Introduction
CHAPTER I

INTRODUCTION

Quality teaching is both an art and a science. The components of the instructional process develop the teaching science. The art emerges when educators skilfully use their creative talent and intuitive personalities. Identifying critical learning from the curriculum, organizing learning into sequential steps, determining pre-requisites, and finding higher-level questions are critical components of good instructional planning.

The planning phase of the instructional process is intended to guide teachers to tie together concepts, objectives, tests, teaching strategies, and student outcomes so all are aligned. Alignment, checking for understanding, active participation, self-evaluation, and high levels of thinking are ongoing constants in the instructional process. Beyond using the process to teach students, many teachers have discovered the value of teaching students to understand and identify the components of the instructional process. This way, students can give us more accurate feedback where we are missing the mark with them.

One of the teaching strategy used as instructional process is Mastery Learning where the learner is required to be a master of the content after completion of the instruction.

MASTERY LEARNING

Mastery Learning woven into the instructional process reveals a set of sound instructional practices, which create the conditions for the philosophy [all can learn well] to bloom in the lives of the learners. Mastery Learning is an
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optimistic philosophy. This philosophy asserts that any teacher can help virtually all students to learn excellently, quickly and self confidently. Mastery Learning involves a set of clear steps for selecting content, teaching and determining student's progress. The concept of Mastery Learning implies that there is some identifiable and circumscribed body of skills or knowledge that an instructional programme attempts to foster in all students. There is a level of performance that indicates mastery of skills/content areas and there are some means of determining whether mastery levels are attained. Thus, it involves programme goals and objectives, standards and special problems of measurement.

Mastery Learning is based on two basic assumptions:

- Virtually all students can learn all, important content to a level of excellence
- The primary function of school is to define learning objectives, and to help all students to achieve them (Bloom, 1960)

Mastery Learning is defined as teaching learning approach which asserts that under appropriate instructional conditions virtually all students can and will learn most of what is taught in schools (Carroll, 1963). Block (1980) has pointed out two things

- Mastery Learning is an optimistic theory about teaching learning
- Mastery Learning is an effective set of individualized instructional practices that consistently help most students to learn excellent. Salvin (1987) defined it as *the organization of time and resources to ensure that most students are able to master instructional objectives.*

Any group of students will always enter a learning situation with great many individual differences in everything from preparation in the subject, to
learning style and to personality. Therefore, the advocates of Mastery Learning point out that:

- Students enter school with different skills, and that there exists great differences in achievement between school system, schools and classes.
- Children may have different styles of learning.
- What looks like a difference among students in rate of learning is usually really a difference in proportion of time spent on task.

John B. Carroll inaugurated a fundamental change in thinking about the characteristics of instruction in 1963 when he argued for the idea that student aptitudes are reflective of an individual's learning rate. In this new paradigm, Carroll suggested that instruction should focus more on the time required for different students to learn the same material. This was in contrast with the classic model in which all students are given the same amount of time to learn and the focus is on differences in ability.

He called this learning rate, LR, the degree of learning, which is demonstrated in the formula:

\[ LR = \frac{\text{TimeSpent for Learning}}{\text{TimeNeeded to Learn}} \]

This describes that the learning rate is a function of the time a learner has to learn to the time he actually needs to learn a given situation of instruction. Carroll's new theory was based on the idea that all learners can have the potential to learn any instruction given, but take different amounts of time to do so. So when a learner's aptitude is seen on the context as an index of the learning rate then students are not seen as good or bad learners, but as fast or slow learners (Guskey, 1997).
John B Carroll (1963) supplied the impetus for the emergence of Mastery Learning system. This approach suggests that if each student takes the necessary time to learn material to a specific level of achievement, the student will probably achieve that level. The Carroll’s Model can be summarized as:

Carroll identified two factors that affected the learning rate of a student, perseverance of the student, and the opportunity to learn. The first is controlled by the students, that is, how much time they spend on learning, the former is the time allotted to learn by the students in the classroom, or access to materials, etc. Ability to understand instruction, time allowed & quality of instruction affected the time needed to learn.

However, it was Bloom in 1968, who fully developed the concepts now known as Mastery Learning. In the 1960s, Benjamin Bloom was involved in research on individual differences as applied to learning. Impressed with Carroll’s ideas, he took them further by concluding that if,

1. aptitude could predict a learner's learning rate, then he believed that it should be able to set the degree of learning expected of a student to some level of mastery performance. Then,

2. see to the instructional variables under an instructors control, such as the opportunity to learn and the quality of the instruction. Thus,

3. the instructor should be able to ensure that each learner can attain the specified objective.

Bloom concluded that given sufficient time and quality instruction, nearly all students could learn. The rate of learning has been presumed to be dependent upon five variables viz:
Perseverance

Aptitude

Ability to Understand the Instruction

Time allowed

Quality of Instruction

• Perseverance: It is the amount of time the student was willing to spend actively involved in the learning. Providing high quality of instruction and frequent feedback can increase it.

• Aptitude: Aptitude is the amount of time needed to master the task under ideal conditions. It is considered to be a relatively fixed and generic ability to perform various kinds of learning tasks (Clark, 1987).

• Ability to Understand the Instruction: It represented the student’s ability to generally profit from the instruction and was closely identified with general intelligence.

• Time allowed: It is the total learning time the student was allowed. It is the amount of time allocated to the learner for learning of a given task that is under control of teacher.

• Quality of Instruction: It was defined in terms of the degree to which the presentation, explanation and ordering of learning task’s elements approached the optimum for each learner.

The theories of Mastery Learning resulted in a radical shift in responsibility for teachers; the blame for a student’s failure rests with the instruction not on lack of ability on the part of the student. In this type of learning environment, the challenge becomes providing enough time and employing instructional strategies so that all students can achieve the same level of learning (Bloom, 1981; Levine, 1985).
The Basic Practice Model of Teaching (Joyce and Weil, 2003)

The Basic Practice Model of Teaching involves 5 phases:
1. Orientation
2. Presentation
3. Structured practice
4. Guided Practice
5. Independent practice

Phase One: Framework for the lesson is established through Orientation
♦ Provide objective of lesson and level of performance required.
♦ Describe the content of the lesson and relationship to prior knowledge/experience.
♦ Discuss the procedures of the lesson - the different parts of the lesson and student's responsibility during each activity.

Phase Two: Presentation
♦ Explain the new concept(s) or skill(s)
♦ Demonstration with examples - orally and visually
♦ For a concept: Include attributes (characteristics), the rule or definition, and several examples
♦ For a skill: Identify the steps of the skill with examples of each. It is important that pupils have a visual representation of the task (VRT) in the early stages of learning

Phase Three: Structured practice
♦ Lead students through practice examples working in a lock-step fashion each step of the task as it appears in the VRT. (e.g., use an overhead projector doing practice examples on a transparency so that students can see the generation of each step)
Then provide a visual instructional plan (VIP) - in which each step is detailed to pupils to use when they get stuck in individual practice or independent practice. Refer to the VRT while working practice examples as a group.

**Phase Four: Guided practice** [in class seat work]. With the teacher circulating [e.g., "praise, prompt, and leave"].

- Monitor student’s work
- Providing corrective feedback as necessary
- Assess performance of the group in determining whether the class is ready for the next instruction
- Additional time for those whose aptitude calls for a longer learning period, can be provided by giving "extra credit" assignments, supplementary activities, etc.

**Phase Five: Independent practice** [additional class time or homework]

- Begins when students have achieved 85% to 90% accuracy level.
- To insure retention and develop fluency, students practice on their own, without assistance and with delayed feedback [e.g., comments on graded papers]. Five or more brief practice activities distributed over a month or more may be required to "fix" the new concept/skill.

The Mastery Learning model is closely aligned with the use of instructional objectives and the systematic design of instructional (ISD) programs (Gagne, 1977). The Criterion Referenced Instruction (CRI) model of Mager of evaluating terminal behaviors is an attempt to implement the Mastery Learning model. Here the instructor can assess student’s progress based on the objectives of the instruction rather than through the traditional norm-referenced test. In addition, the
theoretical framework of Skinner with its emphasis on individualized learning and the importance of feedback (reinforcement) is also relevant to Mastery Learning. Mastery Learning ensures numerous feedback loops, based on small units of well-defined, appropriately sequenced outcomes.

**Mastery Learning** (ML), is an instructional strategy based on the principle that all students can learn a set of reasonable objectives with appropriate instruction and sufficient time to learn. ML puts the techniques of tutoring and individualized instruction into a group learning situation and brings the learning strategies of successful students to nearly all the students of a given group. In its full form it includes a philosophy, curriculum structure, instructional model, the alignment of student assessment, and a teaching approach.

Mastery Learning (ML) is strategy for self-based learning developed and implemented in the late 1960 by Bloom. Self-based represent the idea that the learner learns on its own. Bloom's strategy is based on the idea that the learner is able to learn if he/she was given the enough time he/she needs to learn this task. Essentially, in Mastery Learning the task is broken down into a set of skills and sub-skills to be translated into a set of instructional objectives.

According to Ryan and Schmidt (1979), Mastery Learning is an integrated system of instruction that includes not only procedures for identifying desired learning outcomes and for evaluation, but also (and most importantly) the process of instruction that will enhance students learning of those outcomes.

A fundamental change in thinking about the nature of instruction was initiated in 1963 when John B. Carroll argued for the idea of Mastery Learning. Mastery Learning suggests that the focus of instruction should be on the time required for different students to learn the same material. This contrasts with the classic model (based upon theories of intelligence) in which all students are given
the same amount of time to learn and the focus is on differences in ability. Indeed, Carroll (1989) argues that aptitude is primarily a measure of time required to learn.

Fig 1.1f: Basic elements of Mastery Learning Strategy

*Element 1: Define what is to be learned*

The primary task of the school is to define what should be learned, and to see to it that all students reach that level (second assumption). Here, both the student and the teacher understand and focus on the objectives.
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**Element II: Teach the material**

Initial teaching in a mastery classroom is like that of any effective teacher. Material may be presented through lectures, demonstrations, discussions, films or whatever approach the teacher finds most appropriate. The most evident features are:

♦ Goals for the lesson
♦ Teacher will explicitly let the students know that all students can learn the material well

**Element III: First formative test**

After presenting all the material of the unit, teacher gives a formative/practice test to see what the students have and haven't learned. This step provides the feedback needed and identifies the error in group instruction.

**Element IV: Learning alternatives**

Students are provided with learning alternatives. Those who had trouble with formative test will be re-taught in new ways to correct the errors of the group instruction. Those who have already mastered the material will participate in enrichment activities or help the other students.

**Element V: Second formative test (Retest)**

After the learning alternatives have been completed teacher gives a second test on the same material. Assuming that most of the students master, the class is then ready to move on to new material.

**Element VI: Summative test**

This test is designed to test student's overall learning thus far. It will tell the teacher how much students have retained.
BASIC PRINCIPLES OF MASTERY LEARNING:

➢ Ninety percent of students can learn what is normally taught in schools at an A level if they are given enough time and appropriate instruction

➢ Enough time means:
  • Time required to demonstrate mastery of objectives

➢ Appropriate instruction means

➢ Break course into units of instruction:
  • Identify objectives of units
  • Require students to demonstrate mastery of objectives for unit before moving on to other units

➢ Grades may be determined by:
  • Actual number of objectives mastered
  • Number of units completed
  • Proficiency level reached on each unit
  • Any combination of above

➢ Students can work at own pace if course is so structured, but Mastery Learning can be accomplished with group instruction.

5 Keys to success:

➢ Mastery Learning

➢ Home environment

➢ Pre-requisite enhancement

➢ Make reading automatic, beyond decoding

➢ Emphasis on creativity, higher mental processes [upper levels of the...
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Taxonomy of Educational Objectives, critical thinking, etc

**Mastery Learning is based on six (6) assumptions**

1. Mastery of content is possible for ALL students
2. Instruction must be modified and adapted, not the students
3. Some students may require more time than others to master the content (the school and teacher must allow for this time difference)
4. Most learning outcomes can be specified in terms of observable and measurable performance
5. Most learning is sequential and logical
6. Mastery Learning can ensure that student experience success at each level of the instructional process - which provides incentives and motivation for further learning

**Components of any Mastery Model**

1. Clearly defined instructional objectives – *Defining Mastery*
2. A pre assessment of the learner's present knowledge – *Planning for Mastery*
3. An instructional component with choices and options for students - *Planning for Mastery*
4. Practice, reinforcement, frequent comprehension checks, and corrective instruction at each step to keep the learner on track – *Teaching for Mastery*
5. A post assessment to determine the extent of student mastery of the objectives - *Grading for Mastery*

The tasks of a teacher on each component of Mastery Learning Strategy are as follows:
• **Defining Mastery**

**Main Tasks**

- The teacher defines precisely what is meant by mastery, which includes
- Specify long term and short term objectives
- Specification of abstract outcomes and concrete representations of these abstract outcomes

**Sub Tasks**

- Identify most essential and critical learning outcomes
- Prepare a final summative test
- Set the level of acceptable performance
- Divide the entire course content into a series of smaller learning units
- Sequence the units
- Decide the constitutes mastery for each unit

• **Planning for Mastery**

**Main Tasks**

- Prepare the plan, which includes teaching-learning activities & materials related to unit objectives
- Plan additional supplementary activities/materials for students failing to attain the performance standard on unit formative test
- Monitor student learning on a unit-by-unit basis
- Plan and design steps/measures to overcome errors

**Sub Tasks**

- Design a general plan for students to master the unit objectives
- Prepare a method for interpretation and using information of formative test
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- Develop a set of alternative instructional material and learning activities, keyed to each objective on the unit’s formative test

Teaching for Mastery

Main Tasks
- Specify what is to be learned
- Motivate students learn it
- Provide them with instructional material
- Administer these materials at a rate suitable for each pupil
- Monitor student’s progress
- Diagnose difficulties
- Give proper remediation
- Give praise and encouragement for good performance
- Give review and practice

Sub Tasks
- Provide orientation to students
- Teach each learning unit in sequence
- Administer unit’s formative test
- Announce the day on which initial instruction relative to the next unit will begin
- Analyse the adequacy of corrective instruction
- Pace the cycle

Grading for Mastery

Main tasks
- The purpose of grading is to reward students for the acquisition of essential and critical objectives

Sub Tasks
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♦ Administer a summative test

ALTERABLE ELEMENTS OF INSTRUCTION AND STUDENT ACHIEVEMENT – QAIT MODEL

A model of effective instruction (QAIT) is an attempt to identify the critical elements of schools and classroom organization and their interrelationships. This model, based on the work of John Carroll (1963; 1989), focuses on the alterable elements of Carroll’s model, those which teachers and schools can directly change (Slavin 1984; 1987; 1994). The components of this model are as follows:

1. **Quality of Instruction.** The degree to which information or skills are presented so that students can easily learn them. Quality of instruction is largely a product of the quality of the curriculum and of the lesson presentation itself.

![Diagram of QAIT Model]

- **Instructional Cues**
  - Type I: Directing the student’s effort
  - Type II: Designing the instruction
- **Participation & Practice**
  - Teaching methods
- **Feedback & Correctives**
  - Assessment for learning
- **Reinforcement**
  - Improving self-confidence
  - Improving motivation
  - Developing responsibility

The amount of instructor & P is a direct indicator of QI.
2. **Appropriate Levels of Instruction:** The degree to which the teacher makes sure that students are ready to learn a new lesson (that is, they have the necessary skills and knowledge to learn it) but have not already learned the lesson. In other words, the level of instruction is appropriate when a lesson is neither too difficult nor too easy for students.

3. **Incentive:** The degree to which the teacher makes sure that students are motivated to work on instructional tasks and to learn the material being presented.

4. **Time:** The degree to which students are given enough time to learn the material being taught.

The four elements of QAIT (Quality, Appropriateness, Incentive, Time) model have one important characteristic: *All four must be adequate for instruction to be effective.* Again, effective instruction is not just good teaching. No matter how high the quality of instruction, students will not learn a lesson if they lack the necessary prior skills or information, if they lack the motivation, or if they lack the time they need to learn the lesson. On the other hand, if the quality of instruction is low, then it may makes little difference how much students know, how motivated they are, or how much time they have. Each of the elements of the QAIT model is like a link in a chain, and the chain is only as strong as its weakest link. In fact, it may be hypothesized that the four elements are multiplicatively related, in that improvements in multiple elements may produce substantially larger learning gains than improvements in any one.

The QAIT model can be conceptualized in terms of intermediate effects on time-related variables. The QAIT Model below depicts a model of how alterable elements of instruction might affect student achievement.
In this chart, two types of independent variables are presented: Student inputs and alterable variables. Student inputs refer to factors over which the school has little control in the short run: Student aptitude (including their prior knowledge of a subject) and those aspects of motivation to learn that students bring from home (as distinct from the motivation created by classroom practices). These can be affected by classroom practices. For example, student aptitude to learn a specific lesson may be strongly influenced by background knowledge resulting from earlier instruction, by specific training in thinking, problem solving, or study skills, or by general intellectual stimulation or learning skills provided by the school. Student motivation to learn is also largely a product of past experiences in school.

Fig 1.2 f: QAIT MODEL
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However, in the context of any given lesson, the student inputs can be considered fixed, while the alterable variables can be directly altered by the school or teacher.

The effects of the alterable variables on student achievement are held to be mediated by two time-related variables: Instructional efficiency and engaged time, or time-on-task. Instructional efficiency can be conceptualized as the amount of learning per time. For example, students will learn more in a ten-minute lesson high in instructional efficiency than in a lesson of similar length low in instructional efficiency. Engaged time is the amount of time students are actually participating in relevant learning activities, such as paying attention to lectures and doing assignments. Instructional efficiency and engaged time are multiplicatively related to student achievement; obviously, if either is zero, then learning is zero.

TYPES OF MASTERY LEARNING STRATEGIES

Two prototypes of MLS emerged:

- Blooms Group based and Teacher paced model
- Keller’s Learner based and Individual paced model

BLOOMS MASTERY LEARNING MODEL

Bloom brought together the findings from research into a variety of factors concerning the relationship between students, teaching, and achievement, and developed these into general theory or model. It is important to be aware that Bloom’s model is not a psychological theory of learning, but an input-output model of learning, as shown below.
**Mastery Learning model**

Is an 'Input-Output model' - not a theory of internal psychological processes

Is a 'results-oriented' approach to teaching, rather than a 'theory-oriented' approach

Is not teaching technique – it is a structure within which a teacher designs activities to ensure high standards of student achievement.

Bloom’s Learning for Mastery strategy has evolved from within the field of education and has had a major impact at the elementary and secondary levels of schooling (Block & Anderson, 1989). It is a Group-based teacher-paced instructional situation in which the time allowed for learning is relatively fixed. Bloom’s strategy attempts to minimize the time a student needs to learn the given material. Students learn co-operatively with their classmates and the teacher controls the delivery and flow of instruction.

To provide appropriate learning conditions, Bloom (1971) outlined specific instructional strategies. In using Mastery Learning, the material to be learned is divided into small instructional units. Following instruction covering the material from each unit, a formative evaluation is done to provide feedback on the learning progress. Special corrective activities are provided to learners who have not done well and require additional time to learn the material. Following the corrective work a second formative evaluation is given as a check on the learning progress. For those who have done well, special enrichment activities are provided to
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strengthen and extend their learning. The following diagram provides a framework of Mastery Learning as proposed by Bloom (1971).

Bloom comes to the following conclusion about learning: What any person in the world can learn, almost all persons can learn if provided with appropriate prior and current conditions of learning (Bloom, 1981). Mastery Learning gives the appropriate instruction and learning resources, adequate time spent learning, and perseverance, most students can learn a particular academic skill. Bloom states that "80% of students in a mastery class reach the same final criterion of achievement (usually at the A or B+ level) as approximately 20% of the class under conventional group instruction" (Bloom, 1981). The conceptual framework includes four hypothesis:

BLOOM'S HYPOTHESES

The Mastery Learning model is based on four hypotheses proposed by Bloom. These are;

Hypothesis No 1: A normal person can learn anything that teachers can teach.

In other words, if something can be taught it can be learned by any normal person, if enough time and effort can be devoted to both the teaching and the learning of the subject matter.
Hypothesis No 2: Individual learning needs vary greatly.

People learn best when the content to be learned and the conduct of the learning activity match their individual learning styles. When the material to be learned and the activity do not match their preferences for learning in specific ways they will learn less effectively.

Hypothesis No 3: Under favourable learning conditions, the effects of individual differences approach vanishing point, while under unfavourable learning conditions, the effects of individual differences is greatly exaggerated.

The major causes of variation in student achievement are mostly man-made and not the result of unchangeable factors such as:
- Differences in IQ
- Differences in Aptitude
- Differences between Fast Learners and Slow Learners

Bloom is not pretending that such differences don't exist. What he is saying here is that these differences do not have to condemn many people to poor performance in academic attainment. If the conditions under which learning takes place are favourable to each individual, then the effects of such differences can be eliminated to a large extent.

Hypothesis No 4: Uncorrected learning errors are responsible for most learning difficulties.

Teaching which is designed to detect and correct learning difficulties as they are arising is, with all other things remaining unchanged, bound to produce superior learning than teaching which is not designed to correct errors and
misconceptions. If we build only this one element into our teaching, it will significantly improve the performance of our students.

COMPONENTS OF BLOOM’S MASTERY MODEL

Defining Mastery
♦ Formulate a set of course instructional objectives.
♦ Preparing a ‘final’ test for these objectives and determine the course mastery performance standard which a student is expected to achieve.
♦ Sequence the learning units and determine the course objectives to be covered in each unit.

Planning for Mastery
♦ Preparation of lesson plan by teacher.
♦ Developing feedback procedures.
♦ Developing a set of alternative instructional materials.

Teaching for Mastery
♦ Providing orientation to the students regarding Mastery Learning procedures.
♦ Teaching the first learning unit
  • Administering the unit formative test.
  • Identifying the non-achievers.
  • Ask them to use appropriate corrective measures to complete the unit.

Grading for Mastery
♦ Administering the summative test.
♦ Awarding ‘A’ grade to students who perform according to set standards.
♦ Competition of students is with themselves rather than with classmates.
KELLER'S PERSONALISED SYSTEM OF INSTRUCTION

Fred Keller (1968) is credited with the "invention" of the Personalised System of Instruction, which is also called the Keller system. In 1968 Fred S. Keller, J. Gilmour Sherman, and others developed a synthesis of educational methods and practices & described the procedure, which is based upon programmed learning material, through which each student proceeds at their own pace with the goal of mastering each step. The peer tutor's involvement is largely as a checker, tester and recorder, to ensure tutee mastery.

❖ go-at-your-own-pace
so students can proceed according to their abilities, interests, and personal schedules;

❖ unit-perfection requirement
which means students must demonstrate mastery of a unit before proceeding to other units;

❖ lectures and demonstrations for motivation
instead of for communication of critical information;

❖ stress on the written word for teacher-student communication
which helps develop comprehension and expression skills; and

❖ tutoring/proctoring
which allows repeats on exams, enhanced personal-social interaction, and personalized instruction

The course instructor will:
(a) Select all study material used in the course;
(b) Organize the presentation of this material;
(c) Construct tests and examinations; and
(d) Develop the lab exercises.
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Personal System of Instruction (PSI) involves some type of presentation of material, but fully implements the presentation - performance - confirmation aspects of learning. It is actually an effective implementation of other strategies (such as the lecture) that adds the ingredient of student participation and feedback to an otherwise passive student learning situation. The key factor to the success of PSI is that mastery, not the clock or calendar determines progression on to the next topic. Successful implementation implies that:

1. The presentation of information is relevant and appropriate to the student's current knowledge and skill-level (is student-centered).

2. There are frequent opportunities to test comprehension of information.

3. Confirmation is immediate.

In a PSI setting a student must master each step before moving on to the next. What is new about this strategy is how the student comes into contact with the learning content.

When PSI is most effective

PSI's are often accompanied by study guides that supplement relevant portions of the text. Quizzes and/or mastery tests should occur often, and mastery is required for progression. Goals must be clearly stated, and a proctor is available to work with students and to help the teacher with providing feedback on performance.

Hints to success:

- choose texts/media carefully
- build confidence early
- create manageable units
- build in review-types of assignments
- keep mastery tests consistent with objectives
- encourage feedback from students so adjustments may be made
The course is carefully divided into topics/units. At the start, the student receives a printed study material/guide to direct work on the first unit. This guide introduces the unit, states objectives, suggests study procedures and lists study questions. Before moving on to the second unit in the sequence, student must demonstrate mastery of the first by perfect/near-perfect performance on short examination. Students are examined on unit only when they feel adequately prepared. When the student demonstrates mastery of the first unit, the student receives the study guide for the next unit. Students thus move through the PSI courses at their own rates.
Therefore, Keller plan is:

- **Mastery oriented,**
- **Individually paced courses that use**
  - A few lectures to stimulate and motivate students
  - Printed study guides to communicate information
  - Student proctors to quiz evaluation and one-to-one tutoring.

**STEPS FOR PREPARING PSI PROGRAMME**

**Defining Mastery**
- Operationally defined as perfect performance on a particular number of units by a certain point of time.
- Pre-defining course objectives and the sub-dividing these into a number of learning units.

**Planning for Mastery**
- A set of procedures are developed by which the students master the unit’s objectives. These include:
  - A list of unit’s objectives.
  - Suggestive set of study procedures.
  - A set of questions, and
  - A set of test items.

**Teaching for Mastery**
- The basic features of PSI are presented.
- Units are taught using individual methods, reading is the mode used by the students.
- At the completion of unit, a formative test is given.
- The test, restudy, retesting cycle continues until the student achieves mastery.
Grading for Mastery

- The nature and form of grading depends on the fact that whether the students' performance will be tested only through unit tests or they will be given a final test also.
- The students can be termed as masters or non-masters.

IMPLEMENTATION OF MASTERY LEARNING STRATEGIES

- The Bloom's group-based-teacher-paced Mastery Learning Strategy is for students who are well-prepared and master quickly, group-pacing means that they will spend time doing enrichment activities, as well as helping other students who haven't mastered in the class where the teacher is the master.
- Individualized learning or Keller’s Individual-based-learner-paced, on the other hand, means that all students are taught in one style (usually through a programmed or highly structured set of materials) and are allowed to proceed at their own rates. This means that students with stronger entry characteristics and/or students who learn well independently end up learning far more than their classmates.
- Both these strategies were integrated in the present study by making use of computer as a medium of instruction. An Eclectic Model of Mastery Learning (a Blend of Bloom’s Strategy and Keller’s plan) was implemented through computers.

IMPLEMENTING MASTERY LEARNING THROUGH CAI

COMPUTER ASSISTED INSTRUCTION

Use of computer assisted learning (CAL) in education has burgeoned in recent years (Price, 1991; Nelson & Polumbo, 1992; Hawledge, 1995; Hong,
Young & Lin, 1996). Faced with increasing class sizes and heavier work loads, teachers are looking towards CAL as a means of supplementing class room instruction.

Technology has helped to improve the quality and pace of activity as well as production in most aspects of human endeavor. Computer is one of the most important and powerful impact in the fields of science and technology. Computers are being used in areas of transportation, communication, national defence, food and material production, scientific research and education all over the world.

Broadly speaking, CAI is the use of a computer to interact directly for presenting lesson content and testing student's progress. Because of computer's flexibility and capacity to provide branching instruction, it can assume the guidance role of a potential teacher or instructor, while also providing students with necessary reference material, simulated lab facilities depending upon the capabilities of computers and terminal used by the students. Some of the applications of CAI are to display lesson material, provide drill and practice, reinforce learning, simulate environmental conditions display a relevant stimuli and administer tests.

Computer-assisted instruction (CAI) is an interactive instructional method that uses a computer to present material, track learning, and direct the user to additional material which meets the student’s needs. It can also be used to describe Internet based instruction through the use of webpages, web bulletin boards, listservs and newsgroups, video and real audio, graphics, and hands-on applications. Additionally, self-teaching programs on CD-ROM or the emerging DVD round out the group of available forms of CAI. (Bucholtz 1988)

CAI is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. It is
also known as computer-assisted learning (CAL), computer-based education (CBE), and computer-based training (CBT). CBT allows the students to direct his/her own progress. (Fourie 1999)

FORMS OF COMPUTER-ASSISTED INSTRUCTION

Computer-assisted instruction makes use of multimedia software in the learning process including text, video technology, graphics, sound, and Internet technology. Computer-assisted instruction is heavily used in the growing field of distance education. Traditionally, computer-assisted instruction, like programmed instruction, has been linear in nature. Web based instruction on the other hand is nonlinear. (Lawson 1999)

The antecedents to 20th century Programmed Instruction are not well defined. The rhetoricians of democratic Athens in 400 B.C., and later the catechumens of the Middle Ages, approached an early counterpart to the small steps, sequential instruction, and question-and-answer pattern of 20th century. PI, however, is basically a 20th century phenomenon. In its current forms, its history comprises only 30 years. However, significant contributions were made by Sidney L. Pressey as early as 1915 in his efforts at the Ohio State University to build a simple machine for testing comprehension of material that had been taught. These crude machines presented multiple-choice questions to users while providing immediate knowledge of their results. Only later did Pressey conceive of their usefulness as instructional devices. It is important to note that these early teaching machines represent what Pressey called adjunct auto-instruction i.e. the use of test questions presented after conventional instruction. (Hartley and Davies, 1972) This means that the machines were not integrated into the instructional material; rather, they were added to (or adjunct to) traditional instruction (usually text), much the same as adjunct questions. However, the seeds of PI had been sown.
Skinner's Linear Programming

Modern PI is normally associated with B. F. Skinner, the Harvard behavioral psychologist. While there were a number of programmed precursors to Skinner's method of programming, it was his influence which created the PI phenomenon of the 1950's and 1960's. His involvement is usually traced to his famous 1954 professional address, "The Science of Learning and the Art of Learning," in which he decried the traditional classroom instruction as being too aversive, too large, too negative, and improperly sequenced. His solution to these problems was linear programmed instruction. Unlike Pressey's "adjunct" programming, designed to supplement regular course study, Skinner's linear teaching programs were designed to replace traditional courses of study i.e. to function as an instructor for users with no prior knowledge of a subject. Skinner's PI required the user to construct an answer by filling in a blank with the correct response, rather than to select one of four options as correct as in Pressey's machine. Filling in a blank is a recall type of learning because the user has to recall the answer from memory rather than merely recognizing it as in multiple choice. After filling in the blank, the user compares his or her answer with the correct one. Students work one step at a time, from simple to hard, they work at their own pace, and they are frequently reinforced for their responses. The most frequent complaints against the Skinnerian form of linear programming were that it was boring and monotonous, especially for capable users and that the level of learning being supported was rote and meaningless.

Crowder's Intrinsic Program

Norman Crowder, a contemporary of Skinner, was working independently for the armed services on programmed instruction. He felt that a program was a form of communication between a programmer and a user. Like any communication, the program must be directed to the individual. In an intrinsic or
branching program, each frame presents more text than the average linear frame. After reading, the user responds to an adjunct question, usually in a multiple-option format. Unlike Pressey’s auto-instructional approach, which provides only confirmation of the correctness or incorrectness of that response, branching style optional choices lead users to optional forms of feedback, most of which is corrective. If the user makes a correct response, the program asserts the reasons why she or he was correct and moves on to new material. If an incorrect response is made, the program, at the very least, informs the user that an error was made and then branches the user back to the previous frame for another try.

Depending upon the complexity of the error committed, the program may initiate a remedial sequence of instruction, a practice designed to eliminate the learning deficiency. The term intrinsic refers to the fact that all program options are intrinsic to the program and, therefore, not dependent on any external programming device. This approach is especially adapted to machine presentation, which provides for greater levels of adaptability. The primary difference between Skinner’s conception of programming and Crowder’s is in the function of the response. To Skinner, learning results from making the correct response. Contrary to this response orientation, Crowder believed that learning results from the realignment of the user’s knowledge structure, and that the response is simply a means for controlling the program or machine. The larger chunks of information need to be assimilated and integrated with what the user already knows. The response, he believed, tests the level of integration. This type of programming benefits the higher-ability user, who is more capable of higher-level integration of ideas, more than it does the lower-ability user.

**Shifting Concerns**

The emphasis in programmed learning began to change during the 1960’s from concern with what users do to concern for the process of constructing PI.
The early enthusiasm for the potential of PI was waning. With PI no longer perceived as a panacea and, therefore, the automatic medium of choice when one is faced with learning problems, proponents were forced to justify its use based upon an analysis of learning needs and the nature of the content. They began to rely more on instructional systems development processes, including statements of objectives, task analysis, evaluation, and revision (Hartley and Davies, 1972). The process of creating programs was being applied to alternative media, such as slides, filmstrips, and instructional television. The design questions were more sophisticated. Various methods for sequencing PI were being investigated. PI was just turning into a true technology as it began to fade from prominence.

The Declining Years

The popularity of PI reached its zenith in the mid-1960's but declined steadily through the 1970's. This decline in popularity is attributable to a variety of recognizable and other somewhat vague reasons. Three primary reasons were

- The nature of the material and processes,
- The higher publishing costs, and
- The attitudes of teachers.

Programmed materials were perceived as boring often because of the way in which they were used. Also, their success was largely predicated on users' adequate reading ability, which notably declined during the same period. On the economic side, programmed materials were more expensive to produce because of their nonstandard typography. Because of lower sales, the development costs could not be spread out, forcing up the unit cost of programs, which further depressed their sales.
It wasn’t until the latter 1960’s, when a corpus of research became available which indicated that PI was most effective as a supplement to normal instruction. Concurrent to PI’s decline, the newest bandwagon in education, computer-assisted instruction, was gathering steam. This technological focus only accelerated the apparent demise of programmed instruction. Yet PI never really disappeared. Rather, it was transformed into new issues and technologies that dominated attention in the 1970’s and 1980’s.

Programmed learning is nowhere near extinction. Its dinosaurs consist of the linear-programmed texts and teaching machines that occupied classrooms and school libraries in the 1960’s. Gone also are the scrambled books. However, many programmed texts and teaching materials are still consistently used in the military, in industrial and management training situations, and in distance education projects. More importantly, the principles of programmed learning continue to contribute to educational technology in a variety of forms.

Programmed instruction represents a model of how instruction should occur. Nowhere is this model more consistently applied than in computer-assisted instruction (CAI). Even though PI and CAI were developing independently in the 1960’s, the instructional sequences and techniques of the former were borrowed by the latter. While PI (in its traditionally identifiable form) has declined in popularity, CAI is in big demand. Its continued development has been fueled by the explosion of microcomputers in the 1980’s and 1990’s. The visual and auditory embellishments afforded by the graphics and sound capabilities of microcomputers make the reinforcement of drill and practice programs initially more desirable, and the programs are able to keep records on a user’s performance, but the fundamental instructional model is that of PI.
Another popular form of microcomputer courseware is the **tutorial mode**, which replicates on the screen branching programmed instruction. The computer's program presents some information followed by questions on the screen, and, based upon the response, branches the user to alternative parts of the program. These programs, like intrinsic PI, may confirm the correct response, remediate an incorrect one, or move the user forward or backward in the program stream. Also, a number of authoring systems are available to help computer courseware authors circumvent the need for computer-language proficiency.

It is only when you find simulation or problem solving types of courseware that CAI escapes the conceptual boundaries of PI. So, computer-based learning systems represent the latest reincarnation of PI in some ways. The difference between most CAI and PI is in the form of instructional delivery, the former electronic and the latter print. As the capabilities of computers are further exploited, CAI and PI are destined to diverge. However, for the present, we see evidence of programmed learning principles in numerous educational endeavors.

As stated above, the roots of computer-assisted instruction can be traced back to programmed instruction. The key concepts of programmed instruction (tutorials, management, general enrichment, drill and practice, programming, and simulation programs) are present as well in CAI. When computers were first commercially presented in the 1950's, programmers had to work around the slow speed and small memory of the computer, with limited applications. As technology increased, the next phase of computer software came in the 1980's making computer applications easier to use for the consumer. In 1993, Glenn R. Jones established the first Virtual University offering bachelor's and master's degrees totally over the Internet and was accredited by the North Central Association of Colleges and Schools (NCA) (Helfer 1999). In the 1990's, with
computer speed and power much greater than ever before, the computer's role as a "trainer" has been greatly expanded.

On the horizon currently is intelligent computer-assisted instruction (ICAI), which makes use of artificial intelligence. This software actually adapts to the individual needs of the student. ICAI works by gaining relevant information about the student’s background and knowledge of the subject and then creating a profile of the user. Several CAI applications are being developed currently including an intelligent multimedia tutoring system that teaches the use of hospital emergency room equipment, one that teaches students how to create broadcast news reports, and another that allows students to develop computer simulations for lifelong learning (Moursund 1998).

UNIQUE CHARACTERISTICS OF COMPUTER-ASSISTED INSTRUCTION

There are numerous unique features of CAI which make it an exciting field.

- One of the most useful characteristic is its adaptability for distance learning. Before the dominance of microcomputers, distance learning was mostly accomplished through PI or the US mail system supplemented by telephone contact. On the contrary, CAI provides regular and timely interaction with the instructor and current feedback. Students can repeat tutorials as often as needed and work at their own pace. CAI also can be used with greater numbers of students than a traditional classroom would hold. CAI and web-based instruction have opened avenues of access to individuals with disabilities that were not possible before.

- Intelligent computer-assisted instruction (ICAI) is programmed so that the CAI adapts to the student's individual needs. It acquires information about
the student's current knowledge of a subject and his/her goals in learning the subject and then creates a user profile based on this knowledge. It can then adjust itself to the individual student (Moursund, 1998).

- Web-based instruction is unique in that students and/or instructors can communicate with each other anywhere in the world within seconds via the Internet. Feedback from the instructor can be obtained immediately.

- Children differ widely in their abilities. They work at different rates and with different levels of accuracy and comprehension. So, CAI has an ability to provide individualized instruction. The computer assisted instruction whilst simultaneously handling many students, can allow each to proceed at his own pace and level of achievement.

- Computer assisted learning therefore is concerned with the use of computers to mediate in the flows of information in the learning process. There may be flows between the learner and the factual information that he/she must absorb, feedback from the learner on his or her progress, information about a model with which the learner is working or flows between the learner and his/her tutor or instructor.
The levels of instruction between student and the computer in a CAI system are:

- **Drill and practice**: The computer is used to present the learner with a series of exercises, which he/she must complete by giving some response - An answer. It processes the response and provide the learner with some feedback as congratulatory message if right, or corrective comment, if wrong.

- **Tutorial**: All serried students learn in their own way and at their own pace. The student is presented with material via a dialogue in which information is presented and feedback is elicited through a process of question answer and challenge.
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- **Simulation**: Both drill and practice and tutorial modes operate by providing information in a structured way, according to rules specified by tutor.

- **Modelling**: Help the student to learn by working with an analogue of a real life system or phenomenon, expressed as a set of rules in the computer.

- **Interactive knowledge-based systems**: It comprises a descriptive model of knowledge relating to a particular topic, system or situation.

- **Information seeking**: The power of computer to store, retrieve and process information is used to help the student as he/she browses through the material, responding to questions about related information, retrieving items needed and summarizing statistical data.

**The advantages of CAI include**

- Flexibility for students so that they can work at their own speed at the time that is best for them. With web-based instruction, they can work at home, at school, or anywhere there is a computer with an Internet connection.

- Used with distance learning, it allows students with handicaps or learning disabilities the opportunity to learn in a less restrictive environment. Also, students who enroll in courses via CAI, including web-based classes, gain an opportunity to learn computer skills, which benefit them in many aspects of their lives.

**There are some disadvantages of Computer assisted instruction viz**

- The need to own or have access to a computer with the necessary RAM and operating system, lack of computer skills of many students, physical problems such as carpal-tunnel syndrome and eye disorders (caused by sitting in front of the computer screen for long periods of time without...
blinking), prohibitive cost of educational software, and the lack of human interaction in the learning process (Fourie, 1999).

- It is imperative that the computer-assisted instruction software be designed well from the start. CAI must bridge different learning styles to be fully effective; therefore, it should offer different types of examples and ways to solve problems. (Fourie, 1999) Instructors and students using and web-based learning must be sure to give frequent feedback. Delays in communication may actually hinder students' success in comprehending the material.

- Another approach is to combine the traditional classroom with CAI or the Internet. Studies have shown that combining technology with the standard classroom approach actually improves student performance (Christmann, 1997).

**USING CAI & WEB-BASED INSTRUCTION**

Computer-based instruction has been used for several years especially in independent study and distance learning.

- It builds on the history of programmed instruction. It may be in the form of tutorials, simulation situations, or drill and practice (Moursund, 1998). It may be embedded in any computer application, such as Word 1997 & 2000, Excel 1997 & 2000, and many graphics packages. Intelligent computer-assisted instruction (ICAI) adapts to individual learning needs by forming a model based on the student's progress in the CAI program.

- To use any CAI (including web-based), the student must first obtain a general knowledge of how to work the hardware and software. Students need to learn to navigate the mouse by practicing or "playing" games on the computer to develop skill with the peripheral device. To avoid
"technostress," students should not try to learn everything about the computer all at once. Whereas PI conducts interactive question and answer prompts, CAI and web-based instruction can ask open ended questions with the intent being to challenge the student further as well as use the knowledge to create deeper learning. To create deeper learning, students must:

1. Understand the material and see how the concepts fit together.
2. Combine the information in their own minds.
3. Apply the information in a useful way.
4. Receive feedback.
5. Act on the feedback (Dewald 1999).

In the 1980s, the rapid developments in computing and information technologies began to create a new paradigm of learning. This new paradigm characterised by the design, storage and distribution of instruction in interactive, multimedia, flexible and effective ways. Reviewing the literature showed that no medium was captured educators’ attention like computer ever. Heinich et al. (1993) set out many of the interactive capabilities of the computer that gave it popularity at that time. For example,

- Allowing students to learn at their own pace;
- Personalised feedback learner actions;
- Effectiveness with special learners.

As a learning device, the computer has a number of outstanding possibilities to communicate, support and control other devices. For example (Barker, 1985), computers can:

1. Facilitate data archival, retrieval and dissemination;
2. Offer a variety of data-capture techniques;
3. Facilitate control of external devices and of learning progress;
4. Handle text facilities;
5. Generate sounds and graphical effects.

As delivery medium, the development in storage devices has led to a significant impact on the use of computers in distance education programmes (Jones and Kirkup, 1992). The high capacity of CD-ROMs and the availability of CD-ROM drives in most students' machines have encouraged designers to store an enormous amount of text, graphics, audio and even full-motion in a single CD-ROM, and distribute courses to students at homes (McIsaac and Gunawardena, 1996).

With this approach, the learner relies on the programme and the help topics provided with the software. Some designers offer a help-line using telephone or other kind of communication to establish a personal interaction with the learner. In many cases, the courseware can be modified for the learner's needs, assess the learner's performance and provide feedback and guidelines.

Courseware packages range from static electronic pages - show the content (e.g., text, images and audio) as an electronic book with a passive role for the learner - to intelligent courseware capable of dealing with the learner individually and involving him/her in a real learning environment respond to his needs and problems. Swann (1997) indicated that:

- Different educational computer packages allow different levels of interaction;
- There is variation in the quality of presentation;
- There are differences in the accessibility of information and the depth and quality of information presented.
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However, although the literature has discussed far more advantages in using computers in education than disadvantages, many disadvantages were reported as well. The main issue reflected in the CAL literature is the doubt about the effectiveness of CAL programmes.

First, Morse (1991) believes that evaluating the effectiveness of computer in learning is not an easy task since it depends on many variables (e.g., quality of design and development and type of use). In this regard he argued that:

‘A major problem in evaluating the results of studies designed to measure the value of CAI is the elusive factor of the quality of the software used in the study. Not only should the software be well designed, but there also must be a match between the objectives of the software (or courseware), the understanding of the teacher as to how to apply it, and the needs or interests of the students’ (Morse, 1991).

Roblyer (1989) reviewed 38 studies and 44 dissertations in CAL (between 1980 and 1987) focused on the impact of microcomputer use in specific areas and with specific kinds of students. He calculated effect sizes for each study, summarised them across studies and compared them in a number of areas. He examined the effectiveness of computer at certain grade levels, with certain types of content, with certain types of students and in students’ attitudes. He concluded that ‘an overall finding was that computer applications had a statistically significant positive effect (p < 0.05) in a majority of the areas examined’ Roblyer (1989).

According to Mills and Ragan (1994), classrooms of the next century will be significantly affected by emerging technologies and the development of new instructional delivery systems. However, research on CAL needs to move at a quicker pace in order to provide more clearly a direction for schools and a framework within which teachers can operate.
According to Alexander, educational research (1992) does not move forward at a measured pace. Rather, it is marked by periods of high activity within focused areas followed by periods of introspection and, possibly, reconceptualization.

Initial studies investigating CAL focused on the benefits of computer instruction as compared with traditional forms of presenting content (Schlechter, 1991). It was thought that the computer would save time, students would be more motivated to achieve, and the computer would have the inherent power to accommodate individual differences (Schlechter, 1991). Although CAL appears to have potential for providing a variety of learning environments for students, there are limits to what the technology can do. Clark (1982) writes that most of the studies conducted from 1962 to 1982 have shown no significant differences in achievement levels to exist between students learning from the computer and those who learn from teacher-directed lessons. These findings are consistent with subsequent results found by Day (1984) and Gaston (1988).

Recently, studies examining individual differences and CAL have uncovered some of the reasons why computers have had limited success as educational tools. Research indicates that learning styles, motivation, level of domain knowledge possessed, and attitudes can impact the effectiveness of CAL sessions (Keller, 1968; Butler, 1984; Gregorc, 1985; Nelson & Palumbo, 1992; Stanton, Taylor & Tweedie, 1992).

Collins and Muir (1984) write that the changes to the school system initially anticipated by computer enthusiasts did not materialize, due in part to inadequacies which existed in software. Unfortunately, many of the current educational software packages do not adhere to sound instructional design principles, a factor that could have serious effects on student learning (Jones, 1989; Wallace & Anderson, 1993).
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When planning for instruction, many educators take into account individual differences in terms of knowledge levels, learning preferences and abilities possessed by students. It can be more difficult for the computer to do the same, as the machine is at 'the mercy' of the CAL software that has been created for it; and, according to Shneiderman (1988) 'Designers of interactive systems have had to work from their own experience and intuition...'. This can be quite disconcerting for many educators who have neither the time nor the expertise to evaluate all educational software packages before purchase. Hence, many teachers are forced to take a 'shotgun' approach when selecting software packages.

Although software continues to improve, some believe that today's educational computer programs are akin to 'Edutainment' (Saddy & Watson, 1996), a term used to describe the merging of entertainment and education. Saddy and Watson (1996) report that many of the current educational software packages stimulate the right side of the brain (responsible for image processing) more so than the left side (responsible for language processing and higher-order reasoning). Children may become overwhelmed by the visually appealing images and neglect to learn anything of substance. According to the authors of the report: '...heavy use of multimedia may be building a generation of children who are deficient in left-brain skills such as language processing.

While it is not the intent of this study to find fault with CAL, one of the main areas under investigation is the ability of CAL to accommodate learners who have individual instructional needs. Sparked by the increasing number of schools that are using CAL to augment (and in some cases replace) certain elements of classroom instruction, it has been only recently that education has begun to evaluate critically the computer as a learning medium. Studies examining the effects of individual differences on human-computer interaction have shown that CAL and computer technology in general may not accommodate all learners equally (Butler, 1984; Gregore, 1985; Nelson & Palumbo, 1992; Carver,
Howard & Levelle, 1996; Ellis, 1996). Students with certain preferred learning styles seem to fare better with computers than others. It was with this background and intention that Mastery Learning Strategy was proposed to be implemented through Computers and use the benefits of both CAI and ML models.

**APPROACHES TO LEARNING**

In the last twenty years, this line of inquiry, (in which the idea of styles emerges as secondary to a larger preoccupation with approaches to learning) has been pursued by many researchers working in a variety of countries. The research has looked at thousands of students studying in over 40 disciplines. Repeatedly, it has found fundamental patterns in studying and learning behavior as it actually occurs within the contexts of university education. Probably the most influential finding of the original experiments, the researchers say, was what they describe as an obvious aspect of learning virtually ignored by earlier research. And that was the fact that many students did not get the point of what they were reading **simply because they were not looking for it.** Pask (1976) wrote of holistic and serial approaches to learning, Baird and White (1982) of contextual rationalisation and task directed learning and Flavell (1976) of metacognition. Each of these approaches essentially identifies the extent to which students reflect and attempt to attach meaning to what they are learning.

**3P MODEL OF LEARNING**

The "3P" systems model of teaching and learning identified three components of student learning - presage, process and product - which interact to form a stable equilibrium (Biggs, 1987). Students' approach to learning is in this view a function both of student-related factors such as prior knowledge and experience, ability, preferred learning style and expectations, and of the teaching...
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environment, including assessment. Thus, when exposed to a particular context, the students are differentially responsive to the teaching context factors such as curriculum, teaching and assessment methods, and institutional provisions and restraints, according to their perceptions of the teaching context (Ramsden, 1984, 1988; Biggs, 1987; Entwistle, 1988; Meyer and Muller, 1990; Meyer, Parsons and Dunne, 1990).

Hence, in the actual learning situation, students develop a context-specific *study orchestration* in response to the perception of the requirements of the learning context (Meyer et al., 1990). Among all the contextual factors,
assessment has been demonstrated to have a powerful effect on the learning process (Entwistle and Ramsden, 1983; Newble and Jaeger, 1983; Entwistle and Marton, 1984; Crooks, 1988; Heywood, 1989; Boud, 1990).

**Student factors** are relatively stable learning related characteristics which include conceptions of learning, prior knowledge, motivation, work habits, study skills, abilities, locus of control orientation, perceived self efficacy, learning style and social & cultural factors. Teaching factors include conceptions of learning and teaching, teaching styles and methods, curriculum organization, task difficulty, assessment procedures, time available, freedom allowed, classroom management, resource materials and the classroom climate.

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**Fig 1.6 COMPONENTS OF 3P MODEL**
Introduction

Process factors are the result of interaction between student and teaching presage factors and refer to the way the students handle the learning task by adopting suitable learning approaches: surface, deep and achieving. Deep is defined as learning approach characterized by an intention to seek the meaning of the material to elaborate and transform it. In Surface approach, material being studied is reproduced using routine procedures. An Achieving approach, in which intention is ego enhancement or excelling in organized activities and cue-seeking behaviour.

Product factors are the outcomes of learning and are determined mainly by the approaches to student learning. Outcomes may be categorized quantitatively (how much is learned), qualitatively (how well it is learned) and institutionally (relating to either quantitative or qualitative outcomes or both).

Marton and Saljo (1976) in their seminal work asked students to read extended passages from academic articles. The students were then asked about the content of what they had read and how they had read it. From this experiment Marton and Saljo distinguished between deep and surface approaches to learning. There are two interpretations of approaches to learning. It can refer to the process adopted prior to the outcome of learning or, it can refer to pre-dispositions to adopt particular processes, which is what is meant when students are asked by questionnaire how they usually go about learning (Biggs, 1987).

Biggs (1987) developed the Study Process Questionnaire (SPQ) to study tertiary learning and documented the deep, surface and achieving approaches to learning. In its original conception, Biggs (1987) identified student approaches to
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studying as comprising two elements of motive and strategy. He identified 3 approaches to learning, each with a corresponding motive and strategy.

![Diagram showing Bigg's Conception of a 6-factor structure in student's approaches to learning]

**Fig 1.7 F: Bigg’s Conception of a 6-factor structure in student’s approaches to learning**

**THEORY BEHIND THE 3P MODEL**

A student’s approach to learning has two components:

1. How the student approaches the task (strategy)
2. Why the student wants to approach it (motive)

There are three common approaches to learning:

- Surface Approach
- Deep Approach
- Achieving Approach
Achieving Approach

- **Surface Approach**: The motive here is extrinsic; it is to carry out the task because of either positively or negatively reinforcing consequences. The student is willing to engage in learning tasks and pass minimally either because life will be even more unpleasant if he does not, or because he/she wishes to gain a paper qualification with minimal trouble or effort. Surface motivated students focus on what appear to be the most important topics (as defined by examinations) and aim to reproduce them. Because of this focus, they do not see interconnections between elements, or the meanings and implications of what is learned.

- **Deep Approach**: The deep motive is based on intrinsic motivation or curiosity; the strategy arising from curiosity is to seek meaning. When a deep approach is adopted, there is a personal commitment to learning, which means that the student relates subject material to personally meaningful contexts or to existing prior knowledge, depending on the subject concerned. Deep processing involves processes of a higher cognitive level than rote learning - searching for analogies, relating to previous knowledge, theorising about what is learned, and deriving extensions and exceptions.

- **Achieving Approach**: Whereas the deep motive is focused on the process, the achieving motive is similar to the surface approach in that it is focused on a product, in this case the ego trip that comes from obtaining high grades and winning prizes. The general strategy is thus to maximise the chances of obtaining high marks. While this may lead to optimal engagement in the task (as does deep strategy), such engagement is the
means, not the end (unlike deep strategy); the nature of the engagement really depends on what earns the most marks.

Table 1.1 Motive & strategy in Approaches to Learning and Studying

<table>
<thead>
<tr>
<th>Approach</th>
<th>Motive</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Approach</td>
<td>To meet requirements minimally</td>
<td>Reproductive</td>
</tr>
<tr>
<td>Deep Approach</td>
<td>To actualize interest and competence</td>
<td>Meaningful</td>
</tr>
<tr>
<td>Achieving Approach</td>
<td>To obtain higher grades</td>
<td>Behave as model student</td>
</tr>
</tbody>
</table>

Table 1.2 Defining Features of Three Approaches to Learning:

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deep Approach</strong></td>
<td>Knowledge Transforming</td>
</tr>
<tr>
<td></td>
<td>➢ An intention to understand material for oneself</td>
</tr>
<tr>
<td></td>
<td>➢ Vigorous and critical interaction with knowledge content</td>
</tr>
<tr>
<td></td>
<td>➢ Relating ideas to one’s previous knowledge and experience</td>
</tr>
<tr>
<td></td>
<td>➢ Discovering and using organizing principles to integrate ideas</td>
</tr>
<tr>
<td></td>
<td>➢ Relating evidence to conclusions</td>
</tr>
<tr>
<td></td>
<td>➢ Examining the logic of arguments</td>
</tr>
<tr>
<td><strong>Surface Approach</strong></td>
<td>Information Reproducing</td>
</tr>
<tr>
<td></td>
<td>➢ An intention simply to reproduce parts of the content</td>
</tr>
<tr>
<td></td>
<td>➢ Ideas and information accepted passively</td>
</tr>
<tr>
<td></td>
<td>➢ Concentrating only on what is required for assessment</td>
</tr>
<tr>
<td></td>
<td>➢ Not reflecting on purpose or strategies</td>
</tr>
<tr>
<td></td>
<td>➢ Memorising facts and procedures routinely</td>
</tr>
<tr>
<td></td>
<td>➢ Failing to distinguish guiding principles or patterns</td>
</tr>
<tr>
<td><strong>Achieving Approach</strong></td>
<td>Intention to obtain highest possible grades</td>
</tr>
<tr>
<td></td>
<td>➢ Organise time and distribute effort to greatest effect</td>
</tr>
<tr>
<td></td>
<td>➢ Ensure conditions and materials for studying appropriate</td>
</tr>
<tr>
<td></td>
<td>➢ Use previous exam papers to predict questions</td>
</tr>
<tr>
<td></td>
<td>➢ Be alert to cues about marking schemes</td>
</tr>
</tbody>
</table>
While at any given time Surface and Deep approaches are mutually exclusive, an Achieving approach may be linked to either. Surface-Achievers systematically learn selected details by memorization to obtain high grades. Deep-Achievers, who often are the better students, are organized and they plan their search both for meaning and for high marks. Ramsden (1985) notes that whilst a surface approach will inevitably lead to poor understanding, and a deep or achieving approach to a high level of understanding this should not be extended to the view that a surface approach is necessarily adopted by weaker students and a deeper approach by highly competent ones. The approaches to learning are not necessarily mutually exclusive. Students may adopt different approaches according to the task, the course or the teaching context. In this sense teachers have a direct and powerful impact on the learning outcomes of their students. Similarly, a desire to understand at a deeper level of itself, will not necessarily give rise to this outcome as students differ in terms of their cognitive development, Perry (1970); their perceptions of the course or task itself, Meyer, Parsons and Dunne (1990) previous experience which they bring to the task, Entwhistle and Ramsden (1983); and their perceptions of the assessment demands of the subject, Thomas (1986) cited in Entwhistle and Entwhistle (1991)

There are two main influences on the student’s development of a certain learning approach: personal factors and the teaching context

1. On the personal side, some factors in the student’s background or personality seem to be associated with a Surface Approach and others with a Deep Approach.

2. On the teaching side, time pressures, stress from exams, and standardized tests encourage a Surface Approach.
Simply stated, deep learning involves the critical analysis of new ideas, linking them to already known concepts and principles, and leads to understanding and long-term retention of concepts so that they can be used for problem solving in unfamiliar contexts. Deep learning promotes understanding and application for life. In contrast, surface learning is the tacit acceptance of information and memorization as isolated and unlinked facts. It leads to superficial retention of material for examinations and does not promote understanding or long-term retention of knowledge and information. Critical to our understanding of this principle is that we should not identify the student with a fixed approach to learning, but it is the design of learning opportunity that encourages students to adopt a particular approach.

The deep and surface approaches to learning were confirmed by other studies in a number of different countries, e.g., Hounsell (1984); Morgan, Taylor and Gibbs (1982) and Ramsden (1979, 1984) in the United Kingdom, Watkins (1983) in Australia and Van Rossum and Schenk (1984) in the Netherlands. Ramsden (1979) identified a third approach which he called a strategic approach.

The defining features of the three approaches to learning are summarised in the following table compiled from the work of Biggs (1999), Entwistle (1988) and Ramsden (1992) provides some very valuable characteristics of the approaches and illustrates the importance of how we manage the curriculum impacts on the learning process. For example, clearly stated academic aims, opportunities to exercise some choice and well aligned assessment strategies that help students to build confidence can be found among the factors identified as encouraging a deep approach.
Table 1.3 Compares the characteristics and factors that encourage Deep and Surface Approaches to learning. (Compiled from Biggs (1999), Entwistle (1988) and Ramsden (1992))

<table>
<thead>
<tr>
<th>Deep Learning</th>
<th>Surface Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition:</strong></td>
<td>Accepting new facts and ideas uncritically and attempting to store them as isolated, unconnected, items.</td>
</tr>
<tr>
<td>Examining new facts and ideas critically, and tying them into existing cognitive structures and making numerous links between ideas.</td>
<td></td>
</tr>
<tr>
<td><strong>Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>• Looking for meaning.</td>
<td>• Relying on rote learning.</td>
</tr>
<tr>
<td>• Focussing on the central argument or concepts needed to solve a problem.</td>
<td>• Focussing on outwards signs and the formulae needed to solve a problem.</td>
</tr>
<tr>
<td>• Interacting actively.</td>
<td>• Receiving information passively.</td>
</tr>
<tr>
<td>• Distinguishing between argument and evidence.</td>
<td>• Failing to distinguish principles from examples.</td>
</tr>
<tr>
<td>• Making connections between different modules.</td>
<td>• Treating parts of modules and programmes as separate.</td>
</tr>
<tr>
<td>• Relating new and previous knowledge.</td>
<td>• Not recognising new material as building on previous work.</td>
</tr>
<tr>
<td>• Linking course content to real life.</td>
<td>• Seeing course content simply as material to be learnt for the exam.</td>
</tr>
<tr>
<td><strong>Encouraged by Students</strong></td>
<td></td>
</tr>
<tr>
<td>• Having an intrinsic curiosity in the subject.</td>
<td>• Studying a degree for the qualification and not being interested in the subject.</td>
</tr>
<tr>
<td>• Being determined to do well and mentally engaging when doing academic work.</td>
<td>• Not focusing on academic areas, but emphasising others (e.g. social, sport).</td>
</tr>
<tr>
<td>• Having the appropriate background knowledge for a sound foundation.</td>
<td>• Lacking background knowledge and understanding necessary to understand material.</td>
</tr>
<tr>
<td>• Having time to pursue interests, through good time management.</td>
<td>• Not enough time / too high a workload.</td>
</tr>
<tr>
<td>• Positive experience of education leading to confidence in ability to understand and succeed.</td>
<td>• Cynical view of education, believing that factual recall is what is required.</td>
</tr>
<tr>
<td>• Positive experience of education leading to confidence in ability to understand and succeed.</td>
<td>• High anxiety.</td>
</tr>
</tbody>
</table>
During the past twenty-five years educational researchers have predominantly used the phenomenographic approach to investigate the relationship between the learners' approach to studying and their level of understanding. The principles of this conceptual framework are that an understanding of the phenomenon of learning should be sought through examining the learners' experiences and should involve the actual context and situation that people learn with, that is a 'naturalistic' setting (Marton and Entwistle 2001).

The results of these studies have suggested several descriptions of the deep and surface approaches. Ramsden (1988) has summarised the aspects evident in the learner, according to each approach. Firstly, the deep approach correlates with an intention to understand. Specifically there is a focus on what is signified, for example the author's arguments; there is the occurrence of relation and distinction
between new ideas and previous knowledge; the relation of concepts to everyday experience; the organisation and structuring of content and an internal emphasis on learning, including the idea that learning helps the learner construct their view of reality. These aspects suggest a subject focused approach with learning having an intrinsic value for the learner.

Whereas the surface approach is related to aspects marked by an intention to complete the task (or learning) requirements. Specifically there is a focus on the 'signs' such as the text itself and on discrete elements, along with the memorisation of information and procedures for assessment. Also evident is the unreflective association of concepts and facts; a failure to distinguish principles from evidence or new from old; the treatment of the task as an external imposition and finally external emphasis, such as the demands of the assessment and knowledge remaining separate to everyday reality (Ramsden 1988). The aspects related to the surface approach suggest a learning which is task focused and more commonly having extrinsic value, for example the value associated to the grade achieved through a particular instance of learning. However, these approaches are analytic categories derived from research and thus only describe the relative prominence of each approach to studying in a student (Entwistle 2000). This suggests that there may be difficulty in classifying some students, where neither approach is strictly prominent.

The importance of the learner's approach becomes apparent in Entwistle's conclusion that it is a crucial factor in the level of understanding attained. This is supported by research conducted by Marton and Säljö (1976). In the subject's summaries of an article concerned with curriculum reform they found a relationship between the approach and four hierarchical categories of understanding. That is, of those classified as adopting the surface approach five students responded in relation to the lowest level of understanding, eight responded to the next stage of understanding, one student responded in the second
highest level but none could be categorised with the highest level of understanding. Whereas of those who displayed a deep approach, five responses were categorised at the highest level, four at the second highest but there were none in the lowest two categories of understanding. This research suggests that a deeper approach to learning is linked to a higher level of understanding in learning.

**FACTORS DETERMINING APPROACHES TO LEARNING**

Entwistle (1998) proposes that there are three influential factors that determine which approach is adopted by the learner.

- He cites early quantitative research which demonstrates evidence of a development in the nature of thinking during higher education, whereby students gradually shifted from a belief in dualism to a recognition of relativism. That is, from a belief in correct answers which are transmitted by the lecturers to be reproduced in assessments, to the recognition that conclusions are based on evidence which a learner must interpret for themselves (Perry 1970). However the research that Entwistle bases this conclusion on used a sample of American middle class male students, therefore caution must be taken before applying conclusions to the diverse general population. More specifically, Belenky et al (1986) conclude that the work has overlooked specific issues relating to female intellectual development, yet Morgan (1993) argues that it nevertheless provides a sound basis for reflection on education. Despite the criticisms of Perry's research, the significant concepts within the theory have been justified by later research.

- The second influential factor was identified by Säljö (1979) when he described a similar development in the student’s conception of learning. There is an evident contrast between students who perceived that learning
involved storing and reproducing information and others who attempted to grasp the meaning for themselves with the aim of transforming the material provided. There are three proposed stages to this development

(i) Firstly, the student becomes aware of the influence of the context in learning about what you should learn and how you should set about it (Säljö 1978), but this awareness is not necessarily applied to the student’s own learning.

(ii) The second stage in this development is related to a distinction between 'learning for life' versus learning in school (Säljö 1978), this indicates some recognition that the nature of the learning context is artificial and possibly unrelated to situations outside of it.

(iii) The final stage of development is a distinction made by some participants between learning and real learning, or even more commonly, as that between learning and understanding (Säljö 1978). The existence of stages in the conceptualisation of learning suggests that it is neither static nor consistent over time. According to Entwistle (1998), the development of the conception of learning (from reproducing to transforming) and the intellectual development (from dualism to relativism) are factors that influence which approach is adopted, therefore supporting the argument that the same approach is not consistently adopted by the learner.

- Phenomenographic studies have also focused on the context of the learning, as a third influential factor. For example, Säljö (1979) asked seventy-two subjects to read a paper concerned with surface and deep approaches. He concluded that, 'a clear majority of subjects participating in this study recognise the dichotomy between a deep and surface approach and they can furthermore relate their own methods and procedures of learning to this
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perspective. A surprising result, however, is the finding that very few describe themselves as belonging exclusively to either of these categories. Rather, the general attitude among 61 of the 72 subjects, who described their own learning in the perspective outlined in the text used as learning material, is that they consider both of these approaches to be applicable to their own learning...the subjects perceive their approach to learning as being contextually dependent.

The two qualitatively different approaches to learning are consistent with the surface and deep learning approaches described in many other situations (Booth, 1992; Crawford et al., 1994; Eizenberg, 1988; Entwistle & Ramsden, 1983; Hazel & Prosser, 1994). Both surface and deep learning approaches have been found to allow for a number of preferred learning styles but the intention with which a learning style is applied is the key to distinguishing the approaches. The intention of a surface learning approach is to recall isolated pieces of knowledge and procedures in assessment situations. The intention of a deep learning approach is to develop a personal understanding (Prosser & Trigwell, 1999).

The existence and nature of a relationship between approach to learning and level of understanding has also been investigated (Crawford et al., 1994; Hazel & Prosser, 1994; Hazel, Prosser & Trigwell, 1996; Marton & Säljö, 1976; Prosser, 1994; Prosser & Millar, 1989; Trigwell & Prosser, 1991). Surface learning approaches have been associated with lower levels of understanding of a phenomenon, and deep learning approaches, deeper levels of understanding. The establishment of a relationship between approach to learning and level of understanding of a key concept has allowed student learning researchers to investigate the nature of learning approaches that have been associated with the development of deeper levels of understandings.
Approaches to Learning (ATL) refers to those characteristics students bring to the learning process. An analysis of the ATLs of students can provide insight into the types of teaching strategies and strategy adaptations that can lead to increased achievement. The ten most significant ATLs for the high school learner appear below. To access specific teaching strategy adaptations associated with each characteristic, select the highlighted phrase of that characteristic.

**TOP 10 Approaches to Learning for High School Students**

1. *Completes daily assignments* and personal study independently.
2. *Is an auditory learner.*
4. *Uses study skills* to organize and manage learning tasks.
5. *Has reading skills* consistent with reading tasks required.
6. Uses *productive techniques for expressing frustration*, anger, pleasure, accomplishments and other emotions related to learning activities.
7. Has *writing skills* required in assignments and testing.
8. Can *tolerate the necessary levels of frustration*.
9. *Stays focused* and participates in classroom discussion and group activities.
10. *Generalizes learning* to situations beyond the classroom.

**TOP 10 Approaches to Learning for Intermediate Students**

1. Uses *study skills* to organize and manage learning tasks.
2. Has *reading skills* consistent with reading tasks required.
3. Has *writing skills* required in assignments and testing.
4. Has *language conventions*, vocabulary and syntax to support learning.
5. *Stays focused* and participates in classroom discussions and group activities.
6. Has *mathematics skills* to support learning.
7. *Completes daily assignments* and personal study independently.
8. *Attends to tasks* that require reading, problem solving and similar activities for the time it takes to complete them.
9. *Feels that studying and learning are important* in his/her life and need time and effort.
10. Has *prerequisite knowledge* necessary to succeed in school.

**TOP 10 Approaches to Learning for Middle Level Students**

1. Uses *study skills* to organize and manage learning tasks.
2. *Completes daily assignments* and personal study independently.
3. Completes *long range projects*.
4. Uses *productive techniques for expressing frustration*, anger, pleasure, accomplishments and other emotions related to learning activities.
5. Is a kinesthetic learner (i.e. learns by doing and experiencing).
6. Is a visual learner.
7. Is an auditory learner.
8. Attends to tasks that require reading, problem solving and similar activities for the time it takes to complete them (20 minutes or more).
9. Seeks assistance of teachers and other school staff to support successful learning.
10. Approaches learning tasks and testing without fear of failure.

**TOP 10 Approaches to Learning for Primary Students**

1. Has prerequisite knowledge necessary to succeed in school.
2. Has reading skills required in the learning environment.
3. Has listening skills required in the learning environment.
4. Has memory and information retention skills.
5. Stays focused and participates in classroom discussion and group activities.
6. Has support of parents and family for learning and school participation.
7. Attends to tasks that require reading, problem solving and similar activities for the time it takes to complete.
8. Has writing skills required in assignments and testing.
9. Uses study skills to organize and manage learning tasks.
10. Has personal experience useful in learning which is comparable to that of other students.

Ramsden and Entwistle (1998) found that student’s preferred orientation to learning was influenced by eight elements in the learning environment. The six elements that positively promote learning are:

- **good teaching**: the perception of the preparation, confidence and skill of the faculty in facilitating learning;
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- openness to students: willingness of faculty to help, friendliness and flexibility of faculty.
- freedom in learning: the degree to which the students feel they have a choice in what they learn and how they learn it;
- clarity in goals and standards: a degree to which the students feel that the assessment is clearly defined and appropriate; for example, a low rating would be given if the students feel that "professors are more interested in testing what we have memorized than what we have learned."
- vocational relevance: how pertinent the students perceive the course content to be for their future careers;
- social climate: students report good academic and social relationships with each other.

The two elements that tend to negatively promote learning are:

- workload: excessive demands from the curriculum and the assessment procedures. "The shear volume of work to get through in this course means that you can’t comprehend it all thoroughly."
- formal teaching methods: the student’s perception that timetabled lectures (versus self-directed, group or individual study) are the main source of learning.

For example,

✓ The elements that tend to promote Surface Learning include: I appropriate assessment methods (especially the use of short answer and multiple choice questions for factual recall), heavy workload, perceived inadequacies in teaching, inadequate feedback on assignments, long delay before feedback, spoon-feeding through handouts and lack of relevance or choice. In particular, heavy workload and lack of freedom in learning [defined by Ramsden11 as control-centeredness] correlated with Surface orientation (p<0.001).
The elements that promote Deep Learning orientation include matching the content to previous knowledge, the perceived relevance of subject matter, good teaching (with appropriate level, pace, structure, explanation, enthusiasm and empathy), opportunities for individual choice and study skills training and support. In particular, good teaching plus freedom in learning [defined by Ramsden as student-centeredness] correlated with Deep learning orientation (p<0.01).

Approaches to Learning can be described as the relationship between the student and a learning task. This process is not static but is dynamic and changes as the situation changes.

**THE SOLO TAXONOMY: STRUCTURE OF OBSERVED LEARNING OUTCOMES**

It was developed by Biggs and Collis (1982), and is well described in Biggs (1999). It describes level of increasing complexity in a student's understanding of a subject, through five stages, and it is claimed to be applicable to any subject area. Not all students get through all five stages, of course, and indeed not all teaching (and even less "training" is designed to take them all the way). There are fairly clear links not only with Säljö on conceptions of learning, but also, in the emphasis on making connections and contextualising, with Bateson's levels of learning, and even with Bloom's taxonomy in the cognitive domain. Like pyramidal representation of Bloom, the assumption is that each level embraces previous levels, but adds something more as follows:

1 **Pre-structural Level:** here students are simply acquiring bits of unconnected information, which have no organisation and make no sense.

2 **Unistructural Level:** simple and obvious connections are made, but their significance is not grasped.
3 Multistructural Level: a number of connections may be made, but the meta-connections between them are missed, as is their significance for the whole.

4 Relational level: the student is now able to appreciate the significance of the parts in relation to the whole.

5 Extended abstract Level: the student is making connections not only within the given subject area, but also beyond it, able to generalise and transfer the principles and ideas underlying the specific instance.

As Surface Processing is characterized by two things. One is memorizing and the other is limiting the domain of activity. Its focus tends to be on completion of the task with minimum conceptual effort. The task may be seen to be accomplished as expeditiously as possible with mechanical activities. Extrinsic motivation may promote more surface approaches, as part of effort to meet requirement. Pre-structural and Unistructural Levels show the similar characteristics.

Deep Processing is the long term learning which refers to an active process of:

- Making associations with already familiar material.
- Examining interrelationship within the new material.
- Elaborating the stimulus through further development of it.
- Connecting the new material with personal experience.
- Considering alternative interpretations.

The learner uses the new material to reconstruct the conceptual framework by seeking personal meaning in the material. It is the intrinsic motivation that can be expected to lead towards deep processing strategies. The characteristics shown
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by Multistructural, Relational and Extended abstract Levels are similar to the characteristics as shown by deep learners.

LEARNING APPROACHES VS MOTIVATION

Fransson's (1977) study of the relationship between approaches to learning and motivation, concludes that intrinsic motivation is associated with a deep approach. Students who adopt a deep approach are intrinsically interested in their course and entered higher education believing they could work independently and had effective study skills. They consider learning to involve personal understanding and development and being able to use information acquired. They feel confident in their study skills and favour teaching which promotes deep learning.

Prosser and Millar (1989) showed that only students who had used a deep approach to their learning changed their conception of technical material in the ways required by the lecturers. Students relying on surface approaches were left with inadequate conceptions that would create increasing problems for them as they progressed through the course.

Tait et al. (1997) also report that a deep approach to learning is positively related to an intrinsic interest in the course and with a preference for teaching and courses which support deep learning.

Fransson, Biggs and Entwistle (1999), showed that surface approach was associated with anxiety and fear of failure, and to some extent with vocational motives, while a deep approach was consistently linked with academic interest in the subject for its own sake, and with self-confidence. Although these forms of motivation are characteristics of the learner, interest and self-confidence, or boredom and anxiety, are also the products of experiences within higher education.
The study also determine that deep approach to learning is to link to intrinsic motivation and a surface approach to extrinsic motivation. Intrinsic motivation is associated with students that want to understand subject and are curious to learn. Extrinsicly motivated students are concerned only with their grades and want to get approved from others (Newstead & Hoskins, 1999).

LEARNING APPROACHES VS LEARNING ENVIRONMENT

Biggs (1989, 1992) has developed an interactive systems model of teaching and learning to map how students’ general conceptions of and approaches to learning interact with characteristics in the learning environment to produce particular learning outcomes. The system has three components: presage, process, and product. Presage factors include not only the aforementioned student characteristics concerning beliefs about knowledge and conceptions of learning, but also the learning context, involving teacher and school attributes. Process factors include students’ perceptions of a given learning situation and the specific learning strategies that they consequently adopt for that learning task. The product, or learning outcome, is largely influenced by the strategy adopted. The particular learning strategy adopted by a student in a given situation is thus determined by a complex interaction between, first, the student’s pre-existing beliefs about knowledge and learning, and general pre-disposition towards particular approaches to learning, and, second, the student’s perceptions of the learning approach that is required by the educational context. The way in which the student perceives the latter, however, will also depend on the student’s pre-existing beliefs, with different students perceiving the same learning environments very differently (Perry, 1981, 1988).

Watts & Bentley (1987) and Noddings (1993) stress the importance of a safe, supportive, caring classroom environment if students are to be willing to take the risk of engaging in constructivist approaches to learning rather than adopting
the safer option of reproducing that transmitted to them by their teachers. Effective learning is a unique combination of the learning environment and the student's preferred orientation toward learning.

**Chickering and Gamson and Ramsden** suggest key principles to follow to create an effective learning environment are:

1. Stimulate interest and provide quality explanations.
2. Show concern and respect for students and students learning.
3. Use appropriate assessment with genuinely helpful feedback.
4. Have clearly stated goals that are intellectually challenging and expect students to succeed.
5. Provide students with a choice over how to learn the subject matter in active and cooperative learning environments.
6. Focus on "student learning" rather than on "teacher teaching" by diagnosing how well the learning is progressing and modifying things accordingly.

Based on Ramsden’s research the most significant measure of environments that promote deep learning is the students-centeredness; the control-centeredness is related to the promotion of surface learning.

**APPROACHES TO STUDY AND PERSISTENCE**

**Kember and Harper** (1986) used discriminant analysis to distinguish between distance education students who completed the subject they were studying and obtained a passing grade (persisters) and those who did not (non-persisters). The fact that older students are more likely to persist is consistent with the finding that older students are more likely to display a deep approach (**Harper & Kember, 1985**). They are more likely to be interested in the subject matter for its own sake, to search for the key concepts and to relate them to their own
experience. Such a meaning orientation must be more fulfilling than rote learning; so propensity to withdraw is reduced.

**APPROACHES TO STUDY AND PERFORMANCE**

**Svensson (1977)** related students’ approach to learning in an experiment with their normal approach to study by an interview question. Only 23% of the students classified as surface learners in both experiment and normal study passed all examinations. However 90% of the students classed as deep learners in both passed all examinations.

**Ramsden and Entwistle (1981)** examined the relationship between approaches to studying and self-reported ratings of academic progress. **Watkins (1982)** reports a study of the relationship between approaches to studying and academic grades awarded. This study found that disorganized study methods, surface approach and negative attitudes to studying were consistently related to academic performance.

**Harper and Kember (1986)** drew the distinction between performance, as an academic outcome, and persistence. Arguing that academic grades from fail to high achievement were not a reliable uniform measure of performance, they considered the difference between high achievers and those who barely passed their course. In the case of external students, having positive attitudes to study, organized study methods and a strategic approach are the best predictors of high achievement. For internals however, students who do not globetrot and display high levels of academic motivation are the most likely to succeed.

**APPROACHES TO STUDY AND ACADEMIC OUTCOMES**

Much of the research on approaches to studying has considered at micro level outcomes, such as the depth of understanding of an academic article. **Marton**
and Saljo (1976) found a clear relationship between a deep approach and a deep level of understanding in such tasks. Svensson (1977) argues that the relationship is inevitable rather than statistical.

Miller (1987) studied the effect of learning strategies on academic success. Results showed that students with high grade point average fared significantly better on deep processing (critical analysis of relationship).

**PERSEVERANCE**

Personality with its great interesting features has played as a major field of probing throughout the history of mankind. Personality includes those underlying relatively stable, psychological structures and processes that organize human experience and shape person’s actions and reactions to the environment. Personality refers to the impression, which an individual makes upon others, to those characteristic attributes, which make an individual stand out from others, which make him attractive or non-attractive. So, personality represents the sum total of that, an individual is, of everything that constitutes a person’s physical, mental, emotional and temperamental make up. Our experiences, memories, knowledge, day-dreams, study, learning, habits, thoughts, attitudes, beliefs, sentiments, intelligence, goals and ideas, in fact all that we are and all that we hope and aspire to become, constitute our personality. Our taste, our understanding, our enthusiasm and ambitions, our principles of life, and conduct, and the like colour our personality, which makes it unique. Each individual differs from others in one or the other aspect.

Personality is the product of its own functioning. What we do today, depends on our accumulated experiences of past. These experiences are
accumulated by continuous interaction with external environment. Personality may be described as collection of traits. These traits are consistencies in the characteristic modes of behavior by an individual in diverse settings. So, it is distinguishable, relatively enduring way in which one individual varies from other as helpful, honest, lazy etc.

Various psychologists have tried to explore the personality based on various traits. Depending upon these studies various factors have been discovered and persistence represent one of the variables representing these factors. Cattell (1957) did the factor analytic studies of personality and discovered A – O (15) factors. One of these factor (D) i.e. excitability and insecurity describe Persistence as one of the characteristics. I. Kunt and W. Wundt (1903) gave the human typology depending on 4 major variables i.e. emotional, non-emotional, changeable and unchangeable. They took persistence as one of the characteristic describing the variables – unchangeable and non-emotional. Edwards (1954) gave 16 factors describing the personality and took “endurance” as one of the factors. Similarly, Eysenck (1951) while describing organization of personality, took 2 aspects into consideration as introversion and extraversion. He took persistence as one of the characteristic to explain introversion.

Persistence, a Latin word, is made up of 2 words *per* and *sistere* meaning By way of and to stand respectively. So, it means remaining unchanged or fixed in a given line of action. To persist is to continue trying to accomplish a task in spite of difficulties, influences, opposition or discouragement (Webster’s Collegiate Dictionary). Carroll (1963) defines persistence as the time the learner is willing to spend in learning. In general, persistence is related to student attitude and interest in learning (Husen, 1967). A student need to spend a certain amount of time to master a task and he or she spends less time than the required amount in active learning, he is not likely to master it. So, the student varies in the amount of persistence brought to a specific learning task. Persistence is not fixed: it can be
increased by increasing the frequency of the reward and evidence of learning success. Even the need of persistence can be decreased by high quality of instruction. 

Persistence is considered to be one of the motivational variables, others are level of aspiration and need of achievement (Sinha, 1970). Here, persistence implies a strong drive and level of motivation. It is a condition reflected in continuance of an activity in spite of failures. In a sample of 27 high and 17 low achievers, he observed that high achievers displayed much greater degree of persistence.

Persistence is regarded as a mental attitude, which arises as the result of definite environmental situation that would tend to hinder the free unfolding of a course either begun or planned by an individual and the attitude indicate a reaction pugnacity towards the thwarting situation. It drives a person one’s he has undertaken a task to complete to its satisfaction. Even literature has its reference as William Hickson writes for continued efforts in the face of failure: -

Tis a lesson you should heed;
Try, try, try again.
If at first you don’t succeed,
Try, try, try again.

Mac Arther (1955) defines persistence as quality by virtue of which an individual continues steadfast pursuit of an aim in spite of difficulties or obstacles. Fernald (1912) said,”..........Success or failure of an individual depend largely on ability to endure and to continue to strive for the sake of achievement in spite of fatigue and discouragement.” According to Woodworth (1918) and Holt (1931), “ It is the capacity for work which determines the extent to which an individual may exert himself”. Ryans (1938), defined it as “ persistence or endurance
appears perhaps a general activity, to be a general native capacity of organism for continuous energy release”. Thronton (1939) stated that in school work there is a good reason to believe that persistence or sticking to a task, is one of the main factors that helps to supplement or compensate for ability……. Persistence is also a prime factor of success in the work-a-day world. Even Eysenck (1947) supported this view, “ among the qualities which make for the efficient use of a person’s abilities in his persistence”. Burt (1954) says, “ among all the qualities which are responsible for the success, the strength of persistence is an important factor”. So, it has been assumed that persistence is an important factor in determining the success or failure of an individual in schoolwork or in any other achievement.

To persist is to continue trying to accomplish a task in spite of difficulties, influences, opposition or discouragement. Fernald (1912) said that Success or failure of an individual depends largely on ability to endure and to continue to strive for the sake of achievement in spite of fatigue and discouragement. According to Woodworth (1918) and Holt (1931), It is the capacity for work which determines the extent to which an individual may exert himself. Ryans (1938), defined Persistence or endurance as it appears perhaps to be a general native capacity of organism for continuous energy release. Carroll (1963) defined persistence as the time the learner is willing to spend in learning. John B. Carroll, whose landmark 1963 article, "A Model of School Learning," defined degree of learning as time actually spent in learning divided by time needed for learning. In Carroll's model, the time needed for a given student to learn a given concept depends upon five factors:

- **APTITUDE** - the amount of time an individual needs to learn a given task under optimal instructional conditions
- **ABILITY** - capacity to understand instruction
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- **PERSEVERANCE** - the amount of time the individual is willing to engage actively in learning

- **OPPORTUNITY TO LEARN** - the time allowed for learning

- **QUALITY OF INSTRUCTION** - the degree to which instruction is presented so as not to require additional time for mastery beyond that required by the aptitude of the learner

A sense of the value of time—that is, of the best way to divide one's time into one's various activities—is an essential preliminary of efficient work. —Arnold Bennett.

Understanding the research on the effects of time factors requires some familiarity with the different kinds of educational time with which researchers are concerned. According to Anderson (1983), Bloom (1976), and Fisher, et al. (1980). **ALLOCATED TIME** is the amount of time specified for an activity or event. When educators and educational researchers speak of allocated time, they are referring to one of the following elements:

- **SCHOOL TIME** - the amount of time spent in school. When used this way, allocated time may refer to the number of school days in a year or the number of hours in a school day.

- **CLASSROOM TIME** - the amount of time spent in the classrooms within the school (i.e., excluding lunch, recess, time spent changing classes, etc.).

- **INSTRUCTIONAL TIME** - the portion of classroom time spent teaching students particular knowledge, concepts, and skills pertaining to school subjects (i.e., excludes routine procedural matters, transitions, and discipline).

  - Instructional time "tells you something about classroom organization"
and management." In other words, the time actually available for and spent in teaching is indicative of the teacher's ability to organize instructional activities and expedite non instructional ones such as transitions and discipline.

- **ENGAGED TIME, or TIME-ON-TASK**, refers to portions of time during which students are paying attention to a learning task and attempting to learn. This excludes time spent socializing, daydreaming, engaging in antisocial behavior, etc.

  - Time-on-task, meanwhile, "tells you something about teaching," that is, it reveals the teacher's skill in selecting learning activities which engage students' attention and in keeping them focused.

- **ACADEMIC LEARNING TIME (ALT)** is a term and concept emerging from a large-scale research effort called the Beginning Teacher Evaluation Study (BTES) conducted in the 1970s. ALT refers to that portion of engaged time that students spend working on tasks at an appropriate level of difficulty for them and experiencing high levels of success (excludes time spent engaged in tasks which are too easy or too difficult).

  - Academic Learning Time "tells you something about learning," in that it refers to situations in which student and learning material are well-matched and learning is occurring in a fairly ideal fashion.

- **DEAD TIME** - refers to periods of classroom time during which there is nothing students are expected to be doing; that is, time which the teacher has failed to manage in any way.

  It is important to note that these different measures do not merely refer to different amounts of time or to time spent in different environments. Instead, they represent different ways of conceiving of time and its expenditure. The values of a
Persistence is used in the sense of continuing with a task in spite of obstacles and failures. It implies among usage and drive and high level of motivation on the part of individual. Persistence is considered to be one of the motivational variables, others are level of aspiration and need of achievement (Sinha, 1970).

Persistence is one of the Habits of mind associated with intelligent behaviour. Persistence is a set of teachable behaviours for approaching problems, challenges and for working to reach other academic or non academic outcomes. (Arthur Costa and Bena Kallick, 2000). Persistence is used to describe the individual student’s to seek encouragement and support to reserve in his/her studies despite the challenges that he/she may face. (Louise Horstmanhof & Craig Zimitat, 2003).

Persistence is to continue trying to accomplish a task in spite of difficulties, obstacles, influences, opposition or discouragement. In other words, to go to resolutely or stubbornly (Marriam Webster Collegiate Dictionary, 2005).

Persistence is considered to be related with the various aspects as:

- Quickness, Introversion and low Verbocity (Crutcher, 1934)
- Success in school achievement (Ryans, 1938)
- With standing discomfort, feeling of adequacy, mental fluency (Thronton, 1939)
- Lesser cortical excitation (Eysenck, 1957)
- Initial estimates of probability of success (Feather, 1963)
- Initial behavioral outcomes (Ziemerman and Blotner, 1979)
- Frequent contact with faculty (Pascarella and Tarenzini, 1980)
• Emotional stability (Dillon, David, Eugene, 1982)
• Academic achievement (Andrew, 1987)
• Have positive coping conditions (Glasscock, Patricia Ann, 1987)
• Past and present academic performance in case of women and social support in case of males (Adams, 1988)
• Beliefs, values and attitudes about themselves (Kala, 1993)
• Ability to articulate and internalize educational goals, low level of stress and feeling of helplessness (Mason, 1995)
• Age, instructional time and learning style (Mickens, Ceasar, 1995)
• Gender (Kim Rapp, 2003)
• Background characteristics, personal resources, aspirations, completion of task (Cohen, 2004)
• Ethnicity (Hoef, 2004)
• Quality of the programme and academic experience (Ivankova, 2004)

Dimensions of Perseverance:

In a study by Ahuja & Vashisht (1998) various dimensions were explored by consulting various experts in different fields as Education, Psychology, Philosophy, Teaching and Research, which have been listed below:

<table>
<thead>
<tr>
<th>-Inquiry</th>
<th>-Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Objectivity</td>
<td>- Courage to question</td>
</tr>
<tr>
<td>-Aesthetic sensibility</td>
<td>- Acquire problem solving</td>
</tr>
<tr>
<td>-Decision making skills</td>
<td>-Discover relationship of science with other subjects and in other aspects of life</td>
</tr>
<tr>
<td>-Confidence</td>
<td>- Overall personality development</td>
</tr>
<tr>
<td>-Participation</td>
<td>- Regularity</td>
</tr>
<tr>
<td>-Punctuality</td>
<td>- Obedience</td>
</tr>
<tr>
<td>-Truthfulness</td>
<td>- Social work</td>
</tr>
<tr>
<td>Leadership qualities</td>
<td>Good behavior</td>
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<tr>
<td>----------------------</td>
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</tr>
<tr>
<td>Reorganization</td>
<td>Construction</td>
</tr>
<tr>
<td>Identification</td>
<td>Recognition</td>
</tr>
<tr>
<td>Manipulation</td>
<td>Drawing</td>
</tr>
<tr>
<td>Intellectually sound</td>
<td>Understanding</td>
</tr>
<tr>
<td>Application</td>
<td>Implication</td>
</tr>
<tr>
<td>Emotionally sound</td>
<td>Perfect equilibrium</td>
</tr>
<tr>
<td>Active</td>
<td>Alert</td>
</tr>
<tr>
<td>Transfer of knowledge</td>
<td>Positive thinking</td>
</tr>
<tr>
<td>Confidence</td>
<td>Frustration</td>
</tr>
<tr>
<td>Will power</td>
<td>Determination</td>
</tr>
<tr>
<td>Revision</td>
<td>Truthfulness</td>
</tr>
<tr>
<td>Cool</td>
<td>Frank</td>
</tr>
<tr>
<td>Practicability</td>
<td>Cooperation</td>
</tr>
<tr>
<td>Internally disciplined</td>
<td>Self study(Extension of concept)</td>
</tr>
<tr>
<td>Inquiry</td>
<td>Scientific temper</td>
</tr>
<tr>
<td>Reasoning</td>
<td>Logic</td>
</tr>
<tr>
<td>Curiosity</td>
<td>Strong observation</td>
</tr>
<tr>
<td>Collaboration of all aspects</td>
<td>Analysis</td>
</tr>
<tr>
<td>Synthesis</td>
<td></td>
</tr>
<tr>
<td>Learn language by communication</td>
<td>Application</td>
</tr>
<tr>
<td>Creative writing</td>
<td>Practice</td>
</tr>
<tr>
<td>Constant exposure</td>
<td>Word association</td>
</tr>
<tr>
<td>Know the sequence</td>
<td></td>
</tr>
<tr>
<td>Understanding of terms, concepts, symbols and mastery of computational process</td>
<td>Develop skills of drawing, measuring, estimating and demonstrating</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Application of knowledge in daily life</td>
</tr>
<tr>
<td>Thinking</td>
<td>Reasoning</td>
</tr>
<tr>
<td>Analyzing</td>
<td>Use of computers, calculators</td>
</tr>
<tr>
<td>Independence of thought process</td>
<td></td>
</tr>
<tr>
<td>Alert</td>
<td>Quick to respond</td>
</tr>
<tr>
<td>Regular</td>
<td>Inquisitive</td>
</tr>
<tr>
<td>Cooperative</td>
<td>Independent in decision</td>
</tr>
<tr>
<td>Leader</td>
<td>Obedient</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Emotionally sound</td>
</tr>
<tr>
<td>Objective</td>
<td>Creative</td>
</tr>
<tr>
<td>Trait</td>
<td>Trait</td>
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<td>-----------------------</td>
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<tr>
<td>Eager to help</td>
<td>Inquisitive</td>
</tr>
<tr>
<td>Sense of responsibility</td>
<td>Sense of respect</td>
</tr>
<tr>
<td>Initiative</td>
<td>Practical</td>
</tr>
<tr>
<td>Sound personality</td>
<td>Keen observant</td>
</tr>
<tr>
<td>Punctuality</td>
<td>Hard work</td>
</tr>
<tr>
<td>Constant exposure</td>
<td>Constant efforts</td>
</tr>
<tr>
<td>Leader</td>
<td>Cooperative</td>
</tr>
<tr>
<td>Competitive</td>
<td>Confident</td>
</tr>
<tr>
<td>Constructive</td>
<td>Alert</td>
</tr>
<tr>
<td>Quick in decision</td>
<td>Reorganization</td>
</tr>
<tr>
<td>Numerical ability</td>
<td>Curious</td>
</tr>
<tr>
<td>Determination</td>
<td>Frank</td>
</tr>
<tr>
<td>Intelligence</td>
<td>Interested in studies</td>
</tr>
<tr>
<td>Speed of writing</td>
<td>Pronunciation</td>
</tr>
<tr>
<td>Able to follow the teacher</td>
<td>Keen observer</td>
</tr>
<tr>
<td>Skilled</td>
<td>Practical</td>
</tr>
<tr>
<td>Determination</td>
<td>Hard work</td>
</tr>
<tr>
<td>Regularity</td>
<td>Punctuality</td>
</tr>
<tr>
<td>Discipline</td>
<td>Curiosity</td>
</tr>
<tr>
<td>Practice</td>
<td>Alertness</td>
</tr>
<tr>
<td>Concentration</td>
<td></td>
</tr>
<tr>
<td>Patience</td>
<td>Hard work</td>
</tr>
<tr>
<td>Determination</td>
<td>Interested in task</td>
</tr>
<tr>
<td>Courage</td>
<td>Inertness</td>
</tr>
<tr>
<td>Alert</td>
<td>Attentive</td>
</tr>
<tr>
<td>Sincere</td>
<td>Objective</td>
</tr>
<tr>
<td>Confident</td>
<td>determined</td>
</tr>
<tr>
<td>Will power</td>
<td>Aspiration</td>
</tr>
<tr>
<td>Regular</td>
<td>Alert</td>
</tr>
<tr>
<td>Interrelated</td>
<td>Communicable</td>
</tr>
<tr>
<td>Practice</td>
<td>Observation</td>
</tr>
<tr>
<td>Curious</td>
<td>Hard working</td>
</tr>
<tr>
<td>Regular</td>
<td>Resistive</td>
</tr>
<tr>
<td>Resistive</td>
<td>Responsible</td>
</tr>
<tr>
<td>Confident</td>
<td>Frank</td>
</tr>
<tr>
<td>Sharp memory</td>
<td>Understanding</td>
</tr>
<tr>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>-Disciplined  -Obedient</td>
<td></td>
</tr>
<tr>
<td>-Obedient  -Regular and punctual</td>
<td></td>
</tr>
<tr>
<td>-Leadership quality  -Keen to learn</td>
<td></td>
</tr>
<tr>
<td>-Help other students  -Independent thinking</td>
<td></td>
</tr>
<tr>
<td>-Class participation  -Inquisitive</td>
<td></td>
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<tr>
<td>-Self study  -Understanding of the concepts</td>
<td></td>
</tr>
<tr>
<td>-Alert  -Very creative</td>
<td></td>
</tr>
<tr>
<td>-Rational thinking  -Divergent thinking</td>
<td></td>
</tr>
<tr>
<td>-Curious  -Constructive</td>
<td></td>
</tr>
<tr>
<td>-Egoistic  -Take firm decisions</td>
<td></td>
</tr>
<tr>
<td>-All round development  -Logical mind</td>
<td></td>
</tr>
<tr>
<td>-Patience  -Scientific attitude</td>
<td></td>
</tr>
<tr>
<td>-Energetic  -Alert</td>
<td></td>
</tr>
<tr>
<td>-Inquisitive  -Divergent thinking</td>
<td></td>
</tr>
<tr>
<td>-Analytic  -Intelligent</td>
<td></td>
</tr>
<tr>
<td>-Creative  -Decisive</td>
<td></td>
</tr>
<tr>
<td>-Patience  -Scientific thinker</td>
<td></td>
</tr>
<tr>
<td>-Go get it  -Repeated efforts</td>
<td></td>
</tr>
<tr>
<td>-Disciplined  -Sincere</td>
<td></td>
</tr>
<tr>
<td>-Cooperative  -Understanding</td>
<td></td>
</tr>
<tr>
<td>-Analytic  - -</td>
<td></td>
</tr>
<tr>
<td>-Ideal  -Understanding</td>
<td></td>
</tr>
<tr>
<td>-Keen to know something new  -Experimenting</td>
<td></td>
</tr>
<tr>
<td>-Decision making  -Perfect equilibrium</td>
<td></td>
</tr>
<tr>
<td>-Perfect coordination  -</td>
<td></td>
</tr>
<tr>
<td>-Punctual  -Inquisitive</td>
<td></td>
</tr>
<tr>
<td>-Busy doing something or the other  -Repetition</td>
<td></td>
</tr>
<tr>
<td>-Revision  -Sharp memory</td>
<td></td>
</tr>
<tr>
<td>-Experimentation  -Analytical</td>
<td></td>
</tr>
<tr>
<td>-Rational thinking  -Independence of decision</td>
<td></td>
</tr>
<tr>
<td>-Decision (independent)  -Perfect personality</td>
<td></td>
</tr>
<tr>
<td>-Emotionally and physically sound  -No sign of fatigue</td>
<td></td>
</tr>
<tr>
<td>-Energetic  -Computations (quick)</td>
<td></td>
</tr>
<tr>
<td>-Sharp memory  -Communicable</td>
<td></td>
</tr>
<tr>
<td>-Cooperative  -Eager to do something new</td>
<td></td>
</tr>
<tr>
<td>-Confident  -Observation</td>
<td></td>
</tr>
</tbody>
</table>
Various dimensions of Perseverance, which were made the basis of the study, have been listed below:

<table>
<thead>
<tr>
<th>Alert</th>
<th>Analysis</th>
<th>Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>Curiosity</td>
<td>Constant exposure</td>
</tr>
<tr>
<td>Concentration</td>
<td>Cooperation</td>
<td>Communication</td>
</tr>
<tr>
<td>Computation</td>
<td>Confidence</td>
<td>Decision making</td>
</tr>
<tr>
<td>Demonstration</td>
<td>Determination</td>
<td>Emotionally sound</td>
</tr>
<tr>
<td>Frank</td>
<td>Fatigue</td>
<td>Handling</td>
</tr>
<tr>
<td>Inquiry</td>
<td>Identification</td>
<td>Internally disciplined</td>
</tr>
<tr>
<td>Independence of thought</td>
<td>Level of aspiration</td>
<td>Leadership</td>
</tr>
<tr>
<td>Manipulation</td>
<td>Objectivity</td>
<td>Overall personality development</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Punctuality</td>
<td>Perfect equilibrium</td>
</tr>
<tr>
<td>Positive thinking</td>
<td>Practice</td>
<td>Responsibility</td>
</tr>
<tr>
<td>Regularity</td>
<td>Reorganization</td>
<td>Reasoning</td>
</tr>
<tr>
<td>Scheduling the daily routine</td>
<td>Self study</td>
<td>Strong observation</td>
</tr>
<tr>
<td>Sequence</td>
<td>Satisfaction</td>
<td>Sustaining physical stress</td>
</tr>
<tr>
<td>Understanding</td>
<td>Will power</td>
<td>Writing</td>
</tr>
</tbody>
</table>

The research literature also reveals that perseverance is an important variable for Mastery Learning strategies as also for individualized or self-

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instructional strategies. It was this hypothesis, which resulted into the inclusion of this variable into the present investigation.

**REVIEW OF RELATED LITERATURE**

The review of the literature provides the background and context for the research problem (Wiersma, 1995).

The literature solves various purposes.

- It shares the results of other studies that are closely related to the study being reported (Fraenkel & Wallen, 1990).

- It provides a framework for establishing the importance of the study as well as for comparing the results of a study with other findings.

Keeping in view the purposes, the results of some of the related studies are discussed below.

**RESEARCH STUDIES ON MASTERY LEARNING**

**Kulik, Chen-Lin C. et al (1990)** did a meta-analysis of findings from 108 controlled evaluations. It showed that Mastery Learning programs have positive effects on the examination performance of students in colleges, high schools, and the upper grades in elementary schools. Effects of mastery programs on student attitudes, instructional time, and college completion rates are discussed.

**Reezigt, Gerry J.; Weide, Marga G. (1990)** did a study as a part of an educational reform in the Netherlands, in which teachers were required to implement models of adaptive instruction, including group-based Mastery Learning. It was expected that Mastery Learning would raise achievement and
reduce differences in achievement among children of different social classes and between girls and boys. In 1987, students and teachers in grades 5 and 7 in 220 elementary schools participated in a study of the performance of the model. In 1988, the same students (who were then in grades 6 and 8) and their teachers participated. In all, about 10,000 children and 1,000 teachers were included in the study. All data were collected using questionnaires and Dutch standardized tests. Mastery Learning was very popular for teaching mathematics, but the Dutch language was generally taught in a conventional way. In comparison with conventional instruction, few effects of Mastery Learning were found. Positive effects were found for language achievement in grade 5, and negative effects were found in the language achievement gain of grade 5 to 6. Differences in the achievement of children of different social classes and of boys and girls were not reduced by Mastery Learning. When the effects of other forms of adaptive learning (ability grouping and individualized instruction) were studied, Mastery Learning was the only form that did not lead to lower achievement scores than did class instruction.

Stevenson and S. Y. Lee (1990) explored that the overlapping confidence intervals of Japanese mathematics performance and Mastery Learning do not support a positive conclusion that Mastery Learning caused the differences, but they do indicate that there is a potential relationship.

Obando, Ligia Torres; Hymel, Glenn M. (1991) studied the relationship between instructional treatment manifested as Mastery Learning and non-Mastery Learning strategies and various measures of Spanish proficiency was studied with 41 freshmen at an all-female high school in the New Orleans (Louisiana) area. Subjects were grouped homogeneously into 2 classes of 22 and 19 students, representing the experimental group that received Mastery Learning instruction and the control group that received conventional/non-Mastery Learning
Introduction

instruction, respectively. Dependent variables of degree of learning as indexed by achievement scores, perseverance on assigned academic tasks, and time required to criterion were examined in the context of a non-equivalent, matched control group, pretest-posttest design. Analysis of covariance and correlated groups t-tests suggest significant achievement scores and time invested favoring the mastery approach, but non-significant differences regarding perseverance. The provision of feedback-correction procedures via diagnostic formative trial tests and the learning corrective prescriptions appears to be a key element in the effectiveness of Mastery Learning as an instructional delivery system.

Anderson, Stephen A. et al (1992) conducted a field experiment in Yale Public Schools (Yale, Michigan) in implementing Mastery Learning. The purpose of the experiment was to provide a hands-on experience for teachers in the implementation of Mastery Learning and to use students as their own controls in order to compare the results of the implementation of Mastery Learning both in terms of cognitive and affective student outcomes. Six classrooms were used in the sample for the experiment which included grades 3 through 6 plus a 5th/6th split grade and a special education resource room class, for a total of six teachers and 94 students. A series of six hour-long in-service classes were held to acquaint teachers with Mastery Learning. All six teachers chose mathematics as the content area for implementation. Test results compared the unit test scores in the fall of 1991 with the test results after implementation of two Mastery Learning units in the spring of 1992. Students were also assessed for any change in their feelings of self-efficacy using Brookover's Self-Concept of Ability Survey. Significant gains in achievement were found for both Mastery Learning units and self-efficacy.

Blakemore, Connie L. et al (1992) compared psychomotor skill performance in isolation and in competitive game situations with seventh grade boys taught basketball using Bloom's Mastery Learning model or nonmastery
procedures. Mastery subjects surpassed control and nonmastery groups on all skills performed in isolation. No significant differences existed in skill performance in competitive game situations.

Obach, Mifrando S.; Moely, Barbara E. (1993) did a study of metacognition and motivation exploring variations over time in the relationships between children's metacognitions about their study activities and various components of motivation for achievement. The study attempted to: (1) identify possible causal relations between metacognitive and motivational variables by looking at their concurrent and predictive relations; and (2) verify the notion that children who report the use of cognitive strategies and self-regulation will exhibit mastery-oriented motivational goal patterns rather than ego-oriented or work-avoidant patterns. Self-report measures assessing study strategy use (rote memory strategy use, cognitive strategy use, and self-regulation), attributional beliefs, and goal orientations were administered to 154 fifth-, sixth-, and seventh-grade parochial school students in the fall and spring of the same academic year. Results confirmed a positive relationship between reported strategy use and task mastery orientation; children who reported strategy use in the fall tended to be task-mastery oriented in the spring; and children who were mastery oriented in the fall reported greater strategy use in the spring. (I.L.)

Mevarech, Zemira R.; Susak, Ziva (1993) examined the effects of cooperative-Mastery Learning (CML) on student's questioning behavior, creativity, and achievement. Comparisons of controls and students trained to generate questions under CML, Mastery Learning, and cooperative learning (CL) indicated that CML and ML students scored higher on measures of higher order questioning skills and originality.
Lazarowitz, Reuven; And Others (1994) reported on a study designed to determine whether academic achievement of students taught in the cooperative group mastery mode would be different from the achievement of students who learn in an individualized method and to determine whether gains or losses would be seen in nonacademic outcomes such as social relations, self-esteem, and classroom learning environment. Results support cooperative learning.

Whiting, Bryan; et al (1994) while studying Mastery Learning: Thousands of Students, Thousands of Excellent Learners investigated that the level of mastery had no effect on students' grades. Mastery Learning produced successful learning experiences for at least 80 percent of the students. The study results supported the concept that Mastery Learning can be effective in subjects other than those that are hierarchically organized. Evaluation of students' opinions indicated that students took a great deal of pride in their accomplishments under Mastery Learning.

Hagborg, Winston J (1995) explored possible gender differences in intrinsic motivation among 120 white students at a semi-rural high school. Researchers drew students randomly from each of the four grade levels. Students provided information on age, grade level, and grade point average, then anonymously completed Harter's 1981 Scale of Intrinsic versus Extrinsic Motivation. The Scale included five subscales grouped into two central components. The Mastery Motivation component was measured by three subscales: (1) preference for challenge versus preference for easy work assigned, (2) learning out of curiosity/interest versus pleasing the teacher or getting grades, and (3) independent mastery versus dependence on the teacher. The Autonomous Judgment component was measured by two additional subscales: (4) independent judgement versus reliance on the teacher's judgment, and (5) internal versus external criteria for assessing success or failure in school. Data analysis indicated
that girls were significantly more intrinsic on autonomous judgement components and the judgement subscale. There were no significant differences on the mastery motivation component and the four other subscales. Grade point average positively correlated with mastery motivation for both sexes. Autonomous judgement significantly correlated with grades for girls but not boys. Overall, boys and girls had similar intrinsic motivation.

Waddington, Tad S. H (1995) It is argued that Mastery Learning is one explanation for the documented differences in mathematics achievement between Japanese and American students. Given its emphasis on mastery at one stage before moving on to the next stage, and the potential accumulated benefits of this approach over time, Mastery Learning appears to be very similar to what occurs in Japanese classrooms. A meta-analysis of studies of elementary mathematics achievement supports the research findings of H. W.

Lange, Garrett W.; Adler, Francesca (1997) examined the role of motivational factors on the academic achievement of children in the 3rd, 4th, and 5th grades. Four motivational factors were assessed: the child's motivational attributions, motivational goal orientation, self-perception, and mastery-oriented behaviors in the classroom. Mastery-oriented behaviors include being goal-oriented, being able to work independently, seeking out challenging tasks, and participating as an active agent in the learning process. Results of parent, teacher, and child measures indicated that intrinsically goal-oriented children tended to have high academic self-concepts, exhibited high levels of mastery behaviors in the classroom, and scored well on school achievement tests. Achievement levels were found to be a joint result of ability and motivation, and mastery behaviors in the classroom were the link between intrinsic goal orientation and achievement, and between self-concept in the classroom and achievement. The behavioral
measure of children's mastery was the most important indicator of achievement. When judgments of the children's abilities were taken from classroom teachers and from parents, it was found that teachers views were more highly associated with achievement levels. Recommendations for teachers based on the study results include allowing students to have choices between equally challenging tasks, and minimizing external rewards as motivators for achievement.

**Yohon, Terasa I (1997)** conducted a study on Mastery Learning Vs traditional teaching methodologies effect on secondary student's anxiety levels and the results show that no difference was observed in state anxiety between teaching methodologies groups over time.

**Lee, Christopher Dewayne (1998)** studied the effect of a Mastery Learning technique on the performance of a transfer training task (Bowline knot). The findings of the study claim that the use of Mastery Learning technique can have a significant positive effect on the ability of participants to transfer knowledge from a classroom training context to a work related task.

**Litteral, Diana B (1998)** designed practicum to increase concept mastery of 11th grade chemistry students by improving instruction, motivation, and writing skills. The problem addressed was that many chemistry students, perform well in group learning situations, such as labs, but perform poorly on content-mastery tests. As a result of reviewing the literature, the writer found that a variety of methods and a student-centered approach made instruction more effective. The solution strategies selected were: (a) improving instruction by adjusting traditional teaching methods, (b) increasing motivation by using technology and cooperative learning, and (c) enhancing writing skills by means of SQ3R (Survey, Question, Read, Recite and Review), graphic organizers, and text analysis. The results of the practicum indicated that the selected solution strategies fostered content-mastery.
among the subject students. There was an increase in the number of correct multiple choice items on content-mastery tests and an increase in volunteered answers. Student essay writing scores improved as well.

**Durning, Jermaine; Matyasec, Maryann (1999)** An attempt was made to improve students' academic grades and students' opinions of themselves as learners through the use of alternative assessments. The format of Mastery Learning using the direct instruction practice model was combined with performance-based assessment to increase achievement, self-esteem, and higher level thinking skills. Researchers selected five students from a sixth-grade heterogeneous mathematics class at a junior high school and five students from a ninth-grade honors English class at a high school. Students were given pretests and posttests at the beginning and end of each unit and were asked to complete charts before and after the experimental instruction indicating what they knew (K), what they wanted to know (W), and what they learned (L). The KWL chart served as an alternative assessment, as did "PMI" (Plus, Minus, Interesting) charts rating topics learned, portfolios, and improvement rubrics allotting bonus improvement points. The use of pretests and posttests allowed the teachers to see that the students were improving. The other assessment strategies also appeared helpful in promoting academic achievement and student self-esteem. The use of bonus improvement points was a good incentive for student improvement. Nineteen appendixes contain sample charts and examples of conventional and alternative assessments.

**Giacomo, Nigro (1999)** studied learning styles and personality traits associated with student success at grade 9 level in individualized study programme. The study concluded that the programmed instruction, peer teaching, independent study and discussion were the preferred learning styles of the subjects.
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Marcon, Rebecca A (1999) Examined impact of three preschool models identified through cluster analysis of teacher-survey responses on 4-year olds' development and basic-skill mastery. Found that children in the child-initiated model demonstrated greater skill mastery than children in programs emphasizing academics and skill instruction. Children in the combination model did more poorly on almost all measures than others. Girls generally outperformed boys.

Urban-Lurain, Mark; Weinshank, Donald J. (1999) did a study on Mastering Computing Technology: A New Approach for Non-Computer Science Majors. A computing literacy course at Michigan State University for non-computer science students was designed with a fixed course structure and continuously changing course content. The structure provides feedback for assessing students and revising content to meet the changing demands of client departments, changing student experience, and changing hardware/software environments. To address potential assessment problems, the course is entirely lab-based, replaces competitive grading with a collaborative learning model, and replaces "points" with a series of Mastery Learning bridge tasks (BTs). This assessment model provides greater opportunity for learning than traditional multiple choice examinations, actually indicates the concepts and competencies that the student has mastered, and is non-competitive. The model provides a database of student performance that is used to improve the instructional design of the course, refine the BTs, and help individual students better understand concepts.

Barron, Kenneth E (2000) The purpose of this study was to provide a comprehensive test of the mastery versus multiple goal perspective. In study 1, a correlational approach was used to identify the optimal goals for 166 undergraduates to adopt for a learning activity. In study 2, which involved 154 undergraduates, an experimental approach was used to identify the optimal goals
to assign for the same activity. Each study reveals benefits of both mastery and performance goals, providing support for a multiple goal perspective.

**Tuan, Hsiao-Lin; Chin, Chi-Chin (2000)** The purpose of this study was to explore four classes of junior high school students' learning motivation toward a physical science course in central Taiwan. Both qualitative and quantitative methods were applied in the study. Students' physical science learning motivation questionnaire (SPSLMQ), modified from multiple dimensions of a motivation instrument (Uguroglu, Schiller, and Walberg, 1981), was developed in the study. It included achievement, affiliation, self-concept, mastery, and locus of control scales. Another questionnaire, consisting of 11 items, was designed to assess students' perceptions toward physical science. Findings from classroom observation, interviews and questionnaire surveys revealed that students think they need to take major responsibility for their own physical science learning. Although students had moderate curiosity about the nature phenomena around them, they did not persist in elaborating their understanding beyond classes, which influenced their physical science learning outcomes. Besides low mastery motivation, students also had a low score on their performance in physical science. Many students' reasons for learning physical science were related to instrumental interests such as knowing more information, preparing for tests, or for attending better schools. Students expressed that having low-pressure learning contexts and lab experiences could motivate them in learning. They agree that teachers' teaching can influence their motivation in learning. Suggestions for science teaching are discussed in the paper.

**Aviles, Christopher B. (2001)** did a study of Mastery Learning versus Non-Mastery Learning Instruction in an Undergraduate Social Work Policy Class. The study reveals that Mastery Learning is a behavioral instructional method that utilizes additional learning time and repeated testing opportunities to increase
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student learning. While successful in higher education, Mastery Learning has not been studied in social work. In this study mastery and non-Mastery Learning instruction were contrasted using four sections of a junior-level introductory social work course in a public, Northeastern college. The four course sections were collapsed into two groups, mastery and non-mastery. Dependent variables included student achievement, instructional preference, and attitudes toward course topic. Instructor hours spent and instructor reactions to Mastery Learning were measured. Both methods resulted in similar achievement and similar changes in attitudes towards the course topic. All of the students preferred mastery instruction. Mastery and non-mastery instruction involved similar amounts of instructor time, but the mastery instructor reported increased classroom time efficiency and coordination between teaching and testing. Mastery Learning should be considered a promising instructional method for social work education.

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Osborne, Jason W.; Rausch, John L. (2001) did a study on Identification with academics is the extent to which an individual bases his or her self-esteem on outcomes in the academic domain. Theory suggests that students who are highly identified with academics should be more motivated to succeed in a domain, and thus more likely to experience desirable academic outcomes and avoid undesirable outcomes, such as dropping out of school or obtaining poor grades. Two studies examined the validity of this hypothesis. In the first study, data from the National Education Longitudinal Study of 1988 show that 2 years prior to dropping out of school, substantial differences in identification are present between those who drop out and those who do not. Study 2, which involved the entire entering ninth-grade class of a high school, showed that identification with academics is related to psychological variables such as holding learning goals, intrinsic valuing of academics, self-regulation, holding a mastery orientation, and amount of processing course material receives. Identification with academics also prospectively predicts future academic outcomes such as grades, behavioral referrals, and absenteeism.

Haught, Laurie; Kunce, Christine; Pratt, Phyllis; Werneske, Roberta; Zemel, Susan (2002) described the intervention programs used to improve student proficiency in learning, recalling, and retaining basic mathematics facts. The targeted population consisted of first, second, third, and fifth grades in four suburban midwestern schools. The problems of recalling basic mathematics facts is documented through teacher surveys, parent surveys, student surveys, and scores obtained on timed pretests. Research of probable causes indicated lack of time given to practicing mathematics facts in school, inconsistent at home practice, and little emphasis of mathematics facts within the textbook. This research also indicated an ambivalence among teachers pertaining to the importance of practicing math facts in school. Because the literature review of
solutions named pro position, con position, and ambivalent position on teaching basic mathematics facts, the researchers focused on the solutions of the pro position, specifically using music or game interventions daily. Students, parents, and teachers were given surveys to record attitudes about learning mathematics facts. A timed pretest of mathematics facts was administered to experimental and control groups to establish baseline data. Weekly two minute timed tests were given to the experimental groups. A Timed posttest was given to the groups to determine improvement in speed and accuracy. Based on the presentation and analysis of data on mastering basic mathematics facts, the results indicated an increase in the test scores from the pretest to the posttest for the targeted first, second, third, and fifth grade levels. This was true regardless of using the games or music as the intervention. Experimental and control group pretest and posttest scores were also compared.

**Turner, Julianne C. et al (2002)** did the Classroom Environment and Students’ Reports of Avoidance Strategies in Mathematics: A Multimethod Study. The relation between learning environment (perceptions of classroom goal structure and teachers’ instructional discourse) and students’ reported use of avoidance strategies (self-handicapping, avoidance of help seeking) and preference to avoid novelty in mathematics was examined. High incidence of motivational support was uniquely characteristic of high-mastery/low-avoidance classrooms, suggesting mastery goals include an affective component.

**Barron, Kenneth E.; Finney, Sara J.; Davis, Susan L.; Owens, Kara M. (2003)** studied achievement Goal Pursuit: Are Different Goals Activated and More Beneficial in Different Types of Academic Situations? This study was intended to evaluate whether a recently proposed 2 x 2 achievement goal model could be replicated, and it aimed to evaluate whether students were more advantaged by pursuing one type of goal or a combination of goals. The achievement goals and
graded performance of 1,213 undergraduates were studied at 3 time points during a semester using an achievement goal measure and a measure of reason for taking the course. In addition, 577 of these students participated in an additional measurement of interest and enjoyment in class. The only goals that were positively linked to academic outcomes in the class were performance-approach goals and mastery-approach goals, a finding that replicates numerous other studies of college students. Performance-approach goals were associated with academic performance, and mastery-approach goals were associated with interest. The study did not document any negative effects that have been associated with adopting avoidance goals in other studies. There appear to be no benefits to pursuing different types of goals based on reasons for taking the class, but there is continued support for specialized goal benefits of adopting multiple "approach" goals for the class.

Jordan, Nancy C.; Hanich, Laurie B.; Kaplan, David (2003) did a Arithmetic Fact Mastery in Young Children: A Longitudinal Investigation. This Compared reading and mathematics competencies of children with poor arithmetic fact mastery at the end of third grade to those of grade-level peers with good arithmetic fact mastery. Found that children with poor fact mastery showed little growth on timed number facts across second and third grades, despite normal growth in other mathematics areas. Found that fact mastery deficits were persistent and appeared independent of reading and language abilities.

Yamaguchi, Ryoko (2003) studied Children's Learning Groups: A Study of Emergent Leadership, Dominance, and Group Effectiveness. This study explores the importance of the group context in the emergence of leadership, dominance, and group effectiveness in children's collaborative learning groups. Ten 3-person work groups performed a collaborative math activity. Using achievement goal orientation (Ames, 1992; Maehr and Midgley, 1996; Pintrich
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and Schunk, 1996) as a framework, six groups performed the math task under a mastery condition, which emphasized learning and improving. Four groups performed under a performance condition, which emphasized competition and social comparison. The groups were videotaped and fully transcribed. Under a mastery condition, group members exhibited more leadership and positive behaviors, such as giving and seeking help, talking about math strategies, and staying focused on the task. Group effectiveness also varied under mastery and performance group conditions. Under the performance condition, groups were not as effective in completing the math task because of member dissonance, isolation, lack of communication, and dominance. Under the mastery condition, groups were more effective, with more communication among all members and a shared responsibility in completing the math task.

Yamaguchi, Ryoko; Maehr, Martin L. (2003) did a Multi-Method Study of Children's Emergent Leadership in Collaborative Learning Groups This multi-method study explored how children conceptualize emergent leadership in collaborative learning groups, and whether emergent leadership was associated with student achievement motivation. Fourth and fifth grade students participated in a collaborative math activity. After the group math task, 294 students were surveyed on their achievement orientation and emergence of leadership. Within their learning groups, a subset of 18 students was individually interviewed. The interview data revealed that elementary school-aged children are aware of the emergence of leadership in collaborative learning groups, describing leadership behaviors in two domains: task-focused and relationship-focused. The survey data revealed that while task-focused leadership was only associated with performance goal orientations. Relationships-focused leadership was associated with both mastery and performance goals, though the association was stronger with mastery.
goals. Taken together, this study shows the importance of including emergent leadership in the study of collaborative learning groups.

Vansteenkiste, Maarten; Simons, Joke; Lens, Willy; Soenens, Bart; Matos, Lennia (2004) studied Less Is Sometimes More: Goal Content Matters According to expectancy-value theories, increasing the utility value of a learning activity should result in higher motivation and better learning. In contrast, self-determination theory posits that the content of the future goals (intrinsic vs. extrinsic) that enhance the utility value of the learning activity needs to be considered as well. Contrast-cell analyses of an experimental study showed that double goal framing (intrinsic plus extrinsic) facilitated a mastery orientation, performance, and persistence and decreased a performance-approach orientation compared with extrinsic goal framing. However, double goal framing resulted in a less optimal pattern of outcomes compared with intrinsic goal framing, suggesting that the content of the provided goals matters. Goal content effects on both performance and persistence were fully mediated by mastery orientation.

Cortright, Ronald N.; Collins, Heidi L.; DiCarlo, Stephen E. (2005) tested the hypothesis that peer instruction enhances meaningful learning or transfer, defined as the student's ability to solve novel problems or the ability to extend what has been learned in one context to new contexts. To test this hypothesis, our undergraduate exercise physiology class of 38 students was randomly divided into two groups: group A (n = 19) and group B (n = 19). A randomized crossover design in which students either answered questions individually or during peer instruction was used to control for time and order effects. The first factor that influences meaningful learning is the degree of mastery of the original material. Importantly, peer instruction significantly enhanced mastery of the original material. Furthermore, the student's ability to solve novel problems was significantly enhanced following peer instruction. Thus
pausing two to three times during a 50-min class to allow peer instruction enhanced the mastery of the original material and enhanced meaningful learning, i.e., the student's ability to solve novel problems.

He, Tung-Hsien (2005) studied the "Effects of Mastery and Performance Goals on the Composition Strategy Use of Adult EFL Writers". This study examines the combined effects of contrasting mastery and performance goals on the use of composition strategies by adult writers of English as a Foreign Language (EFL). Thirty-eight Taiwanese English-major college seniors of homogeneous writing proficiency consented to participate in the study. Based on responses on a goal scale, 19 participants were assigned to the high-mastery-low-performance (HMLP) group, and 19 were assigned to the low-mastery-high-performance (LMHP) group. Participants in the HMLP group were diagnosed as having stronger mastery but weaker performance goal orientations, whereas those in the LMHP group demonstrated the opposite tendency. Evidence from think-aloud protocols indicated that (a) participants used 20 distinctive strategies classified into five categories; (b) the HMLP group used monitoring/evaluating, revising, and compensating strategies significantly more often than the LMHP group; and (c) the frequency of revising strategies and mastery orientations served as two significant positive predictors for better writing outcomes.

Singer-Dudek, Jessica; Greer, R. Douglas (2005). A Long-Term Analysis of the Relationship between Fluency and the Training and Maintenance of Complex Math Skills. In 2 experiments, each involving different mathematical operations, we compared 2 training procedures for teaching component math skills in terms of their effects on the learning and long-term maintenance of composite skill. The dependent variables were learn units to composite task mastery and performance on the composite task 2 months later. The independent variables were instruction in math facts under (a) fluency and (b) mastery conditions. The
experiments used a simultaneous treatment design in which the students were selected for participation according to prerequisite skills and instructional histories and randomly assigned to receive 1 of the 2 training procedures. Four adolescents with developmental disabilities participated in each experiment. Instructional presentations were controlled by yoked learn units during component skill instruction. Results showed that fluency instruction did not result in fewer learn units to criterion on the composite task. However, 2 months later, the fluent students performed between 83% and 100% correct on the composite task, while the mastery students performed between 17% and 83% correct. The data are discussed in terms of fluency theory and educational practice. Note: The following two links are not-applicable

**Thompson, Ted; Musket, Sarah 2005** Does Priming for Mastery Goals Improve the Performance of Students with an Entity View of Ability?

Background: There is evidence that an entity view of ability (where ability is viewed as a fixed entity that cannot be changed) is linked with social comparison goals and poor performance. On the other hand, an incremental view of ability (where ability is viewed as an acquirable skill) is linked with a mastery goal orientation and positive achievement outcomes. On these bases, the present study sought evidence that priming students with an entity view of ability to pursue mastery goals would result in improved performance. Sample: Participants were 48 students with an entity view of ability, and 48 students with an incremental view of ability. Method: We used a 2 (views of ability: entity, incremental) □ 2 (performance feedback: success, failure) □ 2 (goal priming: mastery, social comparison) between-subjects factorial design to examine the effects of goal priming on performance for students with either an incremental or entity view of ability following either success or failure feedback. Prior to, and following, performance feedback, participants completed parallel measures of state anxiety.
Participants were then primed for either social comparison goals prior to attempting to solve 16 Unicursal (tracing puzzle) tasks. Their performance on a subsequent set of Unicursal tasks was then examined. Finally participants completed a State Goals Scale assessing their degree of endorsement of social comparison/mastery goals whilst working on the Unicursal tasks. Results: The performance of students with an incremental view of ability was comparable irrespective of whether they were initially exposed to success and failure feedback and irrespective of whether they were primed for mastery or social comparison goals. However the performance of students with an entity view of ability improved when they were primed for mastery relative to social comparison goals irrespective of whether they were initially exposed to success or failure. Conclusions: These findings confirm theing consequences of social comparison goals for participants with an entity view of ability, suggesting benefits in encouraging these students to pursue mastery goals.

Kenney-Benson, Gwen A.; Pomerantz, Eva M.; Ryan, Allison M.; Patrick, Helen (2006) examined whether the tendency for girls to outperform boys in the classroom is due to differences in how girls and boys approach schoolwork. In 5th grade and then again in 7th grade, children (N=518) reported on how they approach schoolwork (i.e., achievement goals and classroom behavior), their learning strategies, and their self-efficacy in math; math grades and achievement test scores were also collected. Girls were more likely than boys to hold mastery over performance goals and to refrain from disruptive classroom behavior, which predicted girls' greater effortful learning over time. The sex difference in learning strategies accounted for girls' edge over boys in terms of grades. Girls did not do better on achievement tests, possibly because self-efficacy, for which there was also no sex difference, was the central predictor of performance.
Moos, Daniel C.; Azevedo, Roger (2006) studied the Role of Goal Structure in Undergraduates’ Use of Self-Regulatory Processes in Two Hypermedia Learning Tasks. We collected think-aloud and posttest data from 60 undergraduates to examine whether they used different proportions of self-regulated learning (SRL) variables in two related learning tasks about science topics while using a hypermedia environment. Participants were randomly assigned to one of three conditions (mastery goal structure, performance-approach goal structure, or performance-avoidance goal structure) and participated in two 20-minute learning tasks in which they used hypermedia to learn about the circulatory system in one learning task and the respiratory system in another learning task. Results indicate that a mastery goal structure and a performance-approach goal structure are related to undergraduates’ use of similar proportions of SRL variables in two hypermedia learning tasks, whereas a performance-avoidance goal structure is related to undergraduate’s use of different proportions of SRL variables, specifically “planning,” in two similar hypermedia learning tasks.

Tanaka, Ayumi; Takehara, Takuma; Yamauchi, Hirotsugu (2006) did a study to test the linkages between achievement goals to task performance, as mediated by state anxiety arousal. Performance expectancy was also examined as antecedents of achievement goals. A presentation task in a computer practice class was used as achievement task. Fifty-three undergraduates (37 females and 16 males) were administered self-report questionnaire measures before and immediately following the task performance. As expected, results of regression analyses showed that performance-avoidance goals were positively related to state anxiety. State anxiety was related to poor task performance. The positive relationship between mastery goals and the task score was shown to be
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independent of anxiety processes. Performance expectancy was related to state anxiety through achievement goals.

RESEARCH STUDIES ON COMPUTER ASSISTED INSTRUCTION

Coorough, Randall Phillip (1990) conducted a study entitled *the effects of program control, learner control and learner control with advisement lesson control strategies on anxiety and learning from CAI*. The purpose of this study was to examine the effects of three CAI locus of instructional control strategies on anxiety and learner achievement. The three CAI locus of instructional control strategies examined were learner control (LC), learner control with advisement (LCA) and program control (PC). To examine the effects of CAI lessons on learner anxiety and achievement, split-plot and pre-posttest experimental designs were used. The subjects in this study (N = 106) were undergraduate students enrolled in a general humanities course. The results of the study indicated that there was no significant achievement difference between subjects assigned to PC, LC and LCA locus of instructional control strategies. Finally, the LCA group required a significantly greater amount of time to complete the CAI lesson than was required by the LC group, yet had no associated achievement gain.

Hicken, Sam (1991) conducted a study on *learner control and incentive in CAI*. This study investigated the effects of two general approaches to the provision of learner control and of two types of incentive on achievement use of options and attitude in CAI. In the FullMinus approach, a full instructional program is the default but learners can opt to bypass elements of instruction. Criterion measures consisted of a 32 item embedded posttest and an on-screen 11 item post instruction questionnaire. Learner control results indicated that posttest scores for the FullMinus treatment were higher than those for Leanplus treatment and that the FullMinus groups had more positive attitudes. Yet subjects in the fullminus treatment spent no more time on the program than leanplus subjects. The findings
Clayton, Ida Long (1992) conducted a study entitled the relationship between CAI in reading and mathematics achievement and selected student variables. This study was designed to determine the effectiveness of CAI on reading and mathematics achievement, attitude toward reading and mathematics, and the effect of CAI on reading and mathematics achievement, attitude for low socioeconomic students. The study involved students in grade 2-5 in five elementary schools. Findings indicate that CAI improved reading for students at the fourth-grade level, and increased positive attitude toward reading for third and fourth grade students in the low socioeconomic category. The CAI students in grade 2, 4 and 5 made significant gains in mathematics achievement. A more positive attitude toward mathematics was shown by students in grade 3 and 4 following CAI.

Abadir, Laila et al (1993) discussed the effects of Mastery Learning strategies, interactive video mathematics (IVM), individualized instruction (IND), and the lecture method on mathematics achievement of community college students was studied. Interactions among instructional methods, gender, and age were examined; and the grade success rate was determined for each instructional method. The IND and IVM methods were characterized by Mastery Learning principles. Pretest and posttest components determined the mathematics achievement of college freshmen. Of 377 students enrolled in basic skills mathematics courses at an urban multicampus two-year community college for whom pretest results were available, complete data were obtained for 137 adults aged over 22 years and 82 traditional students aged 17 to 22 years. The efficacy of the methods was compared, and a final grade success rate was determined for each group using chi-square for testing significant differences. IVM and IND methods
had a positive educational influence on students' achievement on mathematics basic skills posttest scores, but, because many of these students did not complete the course in 10 weeks, grade success rate was significantly lower for these methods than for the lecture method. No significant difference was found for gender on the main effects, but a significant difference for simple effects shows that males favor the IVM method. Those over 22 years old had higher achievement than did those in the traditional college age group.

**Pamula, Frederick (1994)** discussed the use of a computer simulation program in teaching the concepts of spectrophotometry. Introduces several parts of the program and program usage. Presents an assessment activity to evaluate students' mastery of material. Concludes with the advantages of this approach to the student and to the assessor.

**Lamb, C.M. (1995)** studied computer - integrated learning system and elementary student achievement in mathematics: an evaluation study. The results showed that the gains of students using the computer were greater than the gains of earlier classes. Higher achieving student's mean scores increased more than average student's scores. Average achieving student's scores increased more than the low achieving students. Females in low achieving groups had greater gains than males.

**Laney, James D. et al (1995)** explored the effects of cooperative and Mastery Learning methods, alone and in combination, on first and second grade students' learning and retention of basic economic facts. A 2 X 2 (cooperative X mastery) factorial design compared the achievement of 120 students randomly assigned by grade level stratification to one of four treatment conditions: cooperative learning; mastering learning; cooperative-Mastery Learning; and a control treatment (no cooperative or Mastery Learning). All subjects were administered a written pretest, posttest, and delayed posttest on their
understanding of economic concepts. In addition, a randomly selected subsample of 64 students was interviewed using an oral pretest, posttest, and delayed posttest. The study suggests that the cooperative-Mastery Learning method is in line with current early childhood practices and has the capacity for simultaneously boosting the conceptual development and language development of young children. This capacity is said to stem from the method's provision of: (a) specific, positive feedback; (b) a social context for sustained effort and involvement in a topic; (c) child-child communication exchanges; and (d) adult-child communication exchanges.

Schalago-Schirm, Cynthia (1995) investigated does the Computer-Assisted Remedial Mathematics Program at Kearny High School Lead to Improved Scores on the N.J. Early Warning Test? The study reveals that Eighth-grade students in New Jersey take the Early Warning Test (EWT), which involves reading, writing, and mathematics. Students with EWT scores below the state level of competency take a remedial mathematics course that provides students with computer-assisted instruction (2 days per week) as well as regular classroom instruction (3 days per week). The study was conducted using 73 ninth-grade students enrolled in the Kearny High School remedial course. The computer instruction provided is specifically designed to help students attain proficiency on the mathematics portion of a state-mandated high school proficiency exam. The students were retested with the "New Jersey Special Edition EWT-Grade 9" after 6 months of remediation, and the sample mean score (March 1994) was compared with the sample mean score (March 1993). Results indicated a statistically significant gain but more than 50% of the sample still needed further remediation.

Lafronza, V.N. (1997) conducted a study on the interaction of adult learning styles and instructional design: implications for the design of computer
assisted instruction. The results indicate that cognitive styles play a significant role in adult learner's performance, at least in CAI learning environment.

Clawford, Oliver Gahlen (1998) did an analysis of the effects of a learning style seminar and a computer assisted instruction package on the academic achievement of selected seminary students. The results concluded that the student's academic achievement was positively affected by participation in the learning style seminar, utilization of the CAI package, and combining the participation in the learning style seminar with the utilization of the CAI package.

Wittman, Timothy K.; Marcinkiewicz, Henryk R.; Hamodey-Douglas, Stacie (1998) did a study on Computer Assisted Automatization of Multiplication Facts Reduces Mathematics Anxiety in Elementary School Children. Fourth grade elementary school children exhibiting high and low mathematics anxiety were trained on multiplication facts using the Math Builder Program, a computer program designed to bring their performance to the automaticity level. Mathematics anxiety, measured by the Mathematics Anxiety Rating Scale--Elementary version (MARS-E), was assessed before and after the students demonstrated automaticity level performance on the multiplication facts. Results showed that all of the students automatized the multiplication facts using computer training. Students in the high anxiety group averaged the greatest improvement in performance and were indistinguishable from the low anxiety group by the end of the automaticity training. The high anxiety girls, but not the high anxiety boys, significantly reduced their mathematics anxiety ratings. No significant change in mean anxiety ratings were detected for students in either of the low anxiety or the control groups. Results indicate that both high and low anxiety boys and girls achieved automaticity level performance of multiplication facts using computer assisted training, and training of multiplication facts to the automaticity level resulted in significant reductions of mathematics anxiety ratings. Results support
the position that mathematics anxiety may result from a failure to learn or inadequate preparation in the mastery of fundamental skills. Implications of these findings for mathematics instruction and curricula development are discussed.

**Ford, Barbara; Klicka, Mary Ann (1998)** An individualized Computer Assisted Instruction (CAI) Mastery Learning format was offered to sections of Fundamentals of Mathematics and Basic Algebra courses over four semesters (two academic years). The effectiveness of this method compared to a traditional lecture approach was examined in the areas of passing the course, passing the final examination, course retention, and passing the next math course. For the Fundamentals course, no significant differences were found among methods in all of the above areas except course retention; course retention was significantly higher in traditional sections. In the Basic Algebra course, traditional sections had significantly higher pass rates and course retention rates. CAI sections had significantly higher exam pass rates.

**Brophy, K.I. (1999)** while studying "Is computer assisted instruction effective in the science classroom?" concluded that CAI can be effective in the classroom if used properly by the teacher.

**Chan, J.S. (1999)** studying the predictors of achievement using CAI: self efficacy for achievement and control of learning beliefs concluded that there was no significant positive relation between time spent using CAI and prior knowledge, self efficacy and control of learning beliefs. From the results of the exploratory analyses, rehearsal, elaboration and critical thinking were more likely to be used by students using CAI.

**Kuchler, J.M. (1999)** studied the effectiveness of using computers to teach secondary school (grade 6-12) mathematics: A meta-analysis. The results suggest that CAI has only an overall small positive effect on mathematics achievement but a possible medium positive effect on retention of mathematical concepts and skills.
of secondary school students. The most effective CAI mode appears to be 'drill and practice'. CAI appears to be equally effective across gender and grade level, but has a greater positive impact on students from low socio-economic backgrounds.

**Penn & Nedeff (2000)** describe a Web-based system for organic chemistry. They demonstrate higher earned test scores for those students making the largest number of attempts on Web-based practice system.

**Rick Mills (2001)** conducted *A comparison study of learning effectiveness of CAI vs. Classroom lecture*. He investigated the effectiveness of using CAI for skill training in the workplace. Manufacturing employees received electrical training using CAI or classroom lecture. Learning, satisfaction, and cost of each method were measured. CAI was found as effective as classroom for factual topic, but not as effective for theoretical topics. CAI learning required less time for factual topics, but more time overall and for theoretical topic.

**Panarat Sangvichit (2002)** conducted a study entitled *The development of CAI in higher vocation certificate curriculum for business computer of computer network*, built and developed the computer assisted instructions, took it for three processing experiments as follows:

1. The one on one testing,
2. The small group testing, and
3. Field testing

With the 35 students who have never learned computer network. The computer assisted instructions for business computer of computer network in higher vocational certificate curriculum concluded that researcher had built and developed take the effectiveness of standard 85.7/85.44. so, this CAI can be used in classes.
Anderson Mark Busey (2003) conducted a study entitled *Features of Programmed Logic for the Automatic Teaching Operations (PLATO), a CAI learning system, that promote student’s mathematics achievement*. A literature review. Studies and analyses sought evidence in support of computer assisted instruction (CAI) program, in general. PLATO, specifically, has gathered much attention as an alternative educational solution to traditional instruction. This learning system provides student users with a self-directed medium for learning. The instructor-as-tutor feature is a resulting effect on the learning environment. In addition to quality of content, three program features are important: self pacing, self-mastery and instructor-as-tutor are integral parts of PLATO software. The instructor-as-tutor feature is a resulting effect on the learning environment. First developed over 40 years ago, PLATO has helped producing significant achievement scores and gains in a variety of learning contexts. Based on a review of 22 studies, the aforementioned features of PLATO seen to reorient instruction around the student user. Teachers become tutors, or guides, to students in a PLATO classroom. However, a limited population of students seemed to have benefited from the use of PLATO program. Hence, questions of equity and access were addressed.

Hay, Kurt Mathew (2003) studied *CAI in mathematics: determining the volume of three dimensional figures*. This study is a field test of CAI in geometry. The subjects were eighth grade general math students from a heterogeneous group from Palos Verdes Intermediate school. The purpose of this CAI was to teach an in-depth, unique lesson of finding the volume of three dimensional figures. This paper discusses the results and significance of field tested CAI program as a means of delivery of instruction. Students responded to an interactive lesson, with remediation, that culminated in a real world example of benefits of understanding volume of three dimensional figures. The pre and post-test evaluation provided the
assessment tool and results indicate that this tutorial was valuable in helping students learn how to determine volume of three dimensional figures.

Sinclair, Kelsey J.; Renshaw, Carl E.; Taylor, Holly A. (2004) did a study focused on the effectiveness of using CAI to teach logarithmic graphing and dimensional analysis. Two groups of ninth graders participated in a one-class period laboratory. Experiment 1 compared a fully automated computer laboratory to an equivalent paper-and-pencil exercise. Experiment 2 compared the same automated computer laboratory in Experiment 1 with a revised, less automated computer version. Both the paper-and-pencil exercise and the less automated computer exercise required students to perform basic mathematical calculations. The results from a post-test revealed that very few students were able to master the complex task of dimensional analysis, but students who took the paper-based and revised, less automated version scored higher overall. These results imply that students required to perform basic calculations had a better understanding of the lab as a whole. These results suggest that until students master basic skills, they do not have the cognitive resources to concentrate on higher-order concepts. This is supported by cognitive load theory.

Coleman-Martin, Mari Beth; Heller, Kathryn Wolff; Cihak, David F.; Irvine, Kathryn L. (2005) determined if the use of computer-assisted instruction would be an effective method to promote word identification using the Nonverbal Reading Approach (NRA). Three students with severe speech impairments and concomitant physical disabilities or autism were provided decoding and word identification instruction using the NRA across three conditions simulating the natural progression of classroom instruction from teacher-directed to computer-assisted instruction. The three conditions were (a) teacher only, (b) teacher plus computer-assisted instruction, and (c) computer-assisted instruction only. All participants reached criteria in each of the three
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conditions. Results indicate that the NRA can be effectively delivered through computer-assisted instruction, thus freeing up teacher time and providing students with the ability to practice decoding and word identification independently.

Pol, Henk; Harskamp, Egbert; Suhre, Cor (2005) developed a computer program about the subject of forces containing hints for the various different episodes of problem-solving. This study was undertaken with a group taking part in the experiment (n = 11) who used both their textbook and the computer program, and a control group (n = 25) who used their textbook only. There was evidence to show that the pupils from the group taking part in the experiment did achieve higher results in solving problems. Exploration and planning were improved but evaluation was not. It appeared that pupils involved in the experiment made better use of their declarative knowledge in solving problems than pupils from the control group.

Zhang, Yixin (2005) determined the effectiveness of computer-assisted instruction (CAI) versus traditional lecture-type instruction on triangles. Two quasi experiments were conducted in six 6th grade classes with a total of 108 students respectively. The students in the control groups were taught the concepts of triangles in their original classes, while the students in experimental groups were instructed in a computer lab. Experimental group students utilized Interactive Middle School Math Bundle, which is an interactive Webpage-typed tutorial. The tutorial, featuring descriptions, sound, animation and self-examination, allowed students to navigate and self-explore themselves. Independent-t was used to analyze the data. The analysis revealed that there was no statistically significant difference between the students' achievement in the control and experimental groups. The result implies that teachers could use computer-assisted instruction software only as a supplemental tool. Further research is recommended to examine effectiveness of computer-assisted instruction with an extended time span.
Cepni, Salih; Tas, Erol; Kose, Sacit (2006) conducted a study to investigate the effects of a Computer-Assisted Instruction Material (CAIM) related to "photosynthesis" topic on student cognitive development, misconceptions and attitudes. The study conducted in 2002-2003 academic year and was carried out in two different classes taught by the same teacher, in which there were fifty two 11th grade high school students, in central city of Trabzon in Turkey. An experimental research design including the photosynthesis achievement test (PAT), the photosynthesis concept test (PCT) and science attitude scale (SAS) was applied at the beginning and at the end of the research as pre-test and post-test. After the treatment, general achievement in PAT increased by 10% in favour of experiment group (EG) at (p<0.05) significant level. Although the increase in cognitive development at knowledge level was 14.8% in the EG and 18.2% in the control group (CG), the development at comprehension and application levels were 19.8-18.5 in the EG and 1.75-0.86 in the CG, respectively. This result showed that using CAIM in teaching photosynthesis topic was very effective for students to reach comprehension and application levels of cognitive domain. However, CAIM did not change major misconceptions related to photosynthesis topic in EG as expected. Meanwhile, same misconceptions in EG about source of energy for plants and their nutrition were decreased more than CG. It was also found out that there was little change about students' attitudes towards science education in both groups.

Rayneri, Letty J.; Gerber, Brian L.; Wiley, Larry P. (2006) examined the learning styles of gifted middle school students, student perceptions of the classroom environment, and possible connections between learning style, classroom environment, and achievement levels. Eighty gifted students from grades 6, 7 & 8 were administered the Learning Style Inventory (LSI) to identify student learning style preferences. They were also administered the Student
Perception Inventory (SPI), developed for the study, in order to determine perceptions of these learning style elements in their classroom environments. Results indicated that the LSI elements of persistence and lighting correlated with achievement in all content areas. Additionally, correlations between higher grade point averages (GPA) and LSI preferences for responsibility and teacher motivation were found in science and math classes. Results of the SPI revealed a correlation between higher grade point averages in social studies and science classrooms and the following items: persistence; motivation; and auditory, tactile, and kinesthetic modalities. All subject areas showed a correlation between higher GPA and the students' perceived level of persistence.

RESEARCH STUDIES ON LEARNING APPROACHES

Garcia, Teresa; Pintrich, Paul R. (1992) identified some of the important correlates of critical thinking, in terms of motivation, use of cognitive learning strategies, and classroom experiences. Participants (N=758) were college students attending three midwestern institutions (a community college; a small private college; and a comprehensive university) during the 1987-88 school year. Twelve classrooms were sampled, spanning three disciplines: biology (three classes, N=219); English (three classes, N=110); and social science (six classes, N=429). The Motivated Strategies for Learning Questionnaires (MSLQ) was administered to students at the beginning and at the end of the winter 1988 school term. The results of the analyses lend further support for the positive relationship between "deep" processing (in this case, critical thinking) and an intrinsic goal orientation. The relationship between critical thinking and a mastery orientation, however is tempered by the content domain. Intrinsic goal orientation is a significant, positive predictor of critical thinking for biology and social science students, but not for English students, at both the pretest and posttest. Metacognitive self-regulatory strategies were consistently positively related to critical thinking, both across
domains and at the two time points. In summary, this study supported the positive relationship between motivation, deep strategy use, and critical thinking.

Lai, Patrick; Biggs, John (1994) compared data from 95 educationally disadvantaged Hong Kong students placed in mastery-learning classes with 64 control students in expository-learning classes. Results indicate that under Mastery Learning, deep- and surface-biased learners increasingly diverge in performance and attitude, with surface learners doing better unit to unit, and deep learners worse. Implications for Mastery Learning are discussed.

Drew, Po Yin; Watkins, David (1997) studied Affective Variables, Learning Approaches and Academic Achievement: A Causal Modeling Investigation with Hong Kong Chinese Tertiary Students. This study investigates the interrelationships of academic causal attributions, academic self-concept, learning approaches, and their effects on academic achievement among Hong Kong Chinese tertiary students. It was hypothesized that academic causal attributions and academic self-concept affect the learning approaches students adopt and subsequently influence achievement outcomes. Structural equation modeling was used to clarify the interrelationships of these variables and their relative contributions to academic achievement. The participants were 162 first-year full-time Hong Kong Chinese university students. Results show that, as predicted, both academic causal attributions and academic self-concept have direct effects on students' learning approaches that in turn influenced their academic achievement.

Chin, C. Hui Li (1998) studied student's learning approaches and their understanding of some chemical concepts in 8th grade science. The analysis revealed the differences between the deep and surface learning approaches regarding generative thinking, nature of explanations, asking questions, meta-cognitive activity and approach to tasks.
Humphreys, B. K. (1998) studied how do students learn or fail to learn in a traditional chiropractic curriculum. The results revealed that student learning was affected by the educational environment, personal and curricular motivations to learn, personal perceptions of curriculum and individual approaches to learning and studying.


Watkins and Wong (1998) conducted a longitudinal study of psychosocial environmental and learning approaches in the Hong-Kong classroom. The study revealed that an enjoyable classroom environment mediated the causal relationship between a deep approach and high level achievement. However, classroom environment did not seem to influence changes in approach to learning.

Yildirim, Ali; Somuncuoglu, Yesim (1998) identified student’s achievement goal orientations, learning strategies. They use and the relationship between goal orientations and learning strategies. The sample included 189 students taking an educational psychology course at the undergraduate level. They filled out a questionnaire on goal orientations and learning strategies. Results indicate that the students are very close to mastery orientation and somewhat ego-social as a whole. Students use deep cognitive strategies often while they use surface and metacognitive strategies sometimes. Mastery orientation predicts the use of deep cognitive and metacognitive strategies, but when such an orientation is salient, less surface cognitive strategy use is expected. Ego-social orientation predicts surface cognitive strategy use, but does not relate to deep and metacognitive strategy use at all. Finally, work-avoidant orientation negatively correlated with both deep cognitive and metacognitive strategy use.
Britton, L.A (1999) conducted an exploratory study of the impact of hypermedia based approach and science-in-fiction approach for instruction on the polymerase chain reaction. The results revealed that the significant conceptual change about the nature of science was not detected, even though most students demonstrated deep and or elaborate learning styles.

Chin, Christine (1999) investigated Learning in Science: How Do Deep and Surface Approaches Differ? The purpose of this study was to compare in greater depth the qualitative differences between what previous researchers have called a deep versus surface approach to learning science. Six grade 8 students judged as typical using a deep or surface approach were videotaped or audiotaped during class group laboratory activities in a chemistry unit. They were also interviewed individually before and after instruction about related science concepts. On analysis of students' discourse and actions during the activities and their interview responses, several differences in learning approaches seemed apparent. These differences fell into five emergent categories: (1) generative thinking; (2) nature of explanations; (3) asking questions; (4) metacognitive activities; and (5) approach to tasks. When students used a deep approach, they ventured into their ideas more spontaneously; gave more elaborate explanations which described mechanisms and cause-effect relationships; asked questions which focused on explanations and causes, predictions, or resolving discrepancies in knowledge; and engaged in "on-line theorizing." Students using a surface approach gave explanations that were reformulations of the questions, a "black box" variety which did not refer to a mechanism, or macroscopic descriptions which referred only to what was visible. Their questions also referred to more basic factual or procedural information. The findings also suggest that to encourage a deep learning approach, teachers can provide prompts and
contextualized scaffolding and explicitly encourage students to ask questions, predict, and explain during activities.

Salimkumar, C (1999) studied the impact of approach to studying and achievement motivation on achievement in Biology in relation with intelligence. The study concluded that there is no impact of approaches to studying and achievement motivation on achievement in Biology for high, low or average intelligence group.

Yin, Lai Po (1999) did a Longitudinal Study of Hong Kong Chinese University Students' Academic Causal Attributions, Self-Concept, Learning Approaches, and their causal effects on Achievement. The longitudinal changes in the causal attributions, academic self-concept, and learning approaches of 549 university students in Hong Kong were studied. Students were enrolled in two different disciplines: language/health studies (n=272) and construction/engineering (n=277). Measurements of causal dimensions, academic self-concept, learning approaches, and achievement were obtained on two occasions with an interval of about 6 months. Causal dimensions, academic self-concept, and learning approaches showed significant change over time for the sample. In general, students exhibited a decrease in internal attributions and a drop in deep approach to learning. The construction and engineering group tended to be less internal in attribution and less deep in learning approach than the language and health studies group. Overall, the causal influence of the variables of attribution, self-concept, and learning approaches on academic achievement, although significant, was relatively weak.

Van Melle, Elaine Patricia (2000) evaluated the use of a CD-ROM to foster learning for understanding using a case study approach. This study examined the use of a multi-media CD ROM entitled HyperClinic: Interactive Case Studies in Microbiology in order to foster to learning for understanding in a
first year microbiology course for nurses. Results of the Study Process Questionnaires showed that there was a significant shift in a deep approach to learning over the course of the term. Student interviews revealed that the computer technology supported this shift by providing students with the opportunity to apply what they had learned in class to specific case studies.

Behrens, Holly Marie (2001) showed that different orientations to teaching by professors are not associated with qualitatively different approaches to student learning via Internet based instruction. This study made use of modified version of the lecture’s Conceptions of Teaching and Learning Questionnaire (Kember & Gow, 1994). The quality of student learning was examined with a modified version of the Study Process Questionnaires (Biggs, revised 1999). The SPQ was administered to the students in a pre – class / post – class design that measured student’s approaches to studying (deep and surface) before and after the course of study. The sample was composed of graduate business instructors and students of same instructor, during various lengths of internet – based instruction. Surprisingly, these results are contrary to similar studies using similar instruments measuring variations in teaching at the individual instructor and department level in the traditional classroom.

Evans, Christiana Janet (2001) studied Approaches to Learning, need for cognition, and strategic flexibility among university students. The purpose was to explore relationships among three questionnaires: The Study Process Questionnaires (SPQ) (Biggs, 1978), the Need for Cognition Scale (NCS) (Cacioppo & Petty, 1982) an Strategic Flexibility Questionnaire (SFQ) (Cantwell and Moore, 1996). The SPQ measures three approaches to learning: deep, surface and achieving. Underlying theory suggested strong similarities among need for cognition, the deep approach and adaptive control, as well as similarities among surface approach, inflexible control, and irresolute control. Further surface,
inflexible and irresolute appeared to be opposites of need for cognition, deep and adaptive. It was proposed that these scales might all be measuring one underlying construct such as self-regulated learning.

Diseth, Age (2002) found the Relationship between Intelligence, Approaches to Learning and Academic Achievement. Administered three tests of intelligence and the Approaches and Study Skills Inventory for Students (Entwhistle, 1997) to 89 Norwegian undergraduates to study the relationships among intelligence, approaches of learning, and academic achievement. Findings support the construct validity of approaches to learning because of its independence from intelligence.

Hei, Luying Melissa (2003) did a Comparison of University Students' Approaches to Learning across Taiwan and Turkey. Compared the approaches to learning of 464 Turkish university students and 546 Taiwanese university students who completed an approaches to learning inventory. Differences were found, but the magnitude was not large; the two cultures shared many characteristics in the measured trait.

Diseth, Age; Martinsen, Oyvind (2003) studied Approaches to Learning, Cognitive Style, and Motives as Predictors of Academic Achievement. The relationship among approaches to learning (deep, strategic, and surface), cognitive style, motives, and academic achievement. Focuses on undergraduate psychology students (n=192) who were around the mean age of 21.7. Reports that motives and styles were related to three learning approaches. Includes references.

Byrne, Marann; Flood, Barbara; Willis, Pauline (2004) investigated on Using the Student Learning Framework to Explore the Variation in Academic Performance of European Business Students. The primary focus of this study is to explore the variation in academic performance of European Business (EB)
students, using the student learning framework. Prior research has shown that student’s approaches to learning and preferences for teaching influence the quality of their learning outcomes. The Approaches and Study Skills Inventory for Students (ASSIST) is used in this study to obtain quantitative information about student’s approaches to learning and preferences for teaching. Academic performance is represented by student’s average mark across all first-year modules. The results show that high-achieving students are more likely to adopt a strategic approach to learning and have a preference for teaching that supports understanding. They are less inclined to adopt an instrumental approach to learning.

Lindblom-Ylanne, Sari (2004) studied on Raising Student’s Awareness of Their Approaches to Study. Experiences from study counseling at the Faculty of Law, University of Helsinki, show that some students confront difficulties in adapting to this kind of learning environment. The participants of this small case study were 11 law students who received study counseling from the author. The students completed the Reflections on Learning Inventory (RoLI) (Meyer, 2000). The students analysed their conceptions of learning and knowledge as well as their study practices with the author on the basis of the results of the RoLI. The results showed that the RoLI functioned very well as a diagnostic tool in study counseling. By analysing their own results of the RoLI, students became more conscious of their conceptions of learning and their approaches to studying, and they were able to develop more efficient and functional study practices in their learning environment.

Karagiannopoulou, E.; Christodoulides, P. (2005) The Impact of Greek University Students’ Perceptions of Their Learning Environment on Approaches to Studying and Academic Outcomes. The relationship between university student’s perceptions of their academic environment, their approaches to study, and
academic outcomes was investigated for first and fourth-final year students. The responses of 88 first and 92 fourth year students were analysed using a path analysis model. The analysis gave two factors which reflect the deep and surface approaches to studying. For the first year students, University grade was not associated with any of the explored variables but the level of satisfaction was predicted by relationships with tutors and fellows. For the fourth year students, good teaching predicted achievement both directly and indirectly through the deep approach to studying. The findings indicate that fourth year student’s perceptions of the current learning environment are a stronger predictor of academic achievement than prior academic ability (university entrance examinations' grade).

Murphy, Suzanne M.; Tyler, Sheila (2005) worked on the Relationship between Learning Approaches to Part-Time Study of Management Courses and Transfer of Learning to the Workplace. The aim of this study was to investigate the relationship between student’s learning approaches to study on part-time, distance-learning management courses, and transfer of their learning to the workplace. Three learning approaches are identified by ASSIST, the instrument used in this study: the deep approach, the strategic approach, and the surface-apathetic approach. Transfer of learning was measured by student self-report. The deep approach was closely related to transfer of learning from the course to the workplace but strategic and surface-apathetic approaches did not show a significant association. Contrary to expectations, academic grades also showed no significant association with transfer of learning.

Wilson, Keithia; Fowler, Jane (2005) Assessing the Impact of Learning Environments on Students’ Approaches to Learning: Comparing Conventional and Action Learning Designs. This study investigated whether student’s approaches to learning were influenced by the design of university courses. Pre- and post-evaluations of the approaches to learning of the same group of students
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concurrently enrolled in a conventional course (lectures and tutorials) and an action learning-based course (project work, learning groups) were conducted. Students who reported themselves as more "typically deep" in their approach to learning were consistent in their approaches across the different environments. However, students who reported themselves as more "typically surface" were influenced to adopt deeper processing strategies in the action learning design. Students explained this "deep shift" in terms of the greater expectations of learner activity and responsibility in the action learning design.

Moos, Daniel C.; Azevedo, Roger (2006) *The Role of Goal Structure in Undergraduates' Use of Self-Regulatory Processes in Two Hypermedia Learning Tasks*. The data on think-aloud and posttest data from 60 undergraduates to examine whether they used different proportions of self-regulated learning (SRL) variables in two related learning tasks about science topics while using a hypermedia environment was collected. Participants were randomly assigned to one of three conditions (mastery goal structure, performance-approach goal structure, or performance-avoidance goal structure) and participated in two 20-minute learning tasks in which they used hypermedia to learn about the circulatory system in one learning task and the respiratory system in another learning task. Results indicate that a mastery goal structure and a performance-approach goal structure are related to undergraduates' use of similar proportions of SRL variables in two hypermedia learning tasks, whereas a performance-avoidance goal structure is related to undergraduate's use of different proportions of SRL variables, specifically "planning," in two similar hypermedia learning tasks.

Spada, Marcantonio M.; Nikcevic, Ana V.; Moneta, Giovanni B.; Ireson, Judy (2006) studied *Metacognition as a Mediator of the Effect of Test Anxiety on a Surface Approach to Studying*. This study investigated the role of metacognition as a mediator of the effect of test anxiety on a surface approach to
studying. The following scales were completed by 109 undergraduate social sciences students: Approaches and Study Skills Inventories for Students (ASSIST), Metacognitions Questionnaire (MCQ), and Test Anxiety Scale (TAS). Positive and significant correlations were observed between test anxiety and a surface approach to studying, and between all five dimensions of metacognition and test anxiety. Positive and significant correlations were also found between four of the five dimensions of metacognition and a surface approach to studying. The results supported the hypothesis that the effect of test anxiety on a surface approach to studying is entirely mediated by metacognition.

Struyven, Katrien; Dochy, Filip; Janssens, Steven; Gielen, Sarah (2006) did a study on the Dynamics of Students' Approaches to Learning: The Effects of the Teaching/Learning Environment. This study investigates the effects of the learning/teaching environment on student’s approaches to learning (i.e. combination of intention and learning strategies) and compares a lecture based to a student-activating setting within the first year of elementary teacher education. Data collection (N = 790) was carried out using a pre-test/post-test method by means of the Approaches to Learning and Studying Inventory (ALSI). Though students’ approaches were similar at the start of the course, a clear distinction was found after experiencing the lecture based and student-activating teaching/learning environments. However, the direction of change was opposite to the premise that student-activating instruction deepens student learning. Instead, the latter pushed students towards a Surface Approach to learning and students' Strategic Approaches suffered significant lowering.

RESEARCH STUDIES ON PERSEVERANCE

Catarina, Mathilda Braceros (1990) studied relationship of individual and academic characteristics on dropout and persistence in adult degree-bound students. This study was undertaken to increase the fund of knowledge and to
determine whether group of antecedent variables would predict dropout or persistence behaviour. The first part of study included tracking students for eight semesters to determine dropout or persistence status and collecting data from existing records. The second part of the study was the analysis of the questionare sent to all the students in the research project. The results indicated that an equation using the variables defined in this study could be utilized to improve the prediction of persistence of adult degree-bound students. The application of this equation for admission decision raises both economic and ethical issues.

Hupp, Susan C.; Abbeduto, Leonard (1991) examined behaviors reflecting mastery motivation in 17 young (ages 2 and 3) children with moderate and severe cognitive delays. Results supported the application of the mastery motivation model to this group of children who used mastery behaviors significantly more often than lower level exploratory behaviors. Use of mastery behaviors was related to the occurrence of success.

Tuttle (1994) conducted a study, which sought to use achievement need, attribution and perception of class room environment to identify those students who are more likely to persist in their programmes. The study used focus group interviews supplemented by quantitative measures to build a profile of the differences, which exist between persisting and non-persisting adult students. The results of this study showed no statistical differences between the 2 groups on quantitative measures. But some differences were identified in the areas of achievement need and perception of classroom environment.

Mason (1995) studied the relationship of academic background and environmental variables in the persistence of adult African-American male students in an urban community college. A working model was used which was based on a model developed by Bean and Metzner which investigated the role of student’s background and defining variables, academic variables, environmental
variables, academic outcomes, psychological outcomes, and intent to leave behavior and their relationship to persistence. A survey instrument was designed to obtain qualitative and quantitative data. The sample consisted of 205 new African-American male students who entered the college in fall of 1992. The model illustrates the relationship of sets of variables that were investigated. The background and defining variables have strong direct effect on persistence; on the set of academic variables; on the set of environmental variables; and on the set of psychological variables. The set of academic variables and outcomes, environmental and psychological outcomes and variables are all interrelated, and have relationship to persistence. The ability to articulate and internalize educational goals are variables that have strongest positive effect on persistence. Stress and intense feelings of helplessness or hopelessness are variables that have the strongest negative effect.

Mickens, C (1995) did a study on effects of learner characteristics and computer based instruction on achievement and persistence of ABE and ASE students. The results show that the variables that had the most impact on achievement were pre-assessment levels and computer managed instruction programme.

Van Blerkom, Malcolm L. (1996) conducted a study on Academic Perseverance, Class Attendance, and Performance in the College Classroom. Although college faculty often complain about class attendance, little data are available on why students miss classes and especially why absences are more common late in the semester. To explore this phenomenon, students’ abilities to persevere in an academic setting and relate that to their actual attendance and performance in a college class were examined. Whether or not this type of motivation is intrinsic to the individual and her/his self-concept, or is it more situation specific was also explored. Students (N=140) in undergraduate college
courses completed a questionnaire about academic perseverance and self-efficacy. Their responses were correlated with both attendance and performance in these classes. Analysis of the data indicated a significant correlation between class attendance and final grade in the course. Correlations among academic perseverance, self-efficacy, class attendance, and course grades were all fairly low. The low correlations could have been affected by range restrictions (in higher level courses there is typically little variation in either grades or attendance behavior). Since motivation may be a multiplicative relationship between self-efficacy and value, students may only be motivated if they feel competent to complete a task successfully.

**Fitzgerald, N.B and Young, M.B (1997)** studied the influence of persistence on literacy learning in adult education. The results indicated that student persistence contributed to reading achievement only in English as a second language (ESL) and had a negative effect in ABE (Adult basic education). Initial activity individualized curricula, full-time staff were primary influences on ABE achievement.

**Nora, A et al (1997)** studied persistence among non-traditional Hispanic students: a course model. The study examined experimental and instructional factors affecting persistence of Hispanic College students. Structural equation modeling was used to explore the effect of variables as grade point average, mathematics ability, family and home responsibilities, financial problems, cultural affinity, social integration, satisfaction with faculty, academic difficulty, academic integration, institutional commitment, intent to persist and encouragement. Finding confirmed the validity of model to explain the student's social and academic adjustment but not the impact of those experiences on their persistence.

**Fly, P.M. (1999)** studied student persistence, reading comprehension and success in the self-paced, computer assisted course. The study concluded that
while reading comprehension is important, the most important variable in determining student's success in self-paced CAI course work is persistence.

**Byer, John L. (2002)** conducted a study on Measuring Interrelationships between Graduate Students' Learning Perceptions and Academic Self-Efficacy. Graduate students (n=145) at a southern university completed a short form of the Student Assessment of Teaching and Learning Statistically significant (p<.05) relationships ranging from r=.16 to r=.41 were found between five of the predictor variables and academic self-efficacy. Factor analyzing the intercorrelation matrix indicated that four factors (labeled as knowledge and academic self-efficacy, skills, absences, and involvement) explained 67% of the variance. These findings provide evidence useful for creating an improved short-form instrument that measures predictor variables that are related to academic self-efficacy.

**Howell, Cynthia Lake (2003)** conducted a study of Resilience in adult women students in higher education: Implication for academic achievement and persistence. The purpose of the study was to identify, describe and analyze the factor or processes contributing to resilience in adult women students in higher education. The findings of the study identified the dispositional factors that enabled the participants to develop resilience to achieve academically and persist in higher education. Perseverance and flexibility emerged as primary components of their perceptions of resilience; risk taking and a sense of self-efficacy emerged as the critical element of the process of developing resilience.

**Cohen, Crecilla Vonetta (2004)** studied the impact of personal resources on college persistence and educational attainment. This study examines the influence of personal resources on educational attainment. Results indicate that, net of other important background characteristics, personal resources as measured by respondent's aspirations, advanced math taking and ACT preparation efforts significantly influence educational outcomes. However, they have stronger effects
on degree completion than persistence. The effects of advanced math courses on degree attainment are significantly stronger for women.

**Hoef, Ted F. (2004)** did a study on Within-year persistence of four-year college students by gender. Considering the major shift in the number of women attending college, there is a need for further persistence research on four-year college students by gender using national data samples such as the National Postsecondary Student Aid Study (NPSAS). The following research questions guide this study of four-year college students: (a) How do background, achievement and aspirations, institutional characteristics, college experiences, prices, debt, and financial aid variables influence the within-year persistence of all undergraduate students, female undergraduate students and male undergraduate students. This study found that the sample of male four-year college students had 24 variables that were significant and associated with persistence. Female college students had 20 variables that were significant and associated with persistence. The differences between males and females included:

- ethnicity,
- dependent,
- father with college experience,
- high test scores, and
- doctoral institution were positively associated with persistence for males, but not for females. Low test scores and living on-campus were positively associated with persistence for females. High debt and low debt were negatively associated with persistence for males, but not for female. While Hispanic ethnicity was negatively associated with persistence for females, but not for males.

**Bagby, Janet Marie (2005)** studied *Persistence to graduation: A study of an alternative high school*. The purpose of this study was to examine the
relationship between alternative school factors obtained from students' records and students' persistence to graduation. A secondary purpose of this study was to determine which, if any, variables can be used to predict graduation or non-completion (dropping out) for other students in the same school setting. Participants were 200 students that graduated (98) or dropped out (102) during the 2001& 2002 and 2002& 2003 school years. A significant relationship was found between persistence to graduation and student, school, and demographic variables.

Guan, Jianmin; Xiang, Ping; McBride, Ron; Bruene, (2006) examined the relationship between achievement goals and social goals and explored how students' achievement goals and social goals might affect their reported persistence and effort expended toward physical education in high school settings. Participants were 544 students from two high schools in the southwest U.S. Multiple regression analysis revealed that social responsibility goals represented the greatest contributor to students' expenditure of persistence and effort toward physical education. This was followed by mastery-approach goals, mastery-avoidance goals, and performance-approach goals. In addition, girls reported significantly higher values on both social relationship goals and responsibility goals than did boys. Findings revealed that students had multiple goals for wanting to succeed in physical education; using both achievement goals and social goals when studying student motivation and achievement in high school physical education settings is recommend.

SIGNIFICANCE OF THE PROBLEM

While reviewing the research literature, it was realized that considering aptitude and time spent as the predictors of learning rate can prove to be revolutionary proposal as it is assumed that all students can learn when provided
with conditions appropriate to their condition. These conditions are provided through Mastery Learning strategies. The research literature reveals that Mastery Learning is highly effective in terms of student's retention, rate of learning, attitudes and self perceptions. The studies by Whiting (1994); Yohon (1997); Lee (1998); Urban and Weinschank (1999); Giacomo (1999) and Aviles (2001) revealed that students taught through Mastery Learning strategies achieve significantly higher than those taught through conventional group learning.

The second approach to Mastery Learning is individual based – Learner paced i.e Keller's Personalised system of instruction which has been implemented the use of computers and is termed as computer assisted instruction. This approach has also been effective resulting in high achievement rate as compared to conventional group learning in the studies by Lamb (1995); Lafronza (1997); Clawford (1998); Kuchler (1999); Chan (1999) and Brophy (1999).

The variable of Perseverance is of great significance as in Mastery Learning it is one of the variables that predicts rate of learning. The more the time spent on learning, the more is the perseverance. This variable has been selected because research studies by Tuttle (1994); Mickens (1995); Mason (1995); Van Blerkom (1996); Nora et al (1997); Fitzgerald and Young (1997); Blair and Price (1998); Fly (1999) and Byer (2002) have established that perseverance / persistence is one of the important predictors of achievement.

Another variable proposed by the study is Learning approaches. This variable has been selected because research studies by Drew and Wakens (1997); Watkins and Wong (1998); Kajic(1998); Humphreys (1998); Chin (1998); Yin (1999); Salikumar (1999); Chin Christine (1999); Britton (1999); Van Melle (2000); Evans, Christiana (2001) and Beherns (2001) revealed that achievement of the learners is affected due to learning approaches.
The present research is humble attempt to study the effectiveness of computer based Mastery Learning in high school Chemistry in relation to Perseverance and Learning Approach, which means implementing MLS through computers for learners with high and low perseverance and deep & surface learning approach. It was presumed that implementation is going to be individualised hence students with differences in perseverance and learning approaches are bound to take different time to accomplish the task. A teacher with a larger group situation should handle all students and must take them to completion of task, by directing remediation / enrichment or repetition as and when required.

STATEMENT OF THE PROBLEM
EFFECTIVENESS OF COMPUTER - BASED MASTERY LEARNING IN CHEMISTRY AT HIGH SCHOOL LEVEL IN RELATION TO PERSEVERANCE AND APPROACHES TO LEARNING

DELIMITATIONS
The present study was delimited with respect to the following:

» Mastery Learning packages based on only Keller's plan were administered through computers.

» The impact of Mastery Learning strategies was studied on Achievement in Science (chemistry).

» Students were equated with respect to intelligence and knowledge in computer.
Introduction

The study was confined to students of class IX in Chemistry from senior secondary schools: which were situated in Batala (Gurdaspur) and were:

- Affiliated to CBSE.
- English medium.
- Co-educational.

**OBJECTIVES**

The study has been designed to attain the following objectives:

- To develop and validate computer-based Mastery Learning packages.
- To study differences among grade IX students with regard to Entry Behaviour status for cumulative score on intelligence and knowledge in computer.
- To study effectiveness of computer-based Mastery Learning packages on achievement as compared to conventional method.
- To study the effectiveness of computer-based Mastery Learning packages on achievement of IX graders in relation to perseverance.
- To study the effectiveness of computer-based Mastery Learning packages in relation to their learning approaches.
- To study the interaction effects of perseverance and learning approaches on achievement through computer-based Mastery Learning packages.

**HYPOTHESES**

The present study was designed to test the following hypotheses:

- **Ho 1**: There will be no significant difference in the means of High, Average and Low Groups on Entry Behaviour (EB) Scores of IX grade students.
Ho 2: There is no significant difference in means of three selected groups on scores of Computer Knowledge Test.

Ho 3: There will be no significant difference in the means of Standard Progressive Matrices scores.

Ho 4: There will be no difference in Perseverance scores of Mastery Learning Group and Control Group.

Ho 5: There will be no difference in Learning Approaches of Mastery Learning Group and Control Group.

Ho 6: The instructional treatment yields equal levels of learning outcomes as measured by achievement scores.

Ho 7: The Learning approaches yields equal levels of learning outcomes as measured by achievement scores.

Ho 8: The Perseverance Level yields equal levels of learning outcomes as measured by achievement scores.

Ho 9: The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches:

Ho 9.1: With MLS: Deep and Surface approach students will achieve equal gain scores.

Ho 9.2: With CGL: Deep and Surface approach students will achieve equal gain scores.

Ho 9.3: For Deep Approach, Achievement scores through Mastery Learning and Conventional groups are not different.

Ho 9.4: For Surface Approach, Achievement scores through Mastery Learning and Conventional groups are not different.
Ho 9.5: For Mastery Learning with Deep Approach and Conventional Group with and Surface Approach Achievement scores are not different.

Ho 9.6: For Mastery Learning with Surface Approach and Conventional Group with and Deep Approach Achievement scores are not different.

Ho 10: The difference in achievement scores through different learning strategies are not qualified by levels of Perseverance;

Ho 10.1: With MLS: High and Low Perseverance students will achieve equal gain scores.

Ho 10.2: With CGL: High and Low Perseverance students will achieve equal gain scores.

Ho 10.3: For High Perseverance, Achievement scores through Mastery Learning and Conventional groups are not different.

Ho 10.4: For Low Perseverance, Achievement scores through Mastery Learning and Conventional groups are not different.

Ho 10.5: For Mastery Learning with High Perseverance and Conventional Group with and Low Perseverance Achievement scores are not different.

Ho 10.6: For Mastery Learning with Low Perseverance and Conventional Group with and High Perseverance Achievement scores are not different.
Ho 11: The difference in achievement scores through different learning approaches are not qualified by levels of Perseverance;

- Ho 11.1: For Deep Approach, Achievement scores through High and Low Perseverance are not different.
- Ho 11.2: For Surface approach, Achievement scores through High and Low Percevereance are not different.
- Ho 11.3: For High Perseverance, Achievement scores through Deep approach and Surface approach are not different.
- Ho 11.4: For Low Perseverance, Achievement scores through Deep approach and Surface approach are not different.
- Ho 11.5: For High Perseverance and Deep Approach Achievment scores are not different from Low Perseverance and Surface approach.
- Ho 11.6: For High Perseverance and Surface Approach Achievement scores are not different from Low Perseverance and Deep approach.

Ho 12: The difference in achievement scores through different learning strategies are not qualified by different Learning Approaches and Levels of Perseverance;

- Ho 12.1: For Deep Approach and High Perseverance, achievement scores through Mastery Learning and Conventional groups are not different.
...Introduction

♦ Ho 12.2: For Deep Approach and Low Perseverance, achievement scores through Mastery Learning and Conventional groups are not different.

♦ Ho 12.3: For Surface approach and High Perseverance, achievement scores through Mastery Learning and Conventional groups are not different.

♦ Ho 12.4: For Surface approach and Low Perseverance, achievement scores through Mastery Learning and Conventional groups are not different.

♦ Ho 12.5: Achievement scores for Deep Approach and High Perseverance through Mastery Learning and Surface Approach and High Perseverance in Conventional groups are not different.

♦ Ho 12.6: Achievement scores for Deep Approach and Low Perseverance through Mastery Learning and Surface Approach and Low Perseverance in Conventional groups are not different.

♦ Ho 12.7: Achievement scores for Surface Approach and High Perseverance through Mastery Learning and Deep Approach and High Perseverance in Conventional groups are not different.

♦ Ho 12.8: Achievement scores for Surface Approach and Low Perseverance through Mastery Learning and Deep Approach and Low Perseverance in Conventional groups are not different.

❖ Ho 13: The instructional treatment will yield equal level of learning outcomes as measured by achievement scores.
Ho 13.1: MLS 1 and MLS 2 will yield equal gain means.

Ho 13.2 MLS 1 and MLS 2 will yield equal gain means.

Ho 13.3 MLS 2 and CGL will yield equal gain means.

Ho 14: The Learning Approaches will yield equal level of learning outcomes as measured by achievement scores.

Ho 15: The Perseverance will yield equal level of learning outcomes as measured by achievement scores.

Ho 16: The difference in achievement gain scores through different learning strategies are not qualified by different Learning Approaches

Ho 16.1: With MLS1: Deep and Surface approach students will achieve equal gain scores.

Ho 16.2: With MLS2: Deep and Surface approach students will achieve equal gain scores.

Ho 16.3: With CGL: Deep and Surface approach students will achieve equal gain scores.

Ho 16.4: For Deep Approach, Achievement gain scores through Mastery Learning Strategy 1 and Conventional groups are not different.

Ho 16.5: For Deep Approach, Achievement gain scores through Mastery Learning Strategy 1 and MLS 2 groups are not different.

Ho 16.6: For Deep Approach, Achievement gain scores through Mastery Learning Strategy 2 and Conventional groups are not different.
Ho 16.7: For Surface approach, Achievement gain scores through Mastery Learning 1 and Conventional groups are not different.

Ho 16.8: For Surface approach, Achievement gain scores through Mastery Learning 1 and MLS 2 groups are not different.

Ho 16.9: For Surface approach, Achievement gain scores through Mastery Learning 2 and Conventional groups are not different.

Ho 17: The difference in achievement gain scores through different learning strategies are not qualified by levels of Perseverance;

Ho 17.1: With MLS 1: High and Low Perseverance students will achieve equal gain scores.

Ho 17.2: With MLS 2: High and Low Perseverance students will achieve equal gain scores.

Ho 17.3: With CGL: High and Low Perseverance students will achieve equal gain scores.

Ho 17.4: For High Perseverance, Achievement gain scores through Mastery Learning Strategy 1 and Conventional groups are not different.

Ho 17.5: For High Perseverance, Achievement gain scores through Mastery Learning Strategy 1 and Mastery Learning Strategy 2 are not different.

Ho 17.6: For High Perseverance, Achievement gain scores through Mastery Learning Strategy 1 and Mastery Learning Strategy 2 are not different.
Ho 17.7: For Low Perseverance, Achievement gain scores through Mastery Learning Strategy 1 and Conventional groups are not different.

Ho 17.8: For Low Perseverance, Achievement gain scores through Mastery Learning Strategy 1 and Mastery Learning Strategy 2 are not different.

Ho 17.9: For Low Perseverance, Achievement gain scores through Mastery Learning Strategy 2 and Conventional groups are not different.

Ho 18: The difference in achievement scores through different learning approaches are not qualified by levels of Perseverance;

Ho 18.1: For Deep Approach, Achievement gain scores through High and Low Perseverance are not different.

Ho 18.2: For Surface approach, Achievement gain scores through High and Low Perseverance are not different.

Ho 18.3: For High Perseverance, Achievement gain scores through Deep approach and Surface approach are not different.

Ho 18.4: For Low Perseverance, Achievement gain scores through Deep approach and Surface approach are not different.

Ho 18.5: For High Perseverance and Deep Approach Achievement scores are not different from Low Perseverance and Surface approach.
Ho 18.6: For High Perseverance and Surface Approach
Achievement scores are not different from Low
Perseverance and Deep approach.

Ho 19: The difference in achievement scores through different
learning strategies are not qualified by different Learning
Approaches and Levels of Perseverance;

- Through MLS 1
  - Ho 19.1: HP / DA students and LP / DA will achieve equal
gain means.
  - Ho 19.2: HP / SA students and LP / SA will achieve equal
gain means.
  - Ho 19.3: HP / DA students will achieve equal gain means as
    compared to HP / SA students through MLS 1.
  - Ho 19.4: LP / DA students will achieve equal gain means as
    compared to LP / SA students through MLS 1.

- Through MLS 2
  - Ho 19.5: HP / DA students and LP / DA will achieve equal
gain means.
  - Ho 19.6: HP / SA students and LP / SA will achieve equal
gain means.
  - Ho 19.7: HP / DA students will achieve equal gain means as
    compared to HP / SA students through MLS 2.
  - Ho 19.8: LP / DA students will achieve equal gain means as
    compared to LP / SA students through MLS 2.

- Through CGL
  - Ho 19.9: HP / DA students and LP / DA will achieve equal
gain means.
Ho 19.10: HP / SA students and LP / SA will achieve equal gain means.

Ho 19.11: HP / DA students will achieve equal gain means as compared to HP / SA students through CGL.

Ho 19.12: LP / DA students will achieve equal gain means as compared to LP / SA students through CGL.

SUGGESTIONS FOR FURTHER RESEARCH

The investigator is quite aware of the limitations under which the present investigation was conducted and therefore that no sweeping generalizations could be made. The findings are only indicative of trends and hence are to be viewed in light of following limitations.

- The sample of the children was drawn mainly from the schools having well developed computer laboratories.
- The sample was limited to only to the urban areas.
- The study was limited to only grade IX of normal children rather than on any specific group of children.
- The variables studied were limited to computer based Mastery Learning Strategy, Learning approaches and Persiverance.
- Study was conducted on both boys and girls.
- Achievement was viewed as performance in Science (Chemistry) only.

The researcher, by virtue of her experience in the field of study humbly offers the following suggestions for further research that could be taken by the perspective researchers.
Introduction

- Based on the present research about computer based Mastery Learning strategy, persistence and learning approach, it is clear that computer assisted instruction seemed to be better in achieving higher gains as compared to control group. For further study, well designed strategy can be focused on promoting achievement even when learner seem to be low in computer knowledge, differ in levels of persistence and types of learning approaches.

- For further study, it is recommended that this research be modified at other levels of education to determine if the results of the study were influenced by other environmental factors.

- Relative interaction effect of the objectives of the study may be studied at large scale, especially for learner of higher education, with the different subject areas, having different persistence levels, and different learning approaches.

- Some experimental studies can be planned and conducted to study the effect of computer based Mastery Learning strategy in various subject areas like mathematics, physics, biology and languages.

- Findings of this study support the need for further research to involve investigations that compare levels of persistence in achievement and different learning situations across different levels of entry behaviour.

- Meta – analysis of the study in respect of computer based Mastery Learning strategies may be conducted.