by both self-efficacy and the level of personal goal setting (Locke & Latham, 1990). Although we may not always be conscious of it, we can name the goal of our actions when we are asked to. We naturally establish goals for specific tasks. Higher goals will lead to higher performance levels (Shalley, Oldham, & Porac, 1987). People that set higher goals exert more effort and persist longer because the degree of outcome-satisfaction depends on obtaining the goal (Locke & Latham, 1990). When people set goals, they establish criteria for self-satisfaction which guides them in directing their behavior and provides a perceived incentive to persist until the goal is obtained (Bandura, 1993).

Research has found that one of the important components of goal setting is feedback. Feedback at the end of a task provides the information that people need to establish goals, and it even encourages spontaneous goal setting. Knowledge-of-scores feedback is necessary at the end of a task in order for students to set goals on future tasks (Erez, 1977).

Student participation in the learning process can only reach high levels when students are being adequately reinforced (Bloom, 1976). If there is no acknowledgment of their effort, students soon learn that what they do has very little value and they lose interest (Stevenson, 1992). Grades need to be high enough to reinforce not punish, and they need to be given frequently during the learning task (Chance, 1992; Bloom, 1976).

In educational settings, students have no independent objective means to evaluate their individual performance (Bandura & Jourden, 1991). Perceptions of success or failure do not necessarily follow as an actual occurrence of outcomes. A student's perception of an outcome is controlled and communicated through the environmental structuring strategies of the teacher. Teachers are the source of authority on the material and, formally or informally, they evaluate students' efforts and progress (Marshall & Weinstein, 1984)

The grading structure that teachers use should focus student attention on the quality of work. A normative grading structure focuses student attention on comparison with other students, whereas a percent correct grading structure focuses student attention more on the material to be learned (Marshall & Weinstein, 1984). Very little, if anything, is accomplished by grading on "effort" (the amount of work completed) rather than quality of performance (Anderson & Faust, 1973). Grades promote a task orientation, and thoughts concerning ability, that would otherwise interfere with learning, are temporarily suspended (Covington & Omelich, 1984)

The Problem

From an operational standpoint, the problem is to get students actively participating in relevant learning tasks. The primary problem that has to be solved is: how can students be motivated in a classroom environment? In most instructional situations, what is learned depends largely on the activities of the student. From the teachers perspective, "You can lead a horse to water, but the only water that gets into his stomach is what he drinks" (Rothkopf, 1970, p. 325). As far as teachers are concerned the problem can be stated as follows: "if he would only complete his assignments, stop day dreaming, and pay attention, I know he could succeed" (Anderson & Faust, 1973, p. 259).

Motivational problems exist when motivational needs are not being met. Students need what everyone needs, and that is: (1) to be involved in work that has value and in which they can be successful, (2) to obtain feedback about the quality of their work and to be shown what is wrong if something is wrong, and (3) they need recognition for their work.

In order to meet the motivational needs of students, teachers need to provide a means for all students to be actively involved in the lesson every day. When students finish their work they need to know how they did on their assignment and the correct answers to any mistakes (Bloom, 1976). They also need a grade or some other type of reinforcement for their work.

When researchers study the quality of instruction, they find that the problems are a lack of student involvement, inadequate feedback for both students and teachers, and low levels of reinforcement (Bloom, 1976). The problems of providing quality instruction exist because teachers simply don't have the time to give adequate feedback to all the students (Elawar & Corno, 1985). Teachers are overburdened with more than 30 students at a time (Lepper, 1983). Some of the classrooms are filled with disrupting and non-achieving students. Teachers have too much responsibility and no tools to provide the amount of feedback and reinforcement that is needed for quality instruction. The problem is not one of

knowing what to do, but of having the tools to do it in an actual classroom (Bishop, 1989).

The Purpose of this Study

This study evaluated the effects of using student response keypads as a tool to provide the critical factors necessary for motivation. If the research findings on motivation can be systematically applied in a classroom environment, then student motivation should improve. If motivation is improved, then students should do more work and do it better. Test grades should improve. Student self-efficacy should improve. Students should set higher personal goals. And students that previously had the lowest motivation should benefit the most. The following research questions were developed as a way to evaluate changes in student motivation.

1. Will the use of student response keypads to provide immediate feedback and reinforcement improve student achievement levels?
2. Will students have a higher perception of self-efficacy and set higher personal goals relative to achievement levels?
3. Will students in general level Biology classes reach achievement levels obtained by students in college preparatory classes?

The Procedure

To conduct the research, pre-existing biology classes in a north Georgia high school were chosen. Two lower level (general), and three higher level (college prep) classes all taught by the same teacher participated.

Data were collected for nine weeks prior to treatment (baseline period). During the baseline period no changes were made in the normal class instruction. Grades and the number of assignments completed on daily classwork, unit tests, and a final exam were averaged and grouped as general or college prep to obtain a measure of baseline achievement rates. A Wood and

Lock (1987) questionnaire was administered at the end of baseline to evaluate self-efficacy and goal setting.

At the end of baseline, keypads were installed on each students desk. Student Response Keypads are a 20-key multifunction terminal with an LCD display and connected to an IBM compatible computer. In response, to written or oral questions from the teacher, students entered their answer choice into the keypad. Students received feedback about their choice and the correct choice through the LCD display. At the end of the lesson students received a percentage grade. The teacher can monitor responses and correct any misconceptions immediately.

The second nine weeks were used as a treatment period. Lessons were developed that would allow students to use keypads for their daily classwork and tests. Both the general and college prep classes used the same daily classwork, unit tests, and final exam with the college prep text book. Students completed their lessons independently with the teacher serving as a facilitator. Grade data were collected in fundamentally the same manner as during the baseline period. The questionnaire was administered at the mid-point of the treatment and again at the end of treatment.

Means were obtained for the general and college prep classes in the areas of classwork, unit tests, and a final exam. From the questionnaire a mean for both self-efficacy and goal setting was obtained. Means for the baseline period were compared with means for the treatment period and patterns were analyzed. Means were statistically compared using repeated measures analysis of variance. Grades, self-efficacy, and goal-setting correlations were obtained.

FINDINGS

Research Question 1: *Will the use of student response keypads to provide immediate feedback and reinforcement improve student achievement levels?*

Findings on the Quality of Achievement

After introducing student response keypads for instruction (the treatment period), student achievement levels substantially increased. Both general and college prep classes had substantially higher grades with the use of keypads. Grades on daily classwork assignments, unit tests, and the final exam all increased. The average grade for classwork went from 71% to 92%. Unit test grades went from 60% to 84%. And the final exam grade improved from 55% to 92%.

Findings on the Quantity of Achievement

Not only did student grades increase, but the amount of classwork that students did and the number of chapters covered also increased. Students studied substantially more and demonstrated a greater concern for the quality of their work. The number of classwork assignments increased from nine for the general classes and twenty for the college prep classes to forty for all classes. The number of chapters covered went from two for the general classes and four for the college prep classes to nine for all the classes. Students did twice as much classwork and studied more than twice as many chapters.

- **Unintended Findings**

The following are student narratives, consistent with this finding: Students expressed amazement at the amount of work they were willingly doing. Nearly every class period, students would come in and start that day's work even before the tardy bell rang. Students commented that they could not believe they were doing their classwork and taking a test on it in the same day (students perceived

the multiple choice sheet as a test of their written work). By the end of the treatment period students were saying that they had learned more in this class than they had in any of their classes all year long.

After four and a half weeks, the classroom teacher still could not believe how hard and enthusiastically his students were working. He said that it was probably just because the keypads were a novelty. Near the end of nine weeks, he agreed the keypads were no longer a novelty, he said he was convinced the students' attitudes toward school work had definitely changed.

Research Question 2: Will students have a higher perception of self-efficacy and set higher personal goals relative to achievement levels?

Changes in Self-Efficacy

Within four and a half weeks after using student response keypads for instruction, students rated their self-efficacy on a Wood and Locke questionnaire (1987) much higher than they did at baseline. Ratings went from a mean of 172.9 to 210.5, out of a possible score of 290, an increase of 13%. During the second half of the treatment period, students rated their self-efficacy even higher. Self-efficacy ratings went from 210.5 to 231.7, an additional increase of 7.3% .

- **Unintended Findings**

The following are student narratives, consistent with this finding: Students reported being more confident in themselves and surprised at how well they were able to learn. Several of the students said that it was "hard to believe" that they could complete so much work so well - all by themselves. Others commented that they never earned such good grades before and they did not understand how they were doing it now. Shortly after the treatment period started, one of the girls commented that the reason she could not do well in school was because she could not read "this junk". The teacher replied, "well

then how are you getting such good grades?" She would say, with a curious look, "I can answer these questions. I just can't read."

As time went on, it appeared that more and more students began to gain confidence in their ability. Lower level students made half-hearted tries at first, but as time went on, it seemed as if every day, another student would announce to the class that he/she just got 85, 97, or 100 and he/she could not believe it. Students who had previously neglected to do their work were slowly coming to realize that they, too, could be successful. Later on during the study, one of the students said, in amazement, up until now he couldn't learn anything because he had brain damage from a childhood accident. Nearly every day he openly commented about his good grades to other students.

Changes in Goal Setting

Within four and a half weeks after using student response keypads for instruction, students rated their class goals on a Wood and Locke questionnaire (1987) much higher than they had at baseline. Goal setting increased from 26.0 to 34.6, out of a possible score of 40, a 21.5 % increase. During the second half of the treatment period student goal setting went up from 34.6 to 36.6, an additional increase of 5%.

- **Unintended Findings**

The following are student narratives, consistent with this finding: As soon as students finished their work and saw their grade, some of them would ask other students how they did, and in a loud voice they would tell their own grade. Other students would just yell out, with their fist raised in the air, "Yes"! As time went on it gradually began to become real, and students thought even more about what they might possibly be able to do. A student commented that he had already met his first goal and now thought he could do even better. As students gained confidence in themselves they set even higher goals. High achieving students began to compete with other high achieving students for one or two

tenths of a point difference. Several students began challenging others to try to top their score.

Self-Efficacy and Grades

Before the treatment period started, grades were low at 61.9%, and students rated their self-efficacy correspondingly low at 59.6%. There was a significant ($p < .05$) correlation ($r = .48$) between self-efficacy and grades. At the end of the treatment period grade ratings were up to 89.2% and self-efficacy ratings were up to 79.9%. Correlation's were still significant ($p < .05$) but much lower than during the pretreatment period ($r = .28$), which is consistent with a smaller standard deviation or range of scores (6.6%) during the treatment period, compared to 19.4% before treatment. When grades were high, students also rated their self-efficacy high.

- **Unintended Findings**

The following are student activities, consistent with this finding: From listening to student comments, it takes a longer period of time for some students to gain confidence in themselves. There appears to be a hesitancy on the part of many students to attribute success to themselves. When some students first started getting good grades, they would just sit and stare at their keypad without any comment. But they would leave the grade visible on the keypad LCD display for others to see. Later on they would ask other students how they did and then tell their own grade.

Goal Setting and Grades

When grades are low, as they were during the baseline period, students set correspondingly low goals. When student grades averaged 61.9%, goals averaged 65% and when student grades went up to 89%, goals also went up to 91.5%.

- Unintended Findings

The following are student narratives, consistent with this finding: One of the aspects of feedback that seemed to encourage goal setting was the weekly grade reports. Every Monday just before grade reports were given out students would comment as to whether they thought their grade average was going up or down. Halfway through the treatment period, a student said that he was already doing better than he thought he could and he exclaimed, "now I think I can do even better yet."

Research Question 3: *Will students in general level Biology classes reach achievement levels obtained by students in college preparatory classes?*

On daily classwork, general students had a grade mean of 2.8 percentage points less than the college prep students. On unit tests, general students had a grade mean of 4.2 percentage points less than the college prep students. Even though these grades were not substantially different for the two groups of students there was enough of a difference for it to be statistically significant ($p < .05$). On the final exam, the grade mean for the general students was 2.6 percentage points less than that for the college prep students. This difference was not statistically ($p < .05$) different for the two groups.

During the treatment period, both the general and college prep classes did the same number of classwork assignments and studied the same number of chapters using the same text and materials. Some individual students in the general classes missed more school and failed to make up more of the missed classwork assignments. Even though, the missed assignments were removed from the data for comparison between the grades, missed work meant a missed learning opportunity which could be expected to account for a portion of the larger difference between the unit test grade means; since, unit tests were based

on the daily classwork. If students did not do the daily classwork then very likely they would miss those questions on the unit tests.

Standard deviations for classwork decreased from 19.4 to 6.6 at the same time that grade means rose from 70.6% to 91.6%. As grade means increased, the variability in scores (range) between the lower level students and the upper level students decreased substantially. The pretreatment range of 51.2% to 90% decreased to a range of 85% to 98.2% during treatment. Decreases in standard deviation along with increases in grade averages indicates that students at the lower end in both groups (college prep and general) were benefiting the most (in terms of grades) from this class procedure.

Less variability in scores (range) is logically consistent with students studying more chapters. When students can keep up with their work in a class, then the whole class can move at a faster pace. Higher self-efficacy and goal setting ratings for both upper and lower level students are understandable when standard deviation decreases and the mean increases. Upper level students were improving their achievement level (upper range increased 8.2%) and lower level students are narrowing the gap with the upper level students (range decreased from 38.8 to 13.2).

- **Unintended Findings**

The following are student narratives, consistent with this finding: Near the end of the research, the classroom teacher was asked if he could tell the difference between his general and his college prep classes by observing their behavior. He said that if he had not already known, he would not be able to tell any difference in the classes by the way students were working.

Additional Unintended Finding

In addition to the unintended anecdotal findings reported above there was an unintended finding on student behavior. Consistent with Bloom (1976) as active participation in learning increased, discipline and student management problems decreased. Near the end of the research, the assistant principal was asked if he noticed any difference in student behavior from the Biology classes. He commented in writing as seen above.

LaFayette High School

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To whom it may concern:

The third nine weeks total number of science discipline referrals was 202 to the asst. Principal in charge of discipline. The fourth nine weeks only two students were sent to the asst. Principal in charge of discipline, an unbelievable change

Larry Parker
Curriculum coord.

Where all students can learn...

CONCLUSIONS

This research was designed to increase the limits of student motivation in two different but related ways. The first, conceptualizes motivation as the amount of work students willing study. The second, particular to education defines motivation as cognitive engagement or the quality of student work.

This research supports the postulate that a student's motivational needs can be met in educational settings with the use of student response keypads. The motivational aspects are fully supported by numerous other research findings as

well. What has been missing is a way for teachers to actually do what the research says they should be doing. Keypads in and of themselves do nothing -- they are only a tool. The findings of this study are the result of a culmination of many factors made possible with the use of keypads. The following discussion is concerned with how this simple tool seems to have facilitated the motivational needs of students in a classroom setting.

There were four factors critical for motivation identified in the literature:

- (1) The need for inclusion in the learning task.
- (2) The need to perceive that success is possible.
- (3) The need to obtain feedback directly and immediately from the learning activity.
- (4) The need for recognition of accomplishments.

The use of keypads made it possible for all the students to be involved in the lesson every day. Bloom (1976) and others (Anderson & Faust, 1973; Bellon, Bellon & Blank, 1992; Levin & Long, 1981) have emphasized that the foundation of a student's learning is inclusion in the learning task. Glasser (1971) said, "People who are involved become motivated; involvement is the basis of motivation" (p. 10). With keypads, all students are being called on to respond to teacher questions. If the lesson is a series of short lectures followed by questions, all students are asked to respond. If the lesson is a picture or a graph displayed on the monitor followed by questions, all students are asked to respond. If students are finding answers to questions on their own from a text book or other materials, all students are able to participate. An endless variety of lessons can be developed, all of which allow all students to be involved in the lesson. Lessons can also be developed for cooperative learning groups with both individual and group scores.

One of the common statements in the literature is, "Students learn by doing" (Anderson & Faust, 1973, p. 200). Also, the more students are taught the more they learn (Barr & Dreeben, 1983). During the treatment period students studied

more than twice as many chapters and substantially increased their grades. Student comments expressed their personal feelings that they were learning more than they ever thought possible. Findings from the general classes show that students who were previously not motivated to do school work were now earnestly working every day. No matter what type or variety of lessons are developed, one of the critical components, made possible with the use of keypads, was that all students were participating in the lesson.

Inclusion without success is insufficient. Success should not be guaranteed, but it should be perceived by students as an imminent possibility with an acceptable amount of effort. When people freely engage in activities, it is the expectation of obtaining a desirable outcome that motivates activity (Brophy, 1983; Corno, 1986; Evans, Bostow, Geiger, & Drash, 1982; Covington, 1984).

Once motivational factors are in place and students are purposefully participating in their lessons then the focus of concern for student success shifts to the task structure. The task structure contained many components to promote both student success and learning.

The written answer to questions format, which required all students to overtly respond, has been reported to increase on-task behaviors and require a greater degree of meta-cognitive processing. Overt responding (Anderson & Faust, 1973) and questioning strategies (King, 1992) have both been found to result in better retention of material over time.

Keypads allow each teacher, rather than an outside source such as a text book company or computer programmer, to develop lessons designed for specific teacher objectives. Keypads give the teacher immediate and accurate feedback everyday, on student responses, which makes it possible to adjust the next day's lesson and improve student understanding. By making the questions relevant to the intended learning objectives, interference effects caused by irrelevant questions can be eliminated.

Repetition, which increases retention, was designed into the classwork so that students were answering the same question at least three times. In order to maintain student interest each repetition used a little different format requiring different skills. Students had to read to find the answer; they had to write the answer out, and then they entered their answer into the keypad.

What has been termed "test effects" has been found to have a substantial positive effect on student achievement (Dempster, 1992). The use of keypads made frequent and cumulative testing possible with very little negative effect on the amount of classwork. Students also perceived that they were taking a test as soon as they finished their daily classwork. When students finished doing their written work, they had to match their answer to one on a multiple choice sheet and enter it in the keypad for a grade. Grades also provide an accountability factor reported to improve student engagement rates (Bellon, Bellon, & Blank, 1992). To promote "test effects" the multiple choice sheet had the questions and answers arranged in a different order than they were on the students copy, which encouraged students to answer from memory rather than looking back on their hand written sheet.

If students' written answers did not match the choices, they could go back to the text book and look up the answer again. Having more than one chance to get an answer correct is an important option for promoting students' confidence in their ability to master the content.

When achievement rates are high on daily classwork, as they were in this research with a mean of 92%, students are better prepared for the next days lesson. The cumulative effect due to distributed study (day after day) contributed to the high test grades (a mean of 84%). After a test, students expressed surprise at how easy it was to learn. They said that they studied very little and sometimes not at all before a test.

After students complete their work they need to know if they have obtained their goal. They need a grade for the work they did, and they need it quickly.

Bloom (1976) said that "most learning theories are in agreement that learning is effective only when it is accompanied by reinforcement" (p. 119). Other research has found that to maximize the effects of reinforcement it needs to be given immediately, and it needs to be accompanied with the correct answers to any incorrect responses (Arnold, 1976; Bandura & Jourden, 1991; Erez, 1977; Frost & Mahoney, 1976; Bandura, 1993).

Grades should be based on quality and result directly from the students' work in order to make the linkage with effort clear. The keypad system gave students a percentage grade through the LCD at the end of each lesson. After students received their grade, the correct answers to any incorrect responses were displayed on their LCD. When students receive an immediate grade and the correct answers to any incorrect responses directly from the keypad, they feel a personal responsibility or ownership of their work. John Dewey (1916) said, "Making the individual a sharer or partner in the associated activity so that he feels its success as his success, its failure as his failure, is the completing step" (p. 14).

With the keypad system teachers do not have to spend as much time grading papers. Grades are accumulated in the computer and can be down-loaded into a grade book program or spreadsheet. This in turn makes it possible for teachers to give weekly grade reports. When students receive weekly accumulative grade reports, they have the information that they need to establish goals. From the work of Locke & Latham, (1990) feedback that provides knowledge of scores from past performance was found to be a necessary component in establishing higher levels of goal setting and performance.

Two of the competing hypotheses for the results found in this research are that students may have increased their interest and motivation because of the novelty of the keypads and/or the extra attention they received for participating in the research. These ideas present a great deal of appeal given that keypads are new and contemporary to students and that the treatment period only lasted

for nine weeks. These ideas have to be understood keeping in mind that the major portion of student work, writing out answers to classwork and taking tests, was about as generic as classes can be. To accept these hypotheses, you would have to believe that with the same class procedure being used day after day for nine weeks, a little novelty and extra attention could keep high school students highly motivated. The only way to determine how much if any effect that these hypotheses had is to conduct the research over a two or three year period of time.

Motivation is fundamental to learning in all classrooms. The generalizability of these findings to other classrooms can be conceptualized by assessing whether student motivation is missing. If motivation is missing, then grades will be low. Teachers will be trying to structure "fun" lessons as opposed to "learning" lessons and teacher thoughts will be on controlling student behavior rather than how to help students learn.

There is nothing new in this research on motivation per se. The motivational aspects have been emphasized time and time again by many well-known researchers. Also, it is well understood that motivation is an intricate part of a person's learning. The significance of this research is that it demonstrates that the tools are presently available and applicable in a natural classroom setting to transform knowledge into practice.

In addition to implementing motivational and learning strategies, keypads can be used by teachers, in most content areas, with minimal computer skills and no computer programming knowledge. The keypad system can be used every day by every student for learning basic knowledge. Teachers are not locked in or restricted to a computer program. Teachers can design their own lessons, using existing materials to correspond to their particular circumstances. This research found that using a keypad system can substantially and significantly improve the quality of a teacher's instruction, improving student motivation and academic

achievement while at the same time promoting a sense of worth and well-being for students.

RECOMMENDATIONS TO IMPROVE STUDENT MOTIVATION

After considering the extensive literature on motivation and how to put it into practice, this study used student response keypads as a tool to implement the research. Considering what student response keypads provided for students to enhance their motivation, the researcher recommends that the following practices be in place to meet the motivational needs of students.

- The need for inclusion in the learning task.
 1. Each student needs a way to overtly participate in lessons every day.
- The need for a task structure that makes success and learning possible.
 2. Each student needs teacher assistance whenever it is requested.
 3. Each student needs lessons designed so that he/she can experience a high level of individual success.
 4. Each student needs lessons that are designed to maximize cognitive involvement.
 5. Each student needs lessons designed so that he/she repeats the material in different formats.
 6. Each student needs lessons that include only the relevant material to be learned.
 7. Each student needs tests that cover exactly what the classwork covered and in the same formats.
- The need to obtain feedback directly and immediately from the activity.
 8. Each student needs to receive the correct answers to any incorrect answers as soon as the lesson is finished.

- The need for recognition of accomplishments.
 9. Each student needs to receive a percent correct grade on all of his/her work as soon as it is finished.
 10. Each student needs to receive a weekly cumulative grade report.

RECOMMENDATIONS FOR FURTHER STUDY

The results of this study are the basis for the following recommendations.

1. This study should be replicated in other schools.
2. This study should be replicated in other subject areas.
3. This study should be replicated with a true experimental design.
4. Other studies should evaluate changes in student behavior and attendance.
5. Studies should be done to evaluate the effects on retention of learning.
6. Studies should be done to determine the extent to which students can apply what they have learned using this procedure to different instances.

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APPENDIX

APPENDIX A

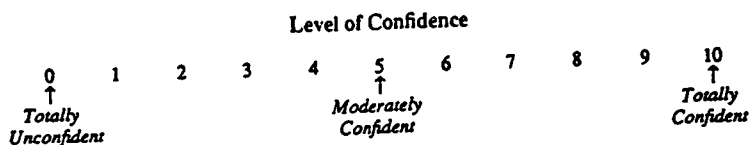
ASE QUESTIONNAIRE

*Read this page carefully. Do not turn over
the page until you are instructed to do so.*

The questions in this booklet ask about your perceptions of your ability to perform various academic tasks, such as reading, note taking and memorization. For each of the tasks you are asked to make two judgements about your ability to perform at varying levels of difficulty.

- (1) Could you perform the task at the level of difficulty described if you wanted to? If your answer to this question is yes, then enter a "Y" in the CAN DO column. If it is no, enter an "N" in that column.
- (2) How confident are you about your ability to perform at that task level? If in the next few days you were given a test of your ability to perform the task, how confident are you that you could perform at the level described?

Indicate your degree of confidence by entering 0 to 10 in the CONFIDENCE column, based on the following confidence scale.



SAMPLE ITEMS

Now consider some sample items. The first asks about assigned reading in the main text for this course. For this item we have filled in a hypothetical student's answers for you to illustrate the use of the scale.

READING ASSIGNED PAGES IN TEXTBOOK

	CAN DO	CONFIDENCE
1. Read at least $\frac{1}{4}$ of assigned material	<u>Y</u>	<u>10</u>
2. Read all of assigned material once	<u>Y</u>	<u>10</u>
3. Read all of assigned material twice	<u>Y</u>	<u>7</u>
4. Read all of assigned material five times	<u>N</u>	<u>0</u>

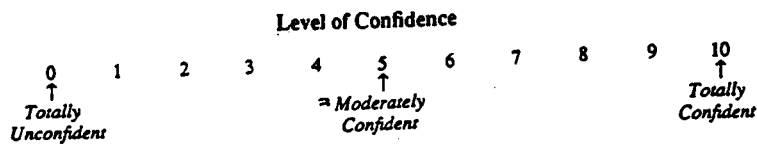
Note that this student is sure s/he can read all the material at least once, but is less confident she can read it twice (7 vs 10). SHe does not think s/he could read it five times (no time? boredom?).

Now answer the next item on your own.

LIFTING - ability to lift weights from a floor

	CAN DO	CONFIDENCE
1. Lift a 5 lb box	<u> </u>	<u> </u>
2. Lift a 20 lb box	<u> </u>	<u> </u>
3. Lift an 80 lb box	<u> </u>	<u> </u>
4. Lift a 300 lb box	<u> </u>	<u> </u>

REMEMBER THE COURSE IN WHICH THIS QUESTIONNAIRE IS BEING ADMINISTERED IS THE ONE YOU SHOULD THINK OF WHEN ANSWERING THE FOLLOWING QUESTIONS.



CLASS CONCENTRATION

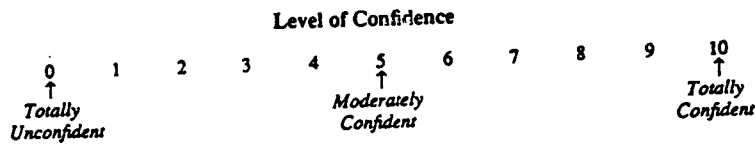
The proportion of class periods for which you feel you are able to concentrate and stay fully focused on the materials being presented.

	CAN DO	CONFIDENCE
1. Concentrate for at least 50% of a class period	_____	_____
2. Concentrate for at least 70% of a class period	_____	_____
3. Concentrate for at least 90% of a class period	_____	_____
4. Concentrate for 100% of a class period	_____	_____

MEMORIZATION

The proportion of facts and concepts covered in the course that you feel you are able to memorize and recall on demand (e.g. exam time, in response to questions).

	CAN DO	CONFIDENCE
1. Memorize 60% of the facts and concepts	_____	_____
2. Memorize 70% of the facts and concepts	_____	_____
3. Memorize 80% of the facts and concepts	_____	_____
4. Memorize 90% of the facts and concepts	_____	_____
5. Memorize 100% of the facts and concepts	_____	_____



EXAM CONCENTRATION

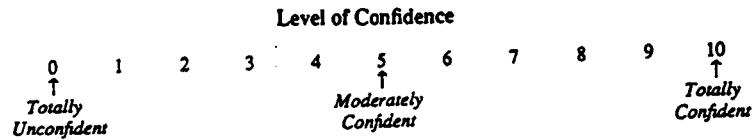
The proportion of time during exams for which you feel you are able to focus exclusively on understanding and answering questions and avoid breaks in your concentration.

	CAN DO	CONFIDENCE
1. Stay focused on the exam for 50% of the time	_____	_____
2. Stay focused on the exam for 70% of the time	_____	_____
3. Stay focused on the exam for 90% of the time	_____	_____
4. Stay focused on the exam for 100% of the time	_____	_____

UNDERSTANDING

The proportion of facts, concepts and arguments covered in the course that you feel you understand as they are presented in lectures, tutorials or course materials (e.g. textbooks, assigned articles).

	CAN DO	CONFIDENCE
1. Understand 50% of concepts as presented	_____	_____
2. Understand 70% of concepts as presented	_____	_____
3. Understand 90% of concepts as presented	_____	_____
4. Understand 100% of concepts as presented	_____	_____



EXPLAINING CONCEPTS

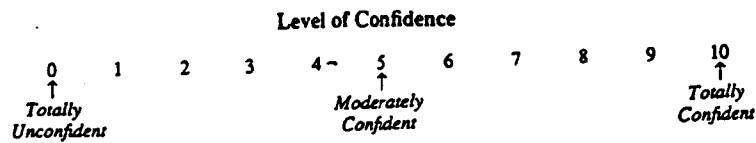
The proportion of facts, concepts and arguments covered in the course (i.e. in lectures, tutorials or course materials) that you feel you are able to explain clearly to others in your own words.

	CAN DO	CONFIDENCE
1. Explain 40% of the concepts, etc. in my own words	_____	_____
2. Explain 60% of the concepts, etc. in my own words	_____	_____
3. Explain 80% of the concepts, etc. in my own words	_____	_____
4. Explain 100% of the concepts, etc. in my own words	_____	_____

DISCRIMINATING BETWEEN CONCEPTS

The degree to which you feel you are able to discriminate between the more important and less important facts, concepts and arguments covered in the course (i.e. in lectures, tutorials and course materials).

	CAN DO	CONFIDENCE
1. Able to identify the most important concepts, points, etc. 50% of the time	_____	_____
2. Able to identify the most important concepts, points, etc., 70% of the time	_____	_____
3. Able to identify the most important concepts, points, etc., 90% of the time	_____	_____
4. Able to identify the most important concepts, points, etc. 100% of the time	_____	_____



NOTE-TAKING

The proportion of the time that you feel you are able to make understandable course notes which emphasize, clarify and relate key facts, concepts and arguments as they are presented in lectures, tutorials or course materials.

	CAN DO	CONFIDENCE
1. Make understandable notes for 50% of the material	_____	_____
2. Make understandable notes for 70% of the material	_____	_____
3. Make understandable notes for 90% of the material	_____	_____
4. Make understandable notes for 100% of the material	_____	_____

GRADES

The degree to which you feel you have the necessary skills to get various grades in this course, assuming that you try.

	CAN DO	CONFIDENCE
1. Get an A in this course	_____	_____
2. Get at least a high B in this course	_____	_____
3. Get at least a low B in this course	_____	_____
4. Get at least a C in this course	_____	_____

APPENDIX B

**LAFAYETTE HIGH SCHOOL
301 NORTH CHEROKEE STREET
LAFAYETTE, GEORGIA 30728**

March 10, 1995

Dear Parents:

The last nine weeks of this semester will be a more exciting time than usual in Mr. Davis' biology classes. In addition to the regularly scheduled labs, assignments and projects, the students in Mr. Davis' classes will participate in a research project from the University of Tennessee, Knoxville.

Mr. Roger Blough, a former Ridgeland High biology teacher will work with Mr. Davis' class on the use of computers for assistance in instruction. Each student will have a keypad at his/her desk and will be able to input information and receive feedback immediately as the class is being taught. Each student will be able to respond to every question and, thereby, can have more active involvement in the class. The computer will check each student's response and immediately notify him or her of its accuracy. The computer will also make frequent progress reports possible, so watch for them. Your child's participation in this project should confirm that computers enhance the teaching/learning process.

While Mr. Blough's research will test the effects of this more active involvement with the teacher on the student's attitudes and performance, parents can be assured that all objectives for biology are covered while this project is in our school. It is known that computer technology is present in all areas of our society, and participation in this project will help prepare our students for working with technology.

We at LaFayette High School appreciate the opportunity to use this computer-assisted project to make biology instruction even stronger.

Thank you for your interest in this project.

Sincerely,


Sandra Scoggins
Principal

STUDENT ASSENT FORM

I am being asked to help my teacher Mr. Davis, and Mr. Blough in a project. The goal of this project is to see if student motivation and learning can be improved by using technology to help in teaching.

If I decide to participate, my part in the project will not take any extra time because all work will be done in class. My name will not be used in any project reports. I will be asked 8 questions about doing school work on a questionnaire at the beginning and again at the end of the project. The project will last for 9 weeks. I will be asked to do my school work each day and enter my answers into a keypad hooked to a computer. This way I will know every day if my work is correct and if I make a mistake I will know what the correct answer is. If I am absent, I may have to make up the work I miss.

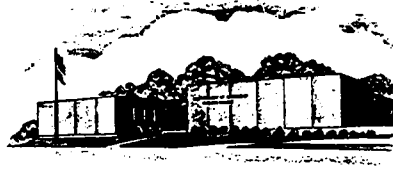
This project has been explained to me and I have been allowed to ask questions about it. I understand that I do not have to fill out the questionnaire if I don't want to and no one will treat me badly. I can stop part way through if I want to and skip questions I don't want to answer. I have read this form, understand the project, and agree to participate.

Student: _____ Date: _____

Parent/Guardian: _____ Date: _____

Teacher(s): _____ Date: _____

APPENDIX C



WALKER COUNTY DEPARTMENT OF EDUCATION

OFFICE OF SUPERINTENDENT

P. O. BOX 29 • LaFAYETTE, GEORGIA 30728
LaFAYETTE: (706) 638-1240 CHATTANOOGA: (615) 267-7054

SCHOOL SYSTEM PERMISSION FORM

Doctoral Research Dissertation For:

Name: Roger L. Blough Date: 3/8/95
Address : P.O. BOX 73107
City: CHATTANOOGA State: TN Zip: 37407

Title of the Dissertation:

A Study of the Effects of Using Student Response Keypads
on Student Motivation and Achievement in a High School
Biology Class

We approve of the use of facilities for research as
described in the attached dissertation prospectus.

Teacher: [Signature] Date: 3/8/95

Principal: [Signature] Date: 3/8/95

Superintendent: [Signature] Date: 3/8/95

APPENDIX D

Name _____

1. What is an angiosperm.
- 858
2. All angiosperms produce _____ in reproductive structures called
345 flowers.
3. Name one feature common to all angiosperms.
4. A _____ is the reproductive structure of an angiosperm.
5. As the seeds of an angiosperm mature, the flower changes into a _____.
6. The name _____ means covered seed, that is, the seed is covered by a fruit.
7. _____ means to scatter.
8. Based on their seed structure, how many groups of angiosperm are
346 there?
9. What feature of an angiosperm is used to separate them into groups?
10. _____ are tiny embryonic leaves inside the seeds of angiosperms.
11. Name the two major groups of angiosperms.
12. _____ are the group of angiosperms that have one cotyledon.
13. _____ are the group of angiosperms that have two cotyledons.
14. _____ have parallel leaf veins.
15. _____ leaves have netlike veins.
16. Tulips, irises, palm trees and grasses are examples of _____.
17. Roses, sunflowers, and maple trees are examples of _____.
18. Where does fertilization occur in angiosperm?
- 347
19. The enlarged tip of a branch where the flower develops is called the _____.
20. The sepals, petals, stamens, and pistils of a flower are attached to the _____.
21. Name the two structures that make up the outermost part of a flower.
22. Which part of the outermost flower are usually green?
23. Which part of the outermost flower are usually white or brightly colored?
24. _____ are the outermost part that encloses the flower before it opens.
- 347
25. Name the male reproductive part of a flower.
26. The stamen of a flower consists of a long filament topped by the pollen-bearing _____.
27. What part of a flower produces the pollen?
28. Where are pollen grains produced?
29. The _____ is the female reproductive structure located in the middle of the flower.
30. What is the name of the part at the base of the pistil?
31. Name the structures in the ovary that develop into seeds.
32. The _____ is the long tubular part above the ovary that supports the stigma.
33. Name the structure that is located on top of the style and is the place where pollen first collects.

Form Number 1

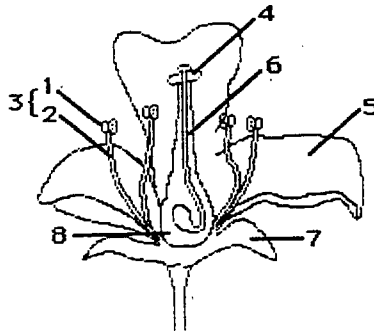
1. Tulips, irises, palm trees and grasses are examples of ____.
(5) monocots (6) dicots (7) pomes (8) drupes
2. Based on their seed structure, how many groups of angiosperm are there?
(5) three (6) one (7) four (8) two
3. ____ are tiny embryonic leaves inside the seeds of angiosperms.
(5) cotyledons (6) styles (7) pistils (8) endosperms
4. Where does fertilization occur in angiosperm?
(5) pollinator (6) cotyledon (7) flower (8) receptacle
5. What is an angiosperm.
(5) the outermost part of a flower (6) fruits that develop from a single ovary in a single flower (7) a flowering plant (8) a non-flowering plant
6. All angiosperms produce ____ in reproductive structures called flowers.
(5) seeds (6) sepals (7) stems (8) tubers
7. What feature of an angiosperm is used to separate them into groups?
(5) fruit size (6) number of leaf veins (7) seed structure (8) stem length
8. The ____ is the long tubular part above the ovary that supports the stigma.
(5) stamen (6) style (7) stigma (8) filament
9. ____ leaves have netlike veins.
(5) aggregate (6) multiple (7) dicot (8) monocot
10. Name the structures in the ovary that develop into seeds.
(5) ovules (6) sperm nuclei (7) anthers (8) stamens
11. Name the two major groups of angiosperms.
(5) berries and drupes (6) fruits and seeds (7) samara and pome (8) monocots and dicots
12. The name ____ means covered seed, that is, the seed is covered by a fruit.
(5) fruit (6) angiosperm (7) ovary (8) stamen
13. Name the structure that is located on top of the style and is the place where pollen first collects.
(5) anther (6) receptacle (7) ovule (8) stigma
14. ____ are the group of angiosperms that have two cotyledons.
(5) achenes (6) monocots (7) dicots (8) endosperms
15. What is the name of the part at the base of the pistil?
(5) pome (6) anther (7) ovary (8) drupe

16. Name the male reproductive part of a flower.
(5) stigma (6) style (7) pistil (8) stamen
17. The ____ is the female reproductive structure located in the middle of the flower.
(5) cone (6) pistil (7) anther (8) stamen
18. As the seeds of an angiosperm mature, the flower changes into a ____.
(5) stigma (6) cone (7) sepal (8) fruit
19. Where are pollen grains produced?
(5) on top of the style (6) in the middle of the pistil (7) in the endosperm (8) in sacs inside the anther
20. ____ means to scatter.
(5) disperse (6) pollinate (7) fertilization (8) aggregate
21. What part of a flower produces the pollen?
(5) anther (6) stigma (7) style (8) ovary
22. The stamen of a flower consists of a long filament topped by the pollen-bearing ____.
(5) style (6) sepal (7) anther (8) filament
23. ____ are the outermost part that encloses the flower before it opens.
(5) sepals (6) petals (7) pistils (8) anthers
24. Which part of the outermost flower are usually white or brightly colored?
(5) sepals (6) stigma (7) petals (8) fruit
25. Which part of the outermost flower are usually green?
(5) petals (6) sepals (7) style (8) pistil
26. Name the two structures that make up the outermost part of a flower.
(5) pome and drupe (6) pistil and ovary (7) stigma and style (8) sepals and petals
27. Name one feature common to all angiosperms.
(5) all angiosperms have both male and female parts on each flower
(6) all angiosperms are monocots (7) all angiosperms have seeds that develop unprotected on the scales of cones (8) all angiosperms produce seeds in reproductive structures called flowers
28. The sepals, petals, stamens, and pistils of a flower are attached to the ____.
(5) ovule (6) pollinator (7) pome (8) receptacle
29. The enlarged tip of a branch where the flower develops is called the ____.
(5) receptacle (6) style (7) ovule (8) stigma
30. Roses, sunflowers, and maple trees are examples of ____.
(5) monocots (6) dicots (7) drupes (8) pomes
31. ____ have parallel leaf veins.
(5) monocots (6) dicots (7) cotyledons (8) stamens
32. ____ are the group of angiosperms that have one cotyledon.
(5) dicots (6) monocots (7) cotyledons (8) legumes
33. A ____ is the reproductive structure of an angiosperm.
(5) monocot (6) flower (7) cotyledon (8) stamen

APPENDIX E

FORM NUMBER 1

1. Name the two types of cones produced by a pine.
 (5) drupes and pomes (6) samara and achene (7) pollen cone and seed cone (8) multiple cone and aggregate cone



2. In the diagram, which number identifies the style?
3. Which number in the diagram identifies a flower petal? (see page 347)
 CHOSE THE NUMBER FOR YOUR ANSWER FROM THE DIAGRAM
4. Which number in the above diagram identifies the green sheath that protects a young flower bud? It's called a sepal.
5. In the above diagram of a flower, which number identifies the WHOLE (NOT JUST PART) of the male reproductive structure (see fig. 21-3)?
 CHOSE THE NUMBER OF YOUR ANSWER FROM THE DIAGRAM
6. Which number identifies that part of the male structure which produces pollen grains.
7. Which number identifies the male filament?
8. Which number in the diagram identifies the location of immature seeds called ovules?
 CHOSE 1 THRU 9
9. Which number in the diagram identifies the ovary?
10. Which number identifies the "sticky" stigma?
11. Which number in the diagram identifies the female reproductive structure on which pollen originally collects?
12. Which number identifies the male anther?

13. Name the two major groups of angiosperms.
(5) berries and drupes (6) fruits and seeds (7) samara and pome
(8) monocots and dicots
14. What part of a flower produces the pollen?
(5) anther (6) stigma (7) style (8) ovary
15. Which part of the outermost flower are usually white or brightly colored?
(5) sepals (6) stigma (7) petals (8) fruit
16. Which part of the outermost flower are usually green?
(5) petals (6) sepals (7) style (8) pistil
17. What is an angiosperm.
(5) the outermost part of a flower (6) fruits that develop from a single ovary in a single flower (7) a flowering plant (8) a non-flowering plant
18. ___ leaves have netlike veins.
(5) aggregate (6) multiple (7) dicot (8) monocot
19. ___ have parallel leaf veins.
(5) monocots (6) dicots (7) cotyledons (8) stamens
20. Many flowers have evolved structures that allow only certain kinds of insects to pollinate them. These insects, in turn, have evolved:
(5) insects have evolved color blindness (6) insects have evolved feeding structures adapted for particular plants (7) insects have evolved a better sense of smell (8) insects live in the flowers that they pollinate
21. Why are bees rarely found on red flowers?
(5) bees cannot distinguish the color red (6) bees are repelled by the color red (7) bees are completely color blind (8) red flowers contain no nectar
22. ___ is a sugary food produced by many flowering plants to attract animal pollinators.
(5) pome (6) pollen (7) nectar (8) honey
23. Name the tree that has fan-shaped leaves with parallel veins, and is the only surviving species of a once-large group.
(5) maple (6) hemlock (7) Ginkgo (8) ash
24. ___ are the outermost part that encloses the flower before it opens.
(5) sepals (6) petals (7) pistils (8) anthers
25. Name the structures in the ovary that develop into seeds.
(5) ovules (6) sperm nuclei (7) anthers (8) stamens
26. Name the structure that is located on top of the style and is the place where pollen first collects.
(5) anther (6) receptacle (7) ovule (8) stigma

27. Name two major groups of plants that are wind-pollinated?
 (5) grass and trees (6) flowers and trees (7) grasses and flowers
 (8) conifers and angiosperms
28. Describe the petals of a flower that a butterfly or moth with a long sucking mouthpart would probably pollinate.
 (5) short, separated petals (6) large, wide petals (7) petals that form a tube with nectar at the base (8) petals that form a shallow, wide cup
29. Do conifers shed their leaves (needles)?
 (5) No, they are evergreens (6) yes (7) most do not (8) never
30. Pine, Spruce, and Fir trees belong to what group of plants?
 (5) simple fruits (6) angiosperms (7) pollinators (8) gymnosperms
31. Ovules mature into ____; ovaries ripen into _____. (read Fig.21-11)
 (5) achenes / pomes (6) eggs / cones (7) seeds / fruits
 (8) fruits / seeds
32. The most numerous gymnosperms are _____.
 (5) conifers (6) cycads (7) gnetophytes (8) ginkgoes
33. The ____ is the female reproductive structure located in the middle of the flower.
 (5) cone (6) pistil (7) anther (8) stamen
34. Name the term used to describe trees that do not drop their leaves in the autumn.
 (5) deciduous (6) mutualism (7) recessive (8) evergreen
35. As the seeds of an angiosperm mature, the flower changes into a ____.
 (5) stigma (6) cone (7) sepal (8) fruit
36. Name one feature common to all angiosperms.
 (5) all angiosperms have both male and female parts on each flower
 (6) all angiosperms are monocots (7) all angiosperms have seeds that develop unprotected on the scales of cones (8) all angiosperms produce seeds in reproductive structures called flowers

APPENDIX F

AT Lafayette High School
IN BLOUGH'S PER.6th College Prep Biology

SCORES AS OF: 06-15-96

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( 1 ) CH-1 Lecture 1: 100 / 100
( 2 ) CH-1 CW 1: 92 / 100
( 3 ) CH-15 CW1: 89 / 100
( 4 ) CH-15 CW2: ( )
( 5 ) CH-15 Q2: ex.
( 6 ) CH-15 CW3: 96 / 100
( 7 ) CH-15 TEST X 4: 376 / 400
( 8 ) CH-16 CW1: 100 / 100
( 9 ) CH-16 CW2: 96 / 100
( 10 ) CH-16 CW3: 93 / 100
( 11 ) CH-16 TEST X 3: 300 / 300
( 12 ) PIG REVIEW: 88 / 100
( 13 ) PIG TEST X 3: 240 / 300
( 14 ) CH-17 CW1: 100 / 100
( 15 ) CH-17 CW2: 94 / 100
( 16 ) CH-17 QUIZ 1: 100 / 100
( 17 ) CH-17 CW3: 89 / 100
( 18 ) CH-17 QUIZ 2: 100 / 100
( 19 ) CH-17 TEST X 3: 273 / 300
( 20 ) CH-20 CW1: 100 / 100
( 21 ) CH-20 QUIZ 1: 100 / 100
( 22 ) CH-20 CW2: 100 / 100
( 23 ) CH-20 CW3: ( )
( 24 ) CH-20 QUIZ 2: 74 / 100
( 25 ) CH-20 TEST X 3: 252 / 300
( 26 ) CH-21 CW1: 100 / 100
( 27 ) CH-21 QUIZ 1: 100 / 100
( 28 ) CH-21 CW2: 100 / 100
( 29 ) CH-21 QUIZ 2: 100 / 100
( 30 ) CH-21 CW3: 96 / 100
( 31 ) CH-21 CW4: 92 / 100
( 32 ) CH-21 QUIZ 3: 100 / 100
( 33 ) CH-21 TEST X 4: 400 / 400
( 34 ) CH-30 CW1: 100 / 100
( 35 ) CH-30 CW2: 100 / 100
( 36 ) CH-30 TEST 1 X 3: 291 / 300
( 37 ) CH-30 QUIZ 1: 100 / 100
( 38 ) CH-30 CW3: 100 / 100
( 39 ) CH-30 CW4: 94 / 100
( 40 ) Flower Lab Report: 62 / 100
( 41 ) CH-30 TEST II X 3: 300 / 300
( 42 ) CH-31 CW1: 83 / 100
( 43 ) CH-31 CW2: 92 / 100
( 44 ) CH-31 CW3: 96 / 100
( 45 ) CH-31 QUIZ 1: 100 / 100
( 46 ) CH-31 TEST X 3: 291 / 300
( 47 ) CH-32 CW1: 97 / 100
( 48 ) CH-32 CW2: 100 / 100
( 49 ) CH-32 TEST X 3: 291 / 300
( 50 ) CH-36 CW1: 96 / 100
( 51 ) CH-36 CW2: ( )
( 52 ) Final Exam Review 1: 95 / 100
( 53 ) CH-36 TEST X 3: 267 / 300
( 54 ) final Exam Review 2: 100 / 100
( 55 ) Final Exam Review 3: 98 / 100
( 56 ) Final Exam Review 4: 98 / 100
( 57 ) Final Exam Review 5: 95 / 100
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* '()' INDICATES A SCORE IS LEFT OUT.
* 'ex.' INDICATES STUDENT EXEMPTED FROM ENTRY.

TOTAL ATTEMPTED POINTS: 7286 / 7700
94.6 % = A

TOTAL POSSIBLE POINTS: 7286 / 8000
91.1 % = B

VITA

Roger Louis Blough was born in Ypsilanti, Michigan on August 29, 1942. He lived on a family farm and attended Cutler school, a one room rural elementary school, near Saranac, Michigan. He attended middle school at Saint Mary's school in Lowell, Michigan before completing high school at Saranac, Michigan in June, 1960. After finishing high school, he worked in the installation division of the Western Electric Co. until he purchased the Big Rapids Greenhouses in December, 1969. After selling the Big Rapids Greenhouses (Big Rapids, Michigan) in 1979, he attended college at the University of Tennessee in Chattanooga, Tennessee. In December, 1983 he received a Bachelor of Science degree with a major in Secondary Science Education. He taught high school science until he entered the Master's degree program at the University of Tennessee Knoxville, Tennessee. He received a Master of Science degree in Curriculum and Instruction in August of 1989. He taught high school Biology classes until he reentered the University of Tennessee and completed his Ed.D. degree in December of 1996.