A proposal for the framework of unified model of teaching.

Timothy L. Seifert
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A Proposal for the Framework of Unified Model of Teaching

by

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For Mary.
Abstract

Educational researchers in the past have tried to develop a unified model of the teaching process. Such a model would be very useful to both teachers and researchers. By combining the ideas of several researchers, a unified model of teaching is proposed. This model is based around the idea of information flow within the classroom. By combining information flow maps with a categorical model of teaching methods, a useful model teaching has been developed.

This model is built around the concept of information flow in the classroom. Interaction with information is the essence of learning. By studying the ways in which information flows in the classroom, insight into the processes which are occurring may be gained. This is accomplished by examining the way teachers, learners, and the environment interact with each other, and the way in which the teacher and/or student controls those interactions.

In addition, the relationships between outcomes and interactions need to be considered, if a complete model is to be constructed. Methods and activities may be described in terms of their "information attributes" which, consequently determines the nature of the interactions in the classroom. By choosing the desired outcomes and then establishing the necessary interactions to achieve those outcomes, teachers can begin to create the optimum learning environment.
Acknowledgement

There are several people whose contribution to this thesis must be acknowledged. Firstly, I must sincerely thank Dr. W.J.I. Crawford and Dr. R. Lewis for their support and commitment to the completion of the thesis. As well, I would like to thank Daniella D'Anello for her assistance in proof-reading and saving me from several embarrassing errors. As well, I need to thank my parents and family for their support throughout the completion of my degree. Lastly, I must acknowledge the support, guidance, and assistance of Dr. J.C. Powell. His insight and wisdom were immensely invaluable. I have learned a great deal from him, for which I am indebted.
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Chapter 1: An Introduction

The research literature is abundant with descriptions of methods and activities for achieving a multitude of learner outcomes (Joyce and Weil, 1980; Eggen, Kauchak, and Harder, 1979; Hersh, Miller, and Fielding, 1980; Garvey and Krug, 1977). Simultaneously, researchers have shown the bulk of activities within the classroom to be confined to a narrow group of activities of the form of information transmission (Goodlad, 1984; Adams and Biddle, 1970; Bellack, Kliebard, Hyman, and Smith Jr., 1966). Thus a problem has occurred of deciphering the theory and implementing it in practice. The problem, from the perspective of the classroom teacher, is not one of locating a particular method, but deciding how and when to use a particular method (Williams, 1980).

This problem clearly illustrates the need for a model of teaching. Such a model would be able to convert the abstraction of theory into the reality of planning classroom events. This thesis is an attempt to construct such a model of teaching by considering the classroom as a forum of information interaction and flow (Powell, 1975; 1972) and describing the existing methods and activities in terms of their information attributes. Through consultation with a model of such a nature teachers may improve their classroom practices and achieve a greater spectrum of learning outcomes.
A Perspective of the Problem.

"Teaching is the name for initiation of an event using educative material aimed at sharing meaning" (Gowin, 1981). According to Gowin's philosophy, educating is significant when methods which involve learner-initiated activities and learner-learner interactions are used in addition to information transmission. If the activities of the classroom are closely examined, then the value of education as a search for meaning and significance must be questioned. Research has shown school is often a forum of information transmission rather than allowing students to engage in interaction with each other, creative thinking, or self-initiation (Adams and Biddle, 1970; Goodlad, 1984). On the other hand, the research literature is abundantly supplied with methods and activities for going beyond information transmission to promote discovery, generation of knowledge, self-awareness, and social development (Slavin, Sharan, Kagan, et.al., 1985; Jaques, 1984; Novak and Gowin, 1984; Schmuck and Schmuck, 1983; Joyce and Weil, 1980; Hersh, Miller, and Fielding, 1980; Garvey and Krug, 1979; Aronson, Blaney, Stephan, and Snapp, 1978), yet these methods do not seem a common part of education as practiced in the modern school.

This paper is an attempt to describe the framework for a comprehensive model of teaching, one that will bridge the theory/practice gap. It is an attempt to expand upon the work of Haddan (1970), Lamm (1976), Briggs (1977),
Powell (1972; 1975; 1984), Eggen, Kauchak, and Harder (1979), Gagne and Briggs (1979), Joyce and Weil (1980), Kemp (1985), and Mosston (1972). "The last two decades of educational research has produced models of teaching, classroom management techniques, and observation tools that are of the form" (Mosston and Ashworth, 1985):

- A "versus" basis - one model or idea is presented against (or better than) the others;
- Fragmentation - models deal with only a part of the teaching process without showing relationships to other variables;
- Subject matter idiosyncracies - proposals confine themselves to subject areas or grade levels;
- Individual idiosyncracies - contributions or models reflect the idiosyncracies of a teacher or researcher;
- Cultural idiosyncracies - proposals reflect the idiosyncracies of a given educational philosophy or political preference;
- Reductionism - proposals reduce teaching to a few general principles or observable and measurable behaviours.

A desirable general model of teaching would encompass all previously described models and forms of teaching (Klauer, 1985). Ideally, such a model would explicate the principles of teaching theory and be culturally invariant. The way in which we teach should be based upon universal principles while what we teach may be determined by cultural aspects of a specific society. In order to accomplish this objective the terminology will need to be clarified by providing operational definitions of the terms theory of teaching, model of teaching, teaching strategy, and teaching method.
Having done this, the model of teaching will be presented with a discussion of its components, followed by practical examples. Lastly, implications and recommendations for further research will be discussed.

A Definition of a Theory of Teaching.

A theory, from the viewpoint of a scientist, is a statement or series of statements explaining some reality the scientist has experienced. The scientist makes some observations acquiring some knowledge. From that knowledge, he builds a theory which is an abstraction of the reality he observed. Various researchers (Hamm, 1982; Carson, 1982; Tyson, 1982; Downey and Kelly, 1975; Mathis and McGaghie, 1974; Haddan, 1970; Silverman, 1967) have described the characteristics of a theory in various ways, but their expositions contain many common elements. A synthesis of these characteristics of a theory are:

a) it is a set of logically connected observations, hypotheses, and principles that are interrelated in such a manner as to represent a particular view of reality;

b) it is explanatory in nature, describing past and present states within the given reality domain;

c) it is predictive in nature, enabling the scientist to postulate future states within the given reality;

d) often, but not always, the theory enables the scientist to manipulate the reality to achieve a desired future state within the given reality.
If a theory of teaching is to be constructed, then it must satisfy these requirements. It must be logical, explanatory, predictive, and prescriptive. A theory of teaching should explicitly state how teachers do (and should) behave under certain conditions, and the effect this has on learners (Haddan, 1970). It should consist of statements of the variables comprising teacher behaviour and the relationships among those variables, and the psychological/sociological conditions under which teaching occurs (Smith in Bellack, 1963). "A theory of teaching must offer an objective description so large in scope and so meticulous in its development that it will accommodate all existing and even all conceivable forms of teaching behaviour, regardless of time, place, subject matter, and the personality of the teacher" (Mosston, 1972). A theory of teaching must be able to predict outcomes of learner behaviour from various patterns of activity and teacher behaviour (Flanders in Bellack, 1963). As suggested by Bruner (1966), and Downey and Kelly (1975) a theory of instruction is prescriptive as well as predictive. It guides the actions of the teacher (and pupils) toward desired learner outcomes. In this manner, a theory of teaching is also manipulative.

As a result of a lack of a suitable theory of teaching, educators have used learning theories to fill the gap (Lamm, 1976; Haddan, 1970). But a theory of learning cannot substitute for a theory of teaching. A learning theory is
descriptive of the learning process and is a subset of a
teaching. Learning theory does not describe the
teacher's behavior. A theory of teaching must describe the
teaching process and guide the teacher through the selection
of alternative courses of action in their attempts to invoke
learning.

A Definition of a Model of Teaching.

A theory was defined as a series of statements,
hypotheses, and propositions forming an abstraction of a
reality. A model then, is a representation of the reality.
The model does not exist in reality, but is an analogy to
explain the theory. It is a tool or device by which the
unobservable becomes observable and enables a further
exploration of the reality (Belth, 1970).

A model has properties similar to that of a theory. It
must depict an explanation of the phenomena. It must account
for the variables in the events and illustrate the
relationships among those variables. It must bridge the gap
between the abstract and the empirical, and clearly account
for both by allowing the conversion of generalizations into
specifics. A model completes a theory.

A model of teaching must describe the teaching process
through a system of symbols of some type. It must illuminate
the process of the classroom, and delineate the variables and
relationships among the variables - the teacher, the learner, and the environment. At the same time, a model must guide the teacher on a pathway through the selection of methods and activities to achieve desired learner outcomes. The model is a link between intended learning outcomes and hypotheses about learner experiences which bring about those outcomes.

Teaching Activities, Methods, and Strategies.

The ultimate goal of a theory and model of teaching is to guide the teacher through alternatives to arrive at a decision regarding suitable activities for the day's lesson. An instructional activity, in this context, is defined as "what the children will be doing". The activities are designed to promote the desired goal. A teaching method can be defined as a group of generic activities - that is activities which are similar in nature and outcomes. For example, a case study is a method, as is role playing. But the individual activities within the family of activities called case studies (or role playing or any other method) will be different, yet might yield similar outcomes.

Ideally, a teacher wanting to choose an activity would consult an educational model. It is from the model that the teacher can interpret the theory. From the theory, the model will suggest several alternative courses of action. The courses of action the teacher chooses is referred to as the "teaching strategy" (Douglas, 1982). Having chosen a
strategy, the teacher then implements activities congruent with the strategy, designed to meet the instructional objectives.

Summary.

To further clarify the distinction between a theory of teaching, a model of teaching, a strategy, and an activity or method consider the following analogy. Imagine a gorge. On one side of the gorge is "What I see happening" or classroom events of an empirical nature. On the other side of the gorge is "What I think is (or should be) happening" or classroom in theory. Through the use of theories, models, strategies, and methods it is possible to build a bridge across the gorge. The theory provides the definitions of the events, the model describes the events, the strategies are the planning of the events, and the methods/activities are the implementation of the events.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Model</th>
<th>Strategy</th>
<th>Method/Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>(definition)</td>
<td>(description)</td>
<td>(planning)</td>
<td>(implementation)</td>
</tr>
<tr>
<td>What I think</td>
<td>What I see</td>
<td>is happening</td>
<td>is happening</td>
</tr>
</tbody>
</table>

Figure 1. Theories, Models, Strategies, and Methods/Activities.

From this analogy it is evident that a sound theory and model of teaching is critical to effective education. If the role of a teacher is to organize the environment in such a
manner as to facilitate learning, then it is desirable to have a teacher do so on the basis of sound scientific principles and rational decisions as suggested by a theory through a valid model. In the absence of a sound theory and workable model, the teacher is reduced from a professional to a technician (Belth, 1970). The professional operates on the basis of some theory that explains his actions. The technician is concerned with the operating of the event itself more than the theory behind the event. Often, he can perform a complex act successfully without understanding the principles involved. If teachers are to operate effectively within the classroom environment, they need the skills of a technician and knowledge of a professional. They need to utilize theory to make sound decisions to create the optimum learning environment.

A Proposal for a Model of Teaching.

Mosston has tried to show that the single axiom "teaching behaviour is a chain of decision making events" (1985; 1972:10) is sufficient for the foundation necessary to build a model of teaching. However, consider the following axioms:

a) A1 - teaching behaviour is a chain of decision making events on the part of the teacher within the context of a learning situation;

b) A2 - the outcome of teaching behaviour is learning behaviour;

c) A3 - learning outcomes are achieved through learner interaction with information and information sources.
The first axiom is supported by the work of Mosston and Ashworth (1985), Mosston (1972), Briggs (1974), Hannah and Michaelis (1977), and Gagne and Briggs (1979) showing teaching behaviour to be an act of manipulating the environment to achieve learner outcomes (as stated by the second axiom) through careful planning. The third axiom states that learning takes place when the learner interacts with information (Dretske, 1981; Gowin, 1981; Rogers, 1983) - by collecting it, analyzing it, manipulating it, and communicating it, a direct result of the planning (decisions) of the teacher. It is the contention of this thesis that these three axioms can be used as the foundation of a model of teaching, much in the same way as Mosston tried to build a model from one axiom. Such a model would be structured around the concepts of information flow and information interaction in the classroom. To accomplish this, it is necessary to further state three postulates:

a) P1 - every teaching method and activity is uniquely determined by the flow of information in the classroom, which in turn, may be represented by an information flow map;

b) P2 - the flow of information within the classroom is determined by the nature of the instructional and organizational interactions occurring in the classroom.

c) P3 - every teaching method and activity may be described in terms of its information attributes - the skills it promotes, the complexity of the information, and the designation of the primary mediator.

Powell (1972) has presented an interactive model of the classroom, owing to the nature of the information attributes
of these methods and activities as suggested by the second postulate (P2).

The purpose of this thesis is to propose the framework for a unified model of teaching. The primary contention is that by showing the above stated postulates are true, a unified model can be built. To show these postulates are valid, it is necessary to combine the information flow maps suggested by Powell (1972) with a three dimensional categorical model of teaching methods and activities to be presented later in this paper. In the categorical model, each dimension represents a different attribute of information within the classroom. The nature of these axes are:

a) learning outcomes as skills acquired from interaction with the information environment (informational skills/personal skills/social skills);

b) the complexity of the information (convergent/ divergent);

c) the designation of the primary mediator of the information (teacher/student).

Chapter 2 will outline the development of the model of teaching by showing the nature of interactions occurring within the classroom (information maps), using previous research on teaching as a basis. This is to be followed by the development of the categorical model of teaching methods. By combining the categorical model with information flow maps, it will be possible to show the postulates to be a valid interpretation of classroom events. In turn, this will
support the forestated axioms, reaffirming the model as useful and valid. The support for this will come by showing how existing teaching methods fit into this model.
Chapter II: Theoretical Foundations

In the past twenty years, there have been several attempts to formulate unified theories and models of teaching. Mosston (1972) has constructed a theory and model based upon decision making on the part of the teacher. Lamm (1976) has stated and described "the nine dimensions of teaching" as the essential elements of teaching. Gagne and Briggs (1979), and Briggs (1977) have introduced Instructional Design as a means of systematically planning lessons. Butler (1985) has provided a model of the teaching/learning process consisting of eight stages of learning, and four processes occurring in learning at each stage. Klauer (1985) has suggested a framework for a theory of teaching alluding to the general relationships between theories from various disciplines to form a theory of teaching, and suggested a General Teaching Algorithm, based upon five molar teaching functions, to assist in the preparation of instruction.

As already mentioned, a theory of teaching is composed of sub-theories, each of which describes a particular aspect of the teaching-learning process. Each of these theories has something essential to contribute to learning but, as Mosston and Ashworth (1985) point out, they tend to be fragmented and the potential relationships are cloudy leaving classroom teachers and researchers asking many questions.
One of the most popular models of teaching to have been developed is the Instructional Design model. Instructional Design, in principle, is a logical and systematic approach to teaching (Briggs, 1977; Gagne and Briggs, 1979). It consists of a series of steps leading to the design of instruction. A typical Instructional Design model includes setting objectives, assessing learner characteristics, choosing a suitable method of instruction to match learner characteristics, conducting evaluations and reassessing instruction (see figure 2).

Instructional Design

![Diagram of Instructional Design Process](image)

Figure 2. The Instructional Design Process (Smith and Boyce, 1984)

Instructional design was developed to enable a teacher to prepare lessons designed to meet the needs of the students. The problem that is encountered with most instructional
Design models is that it lacks specifics. It presents a general outline for preparing instruction matched to learner needs but it does not indicate what those needs are or how they can be met. Instructional Design suggests that teaching strategies be designed to meet the objectives, but does not indicate which strategies are useful for meeting which objectives. It does not allow for a smooth transition from theory to practice. A good model of teaching would illustrate the link between methods and objectives. It would allow the integration of multidisciplinary research and show its applicability in an empirical context.

The Teaching/Learning Process

<table>
<thead>
<tr>
<th>Factors or Conditions</th>
<th>Facilitative Process</th>
<th>Learning Activities</th>
<th>Cognitive Processes</th>
<th>Learning Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Situation</td>
<td>Previewing ↔ Exploring ↔ Perceiving ↔ Awareness ↔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>Affecting ↔ Attending ↔ Differentiating ↔ Purpose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization</td>
<td>Interrelating ↔ Associating ↔ Conceiving ↔ Models</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td>Engaging ↔ Trying ↔ Experiencing ↔ Consequences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation</td>
<td>Apprising ↔ Comparing ↔ Valuing ↔ Choices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repetition</td>
<td>Reinforcing ↔ Practicing ↔ Habituating ↔ Routine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generalization</td>
<td>Extending ↔ Transferring ↔ Translating ↔ Synthesis</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3. The teaching/learning process (Butler, 1985).

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Butler (1985) has presented a model for the teaching-learning process (see figure 3). Butler has described the salient factors and the stages of learning. These factors affect learning in the most general way. Each is affected by the others and all must be considered in the teaching process.

However, the same criticism of Instructional Design must befall Butler’s model. The model is not readily workable from the perspective of a classroom teacher. The primary reason is that the link between outcomes and activities is not clearly defined. A classroom teacher wishing to achieve a particular outcome is not shown how to achieve those outcomes.

### Macrotheories of Teaching

<table>
<thead>
<tr>
<th>Type of Question</th>
<th>Type of Study</th>
<th>Type of Study</th>
<th>Type of Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>What?</td>
<td>A. Descriptive</td>
<td>B. Prescriptive</td>
<td>C. Normative</td>
</tr>
<tr>
<td>A. Objectives/</td>
<td>R. Subject</td>
<td>S. Curriculum</td>
<td>C. Ultimate</td>
</tr>
<tr>
<td>Subject matter</td>
<td>matter in</td>
<td></td>
<td>Ends</td>
</tr>
<tr>
<td>in classrooms</td>
<td>classroom</td>
<td></td>
<td>Link</td>
</tr>
<tr>
<td>B. Curriculum</td>
<td></td>
<td></td>
<td>Theory of</td>
</tr>
<tr>
<td>C. Ultimate Ends</td>
<td></td>
<td></td>
<td>Teaching</td>
</tr>
<tr>
<td>D. Theory of</td>
<td></td>
<td></td>
<td>Objectives</td>
</tr>
<tr>
<td>Teaching Methods</td>
<td>E. Teaching</td>
<td>F. Professional</td>
<td>Theory of</td>
</tr>
<tr>
<td>Methodology</td>
<td>Teaching</td>
<td>ethics</td>
<td>Teaching</td>
</tr>
<tr>
<td>Methodology</td>
<td>Professional</td>
<td>standards</td>
<td>Methods</td>
</tr>
<tr>
<td>Educational</td>
<td>Educational</td>
<td>Educational</td>
<td>Philosophy of</td>
</tr>
<tr>
<td>Psychology</td>
<td>Technology</td>
<td>Technology</td>
<td>Education</td>
</tr>
</tbody>
</table>

**Figure 4.** Macrotheories of a Teaching Theory (Klauer, 1985)
Klauer (1985) has presented a model illustrating the inter-relationships of various disciplines (see figure 4). Klauer suggests that a theory of teaching consists of two, three, or six first-order theories, or macrotheories. Klauer has tried to point out where each of these "theories" fits in relationship to each other in a general theory of teaching.

While Klauer has begun to illustrate the relationships, he has not gone far enough into detail for it to be useful at this time. The relationships between theories, while being clearer, are still not detailed enough to assist in a practical manner.

Mosston (1972) has developed a theory of teaching based upon the decisions made in the teaching process. According to Mosston "every act, statement, or question of a teacher's is the consequence of such a decision." (1972). Furthermore, Mosston states teaching is characterized by three decision sets (see figure 5 below).

These sets are the pre-impact stage (decisions made prior to the act of teaching), the impact stage (decisions made during the act of teaching), and the post-impact stage (decisions made after the act of teaching). The teacher's style is subsequently determined by the decisions made in each of the decision sets. This subsequently lead Mosston to develop his "Spectrum" of teaching styles, a continuum of teaching methods based upon the decision sets.
Mosston falls short of a unified theory from two perspectives. First, he fails to show how other research fits into his spectrum. He does not acknowledge how previously developed methods of teaching can be incorporated into his spectrum. Second, he does not illustrate the link between outcomes and methods - which methods are suitable for which outcomes.

The Anatomy of a Style

<table>
<thead>
<tr>
<th>Pre-Impact</th>
<th>Decisions to be made</th>
</tr>
</thead>
<tbody>
<tr>
<td>(content preparation)</td>
<td>1. whom to teach</td>
</tr>
<tr>
<td></td>
<td>2. what to teach</td>
</tr>
<tr>
<td></td>
<td>3. where to teach</td>
</tr>
<tr>
<td></td>
<td>a. starting</td>
</tr>
<tr>
<td></td>
<td>b. stopping</td>
</tr>
<tr>
<td></td>
<td>c. duration</td>
</tr>
<tr>
<td></td>
<td>d. rhythm/pace</td>
</tr>
<tr>
<td></td>
<td>e. interval</td>
</tr>
<tr>
<td></td>
<td>f. termination</td>
</tr>
<tr>
<td></td>
<td>5. quality</td>
</tr>
<tr>
<td></td>
<td>6. quantity</td>
</tr>
<tr>
<td></td>
<td>7. communication</td>
</tr>
<tr>
<td></td>
<td>8. teaching style</td>
</tr>
<tr>
<td></td>
<td>9. anticipated learning styles</td>
</tr>
<tr>
<td></td>
<td>10. class climate</td>
</tr>
<tr>
<td></td>
<td>11. why</td>
</tr>
<tr>
<td></td>
<td>12. evaluating procedures and materials</td>
</tr>
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<td>13. others</td>
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<tr>
<th>Impact</th>
<th>Decisions to be made</th>
</tr>
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<tbody>
<tr>
<td>(content execution performance)</td>
<td>1. implementing and adhering to the set of pre-impact decisions</td>
</tr>
<tr>
<td></td>
<td>2. adjustment</td>
</tr>
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<td></td>
<td>3. others</td>
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<tr>
<th>Post-Impact</th>
<th>Decisions to be made</th>
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<tr>
<td>(content evaluation)</td>
<td>1. about feedback:</td>
</tr>
<tr>
<td></td>
<td>a. reinforcement: (1) immediate (2) delayed</td>
</tr>
<tr>
<td></td>
<td>b. corrections: (1) immediate (2) delayed</td>
</tr>
<tr>
<td></td>
<td>2. about interpreting and evaluating data procedures and materials</td>
</tr>
<tr>
<td></td>
<td>a. instrumentation</td>
</tr>
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<td></td>
<td>b. frequency</td>
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<td></td>
<td>c. norms</td>
</tr>
<tr>
<td></td>
<td>3. about the teaching-learning transaction itself</td>
</tr>
<tr>
<td></td>
<td>4. others</td>
</tr>
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</table>

Figure 5. Decisions of the Teaching Process (Mosston, 1972).
Powell (1972) has presented a model of teaching based upon the mass communication theory of Westley and MacLean. Powell describes the classroom as an interactive system for information flow (see figure 6). In his description of an
interactive classroom system, the interactions between the teacher, learner, and environment, and teacher or student direction of those interactions are the fundamental processes occurring in the classroom.

From this model, it is possible to see the inter-relationships between the various sub-theories (or macrotheories) and their place in the classroom. However, the link between the outcomes and the methods is still obscure.

An Information Theory Approach to Teaching

The first axiom of teaching (as presented in this paper) states teaching behaviour is a chain of decision making events on the part of the teacher. The premise "Teaching is an act of decision making" is supported by the proponents of the Instructional Design process (Gropper, 1974; Briggs, 1977; Gagne and Briggs, 1979; Kemp, 1985). The basis of instructional design lies in the ability of the teacher to make effective decisions at one stage to complement decisions made at the other stages of the instructional design process. The teacher must identify the instructional outcomes, perform learner characteristic assessments, develop strategies for instruction, design suitable activities, and choose appropriate forms of evaluation (see figure 2). This, in essence, is what Mosston has suggested (Mosston, 1972; Mosston and Ashworth, 1985).
The objective of teaching behaviour (described by axiom 1) is to invoke learning behaviour (axiom 2). Learning is achieved through interaction with information (axiom 3). It has long been recognized by psychologists, philosophers, educators, and information/communication theorists that learning is the result of interaction with information (Attneave, 1959; Parry, 1967; Biggs, 1968; Gowin, 1981). A pupil in a certain state (S) will move to a different state (S') upon receiving some information. By receiving this information, the learner has increased his knowledge and altered his perception of the reality from which he received the information (Dretske, 1981) and perception is the basis of thinking (De Bono, 1976). People act in accordance to the information available to them from internal and external sources, human and non-human (Nelsen, 1980).

Information is something which a person gains by interacting (reading, listening, or observing) with the environment. Information is gained only if the observation tells the observer something he did not already know. Information can be defined as something that reduces uncertainty (Attneave, 1959).

Parry (1967) states that while information is the reduction of uncertainty as described by Attneave, such a description is highly quantitative and not really useful to a psychologist since most human interactions involve an exchange of content. The content of a message (or piece of
information) is that which is said or done between the people involved in the transaction. It takes the form of both verbal and non-verbal communication (Nelsen, 1980). Content within the message is connotative (denoting an object and implying its attributes), an aspect of the information which cannot be measured in terms of Attneave's definition. Other features of a message include noise (interference to the message), redundancy (repetition of meaning within a single transmission), and condensation/suppression (condensing meanings or leaving out parts of the message to transmit the message the fastest and surest way possible) (Parry, 1967).

Information has been categorized in various ways. Penman (1980) has defined two levels of message categorization - the manifest level and the latent level. At the manifest level, the message is categorized by its explicit meaning or the face value of the message. In the latent level, the message is classified according to the deeper, implicit meaning contained within. Each level is expressed in terms of two dimensions, power and involvement. The Power dimension expresses the power relationship between the sender and receiver and ranges from low to high power on the scale. The Involvement dimension expresses the degree of personal involvement between the sender and receiver, and is classified as negative, neutral, or positive involvement.

Penman's dimensions are of interest from an educational perspective. Upon close examination of the type of messages
<table>
<thead>
<tr>
<th>AGGRESS</th>
<th>ADVISE</th>
<th>SUPPORT</th>
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<tbody>
<tr>
<td>high</td>
<td></td>
<td></td>
</tr>
<tr>
<td>assertive</td>
<td>gives solutions</td>
<td>shows understanding</td>
</tr>
<tr>
<td>aggressive</td>
<td>gives guidance</td>
<td>reassuring</td>
</tr>
<tr>
<td>rationalizes</td>
<td>gives explanation</td>
<td>trusting, confident</td>
</tr>
<tr>
<td>disapproves</td>
<td>gives summary</td>
<td>amuses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISAGREE</td>
<td>EXCHANGE</td>
<td>AGREE</td>
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<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td>disagrees</td>
<td>gives information</td>
<td>confirms</td>
</tr>
<tr>
<td>corrects</td>
<td>gives suggestions</td>
<td>reconciles</td>
</tr>
<tr>
<td>criticizes</td>
<td>asks for suggestions</td>
<td>conciliates</td>
</tr>
<tr>
<td>contradicts</td>
<td>asks for information</td>
<td>willingly agrees</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVOID</td>
<td>REQUEST</td>
<td>CONCEDE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>avoids</td>
<td>asks for decision</td>
<td>passively accepts</td>
</tr>
<tr>
<td>withholds</td>
<td>asks for approval</td>
<td>passively supports</td>
</tr>
<tr>
<td>non-committal</td>
<td>asks for evaluation</td>
<td>complies</td>
</tr>
<tr>
<td>uncertain</td>
<td>asks for direction</td>
<td>acquiesces</td>
</tr>
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</tbody>
</table>

negative-----------------------IN VolvEMENT-----------------------positive

Figure 7. A Classification Scheme of Messages (Penman, 1980).

sent within each category at both levels (particularly the manifest level more so than the latent level), a close parallel can be drawn with teaching behaviour in the classroom. The characteristics of the cells within the manifest level seem to describe many behaviours of the teacher within given situations. For example, a teacher who is functioning in the "support mode" is understanding, reassuring, trusting, and confident. These behaviours are necessary for activities which are facilitative in nature, placing the teacher in a high, power/positive involvement situation. An activity such as a lecture or a tutorial requires the teacher function in the "exchange" or "advise"
mode where the emphasis is upon giving information, and explaining.

A second method for classifying interactions within the classroom comes from empirical research conducted by Bellack et. al. (1966), Adams and Biddle (1970), and Goodlad (1984). These researchers have shown that interactions within the classroom are of two forms. They are either instructive or organizational in nature.

Instructive Interactions in the Classroom

Instructive messages are messages designed to invoke learning on the part of the student. These messages generally are of the form of information transmission (explaining, describing, or directing). Organizational messages refer to matters pertaining to management aspects of the classroom. These include structuring activities, movement within the classroom, and directing student behaviour to the task at hand.

Instructional messages flow in many ways within the classroom context. Generally, there are three interfaces at which interactions take place - the teacher/learner interface, the learner/learner interface, and the learner/environment interface. At the teacher/learner interface, information flows between the teacher and the learner. At this interface, the teacher's behaviour can be described in terms of the classification scheme devised by
Penman. The nature of teacher-learner interaction can be categorized as:

a) directive - characterized by messages in the disagree, exchange, and advise categories of Penman’s scheme.

b) facilitative - characterized by messages in the advise and support categories with some exchange messages.

c) non-directive - characterized by messages in the support and agree categories with some advise and exchange.

A teacher who is exhibiting behaviour that is directive, is presenting information to the students. She presents the solutions to the students, telling them the right answer and how to arrive at that solution. A teacher who is exhibiting behaviour that is facilitative is creating a climate where students make their own decisions and find their own solutions under the guidance of the teacher. The teacher has presented the problem to the students and guides them in a less formal manner towards the answer. If the teacher is showing non-directive behaviour, she is letting students pose their own problems and find their own solutions according to their particular needs and interests.

When the teacher functions in the directive mode, the consideration must be given to the design of channels for information flow (instructional materials) and interaction with information (instructional activities) to maximize learning. This includes design of various instructional media to send messages (Allen, 1975; Fleming and Levie, 1978;
Gagne and Briggs, 1979; Levie and Lentz, 1982; Smith and Boyce, 1984; Kemp and Dayton, 1985) and the accompanying teacher behaviour (Bellack, et al., 1963; Adams and Biddle, 1970; Grant and Hennings, 1971). Of particular interest, is the model for matching instructional media to given teaching situations by Reiser and Gagne (1983). This model enables the teacher or instructional designer to plan instruction using various media by following a flow chart through various decisions arriving at a list of "best" alternatives.

At the learner/learner interface, interaction occurs between learners. This interaction between learners occurs in varying degrees, being either on-task or off-task (Hertz-Lazarowitz, Baird, Webb, and Lazarowitz, 1984), characterized as competitive, individualistic, or cooperative (Slavin, 1983; Johnson and Johnson, 1975), and ranging from low to total cooperation, in accordance to the goals and means structure (Sharan and Hertz-Lazarowitz, 1980). For the purposes of this paper, interaction between learners is categorized as being competitive, individualistic, or cooperative.

Interaction between students is competitive if students perceive they can obtain their goal only if the other students, with whom they are associated, fail to obtain their goal. Individualistic interaction exists when achievement of a goal is independent of others. Cooperative interaction occurs when students perceive that they can only achieve
their goal if the other students can achieve their own goals as well (Johnson and Johnson, 1975).

The learner/environment interface is where the learner interacts with the environment, through direct observation (data gathering), indirect observation (via instructional media), attending, recall or recognition. It is at this interface the learner exhibits his learning style (cognitive style) in assimilating or accommodating new information (Dunn and Dunn, 1979; Gregorc, 1979; Practical Applications of Research, 1980; Smith and Renzulli, 1984; Kolb, 1976; Joyce, 1985; Joyce and Weil, 1980). This implies the structure of the information environment the student encounters is important in his interaction with the environment - learning from it and acting reacting to it (Gregorc, 1979).

The learning styles of students have been identified as being along varying dimensions. Among these include:

a) concrete or abstract, sequential or random (Gregorc, 1982; 1979);

b) the conceptual level of the learner (Hunt, 1979; Joyce and Weil, 1980; Joyce, 1985);

c) concrete (experiential), abstract (conceptual), active (experimental), and reflective (observational) (Kolb, 1976);

It is through this array of learning styles the interaction between learner and environment can be described. For the purposes of this paper, interaction between the learner and the environment will be classified only as indirect or direct observation.
Organizational Interactions in the Classroom

Organizational interactions in the classroom can be defined as activities undertaken by teachers to ensure instruction is presented under the most effective conditions (Medland and Vitale, 1984). The techniques for acquiring these "effective conditions" range in description from establishing token economies (or other reward systems based upon behaviour modification principles) to elicit desired behaviours (Sloane, Buckholdt, Jenson, and Crandall, 1979) through to Reality Therapy as a technique to promote interpersonal relationships and socially responsible behaviour (Martin, 1981; Joyce and Weil, 1980). Good management implies good instruction (Brophy, 1983) and consists of three basic tasks. By controlling the physical classroom environment, the teacher can enhance learning (Dunn and Dunn, 1979; Weinstein, 1981). The teacher must direct the interaction with information (providing appropriate activities), and direct the students' behaviour (maintaining on task behaviour) (Brophy, 1983; Brophy, 1982; Martin, 1981).

It is important to recognize that good organization is vital to good instruction. However, the focus of this paper is upon the instructional interactions and the manner in which they form the basis for a model of teaching. Henceforth, consideration to organizational aspects is given only to identifying types of organizational interactions.
occurring in the classroom. Further discussion is beyond the scope of this thesis.

Summary

To summarize, the basic processes identified as occurring in the classroom, with respect to an information flow perspective, are:

**Instructional Considerations**

a) teacher – student interactions:
   - directive, facilitative, or non-directive based upon the type of message sent (aggress, disagree, avoid, advise, exchange, request, support, agree, concede)

b) student – student interactions:
   - competitive, individualistic, cooperative;

c) student – environment interactions;
   - direct observation, indirect observation, no interaction

**Organizational Considerations**

d) teacher directs the classroom environment

e) teacher directs teacher-learner interactions

f) teacher directs learner-learner interactions

g) teacher directs learner environment interactions

h) learners direct learner-learner interactions

i) learners direct learner-environment interactions

**An Interactive Model of the Classroom**

Assuming classroom interactions are either instructive or organizational in nature, then it is imperative that a model of teaching elucidate both elements. The model must illustrate the three types of instructional interactions, and the types of organizational interactions mentioned above. Such a model is an adaptation of a model of the interactive
An Information Flow Map

Figure 8. An Information Flow Map.

1. Teacher controls classroom environment
2. Teacher directs teacher-student interaction
3. Teacher directs student-environment interaction
4. Teacher directs student-student interaction
5. Students direct interaction with each other.
6. Students direct interaction with the environment

Classroom suggested by Powell (1972) to form an information flow map (see Figure 8).
This approach is useful for two reasons. Firstly, it illustrates the processes occurring within the classroom (see preceding discussion). This gives an indication of how each component of the classroom (teacher, learner, and environment) interact with each other. Secondly, because it illustrates these processes, it enables the various theories to be integrated into classroom practice. The processes described as occurring have been researched by various theoreticians and can be linked to classroom interaction through the interactive model. Each of the fields of research listed by Klauer (Figure 4) can be represented in the model, with the exception of objectives. The relationship of instructional objectives to the model is discussed later.

The interactions occurring within the classroom may be mapped to describe the events taking place in a unique way. For example, consider a learning situation subject to the following conditions:

a) teacher - learner interaction is directive in nature; the messages are of the form of exchange and advise;

b) learner - learner interaction is minimized such that the students are isolated from each other (such as sitting in rows facing a blackboard); interaction is individualistic;

c) learner - environment interaction is minimized such that the student's only source of information is the teacher or the textbook (indirect observation);

d) teacher - learner interaction is maximized such that the main message flow is from the teacher to the learner (exchange, advise);
e) the teacher uses reinforcement and reward to keep
the students motivated and on task.

f) the information environment is low in complexity and
highly structured.

This situation is representative of a typical lecture or
demonstration presentation, and can be illustrated on an
information flow map (as shown in chapter 3).

The atmosphere of the classroom changes dramatically if
the relationship between the teacher, learner, and
environment is altered. If the interaction between teacher
and learner becomes non-directive, learner-learner
interaction stays individualistic, and learner - environment
interaction is of the form of direct observation, a
description of a non-directive lesson emerges (illustrated in
Chapter 3).

Because the interactive model can be used to illustrate
the interaction processes occurring in the classroom, it
becomes the realization of the first postulate. The first
postulate stated:

P1 - every method and activity is uniquely determined
by the flow of information in the classroom, and may
be represented by an information flow map.

The precise configuration of the information map is deter-
mined by the processes occurring within the classroom
(instructional and organizational consideration), the
realization of postulate two:

P2 - the flow of information within the classroom is
uniquely determined by the nature of the
instructional interactions occurring in the
classroom.
The nature of the instructional interactions which occur in the classroom is determined by three main factors. These factors are the constituents of a teaching method as suggested by postulate three:

P3 - every teaching method and activity may be described in terms of its information attributes - the skills it promotes, the complexity of the information, and the designation of the primary mediator.

A teacher planning to conduct a lesson, or series of lessons, needs to give consideration to the information attributes. This teacher would need to decide what skills were to be promoted as outcomes, what the complexity of the outcomes should be, and who should be the primary mediator of the information. Upon making these decisions, the teacher has prescribed herself to a particular method or activity suited to achieve the desired outcomes. The teacher has assigned the outcomes, the complexity, and the mediator. The nature of the interactions within the classroom is a function of these assignments, which subsequently assigns a configuration to the information flow map. This necessitates a close examination of the attributes of various methods as outcomes of teaching, and their relationship to the nature of instructional interactions.

Information Skills as Outcomes

The most important consideration a teacher must assume is deciding upon the focus of the lesson(s) - that is specifying the desired outcomes. Several attempts have been made in the
past to try to classify objectives. The most popular classification scheme is the *Taxonomy of Educational Objectives* (Bloom, 1956). This taxonomy categorizes objectives in the cognitive domain as being:

a) knowledge;
b) comprehension;
c) application;
d) analysis;
e) synthesis;
f) evaluation.

A similar taxonomy has been developed to cover the affective domain. Krathwohl, Bloom, and Masia (1964) have developed the *Taxonomy of Objectives for the Affective Domain*. The categories for the classification scheme of objectives in the affective domain are:

a) receiving or attending
b) responding
c) valuing
d) organization of a value
e) characterization by a value

Hannah and Michaelis (1977) have presented a comprehensive framework for instructional objectives. This framework uses the work of Bloom and Krathwohl, and the work of previous researchers in the field, as a foundation from which to build. The framework they have derived consists of data gathering, intellectual processes, skills, and attitudes and values. The exact categories for classification are:

a) data gathering - observing, remembering;
b) intellectual processes - interpreting, comparing, classifying, generalizing, inferring, analyzing, synthesizing, hypothesizing, predicting, and evaluating;
c) skills - imitating, patterning, mastering, applying, improvising:

d) attitudes - responding, complying, accepting, preferring, integrating.

Powell (1984) and Powell and Campbell (1985) have taken an approach to the categorization which is much broader in scope than that of Bloom (1956), Krathwohl, Bloom, and Masia (1964), or Hannah and Michaelis (1977). Powell has suggested eight categories of instructional objectives:

a) information retrieval skills  
b) information processing skills  
c) understanding  
d) self-development  
e) participation  
f) leadership  
g) communication  
h) mutual development

Powell's definitions are much broader than those of the other researchers. It also accounts for skills not subsumed by the other taxonomies and typologies - namely skills needed for group encounters.

For the purposes of this paper, it is argued that objectives may be sorted under three general headings - informational, personal, and social. This typology is similar to that of Joyce and Weil (1980) who have suggested four families of methods based on outcomes - information processing, personal, social, and behaviour models. The advantage of such a typology is threefold. First, it enables a hierarchy of instructional objectives to be created, one which subsumes the classification systems of the other
researchers (see figure 9). Second, such labelling enables various methodologies to be readily organized according to their primary outcomes. Third, it enables some kind of link to be formed between the intended learning outcome and the nature of the interactions within the classroom.

**Instructional Objectives**

![Diagram of Instructional Objectives]

Figure 9. Instructional Objectives in Teaching.

**Complexity of the Information**

The complexity of information refers to the degree to which the information utilized (and processes) in the classroom is divergent. To clarify, the methods of teaching
lead to two categories of complexity — convergent and divergent. The convergence/divergence dimension has been discussed by many researchers. Adams and Biddle (1970) have termed convergence and divergence as the "Information Dissemination Mode" and the "Intellectualization Mode". Shumsky (1968) has used the phrases "climate of repetition", "climate of thinking", and "climate of creativity". Schroder, Karlins, and Phares (1973) have termed convergence and divergence as "content learning" and "process learning". However different by name, these terms have similar connotations.

Patterns, according to de Bono (1976), are the foundations of nature and the mind. The mind functions through recognition of patterns. If in going from state S1 to S2, the probability of going from S1 to S2 is dependent directly upon the probability of recognizing that S2 follows S1. The greater is that probability, the greater is the convergence. Conversely, the lower the probability that S2 follows S1, the greater the divergence. Convergence is characterized by a low degree of uncertainty (requiring fewer bits to carry the information) (Attnave, 1959) and has a high degree of expectancy in terms of context (Guilford, 1967). Convergence refers to teaching leading to a pre-determined "right answer". It is founded on a narrow answer base. It is characterized by reproductive thinking and low in complexity (Joyce and Weil, 1980). There is a high probability of repetition.
Divergence is the polar opposite of convergence. It is characterized by a high degree of uncertainty (needing more bits to carry the information) and low in degree of expectancy in terms of context. Divergence is founded on a broad answer base and is high in complexity. Multiple answers are possible, and the probability of being repeated is low.

Schematically, the concepts of convergence and divergence may be represented using Venn diagrams. Each subset represents a student's answers and are part of the set of all possible answers, both known and unknown. The subset T represents traditional and accepted answers. As indicated by the diagrams, convergence yields a large intersection of the sets A1, A2, ..., An with each other and subset T. Conversely, in divergence the intersection of these sets is considerably less and the possibilities of unique discoveries is enhanced (see figure 10).

Thinking of teaching in this way is advantageous for two reasons. It enables the classroom teacher to begin reflecting upon her own teaching and to evaluate the amount of creative processes nurtured in her classroom. Second, it can be measured and analyzed by researchers using techniques such as content analysis, and creativity scales. This distinction is important for considering the effects the various methodologies have upon reproductive and productive thinking abilities.
Convergence/Divergence

Figure 10. Convergence and Divergence.

Mediator of Information

The primary mediator of information in the classroom refers to the primary manipulator of the information - the person who gathers the data, analyzes it, and forms conclusions. The two possibilities are the teacher and the student. The designation of the mediator of information
gives a clear indication of the degree to which students will interact with the environment, and how. If the teacher is the primary mediator, such as in a lecture or demonstration, the students have little direct interaction with the environment. Any interaction that does occur is in the form of indirect observation. If the student is the primary mediator, such as in concept mapping or Guided Design, the interaction is to a much greater degree and in the form of direct observation.

A Typological Sub-Model of Teaching Methods by Outcomes.

These three dimensions can be combined to form a three dimensional cube, each dimension being one of the cube's axis (see figure 11). This cube categorizes teaching methods according to their potential outcomes. The definitions of the categories are:

Learning Skills

a) social skills - skills necessary and conducive to functioning in a group environment. These include collaboration, cooperation, negotiation, discussing, task sharing, and task focussing. Illustrated on the information flow map by the type of learner-learner interaction occurring.

b) personal skills - skills necessary for self-development and personal understanding. This includes critical and generative thinking, self-initiating, social responsibility, evaluating, and creating one's own meaning. Not directly evident on the information flow map, but is represented by the degree of learner-environment interaction and the degree of control students have over that interaction.
c) information skills - skills necessary to gather and process information. This includes data gathering, recollection, interpreting, comparing, classifying, hypothesizing, inferring, patterning, and imitating. Illustrated on an information map by the degree to which students interact with the environment.

**Complexity**

a) convergence - refers to teaching methods (or information) leading to a "right answer" approach; reproductive thinking. Evident by a narrow structuring of the information environment, and having all learners interact with the environment in the same way. The environment is low in complexity and high in structure.

b) divergence - refers to teaching methods (or information) leading to multiple possibilities; creative or productive thinking. Defined on an information flow map by a complex structuring of the environment, and not necessarily having students interact with the environment in the same way. The environment is high in complexity and low in structure.

**Mediation**

a) teacher-mediated - the teacher defines the problem, gathers the data, and suggests solutions; the learner is a passive observer. Illustrated by little interaction between the student and the information environment, except through indirect observation.

b) student-mediated - the student defines the problem, gathers the data, and suggests solutions; the learner is an active participant. Defined by a large degree of direct interaction between the student and the environment. The teacher-student interactions become of the form of facilitative rather than directive.

**Summary**

From the discussion in Chapter 1, it was clear that a model of instruction must perform two functions. It must illucidate the variables of the teaching process and illustrate the relationships between those variables, and it
must allow prescriptions to be made for the planning and implementing of teaching methods. The work of preceding researchers has concentrated upon these two aspects in an attempt to construct a unified model of teaching. These researchers have built a strong argument describing the relationships between the variables of the teaching process.
However, the establishment of a viable model capable of prescription is weaker. The amount of research linking specific objectives to specific objectives is small.

The purpose of this thesis is to present a description of a framework for a model of teaching, one having the capability of both describing the interactions in the classroom and prescribing instruction. The thesis has examined its viability by relating it to existing research.

The model is comprised of two parts. The first part is the information flow map, adapted from a model of an interactive classroom (Powell, 1972). This part is necessary to indicate the types of interactions occurring within the classroom. Discussion has already been presented relating existing research to the model. This research was used as a logical argument for the basis of the model.

The second aspect involves a categorical sub-model for the classification of teaching methods and activities based upon predefined characteristics. This typology is useful for two reasons. First, it would enable prescriptions to be made by relating desired objectives with specific methods and activities for achieving those objectives. Second, it may enable these methods and activities to be represented using information flow map, illustrating processes of teaching and relating them to relevant research.

Examination of the viability of the model requires an additional step. Descriptions of methods and activities of
teaching need to be described in the terminology of the information flow and categorical aspects of the model. By showing these methods and activities can be described in such a manner, it demonstrates the workability and viability of the model. For present purposes, ten methods will be examined to determine if they fit into the model.
Chapter III: Selected Methods of Teaching.

In the preceding chapter the outline for a model of teaching was presented. The model consisted of two parts. The first part was an information flow diagramme which showed the interaction of the various constituents of the teaching process. The interactions involved were:

a) teacher - learner interactions  
b) learner - learner interactions  
c) learner - environment interactions  
d) teacher directing teacher-learner interactions  
e) teacher directing classroom environment  
f) teacher directing learner-learner interactions  
g) teacher directing learner-environment interactions  
h) learners directing learner-learner interactions  
i) learners directing learner-environment interaction

Illustrating the classroom in this manner enables the processes of the classroom to be delineated and related to previous research and make possible the integration of various disciplines related to educational theory.

The second part of the model is the categorical aspect of the model to classify methods of teaching according to their attributes determined by the interactions occurring above. This section of the model classifies methodologies on the basis of the primary skills learned, the complexity of the information environment, and the primary mediator. In this way, the methods can be described in terms of the above interactions.

To illustrate the viability of this categorical model, several methods of teaching are described in the terminology of interactions occurring in the classroom using this model.

- 45 -
By doing so it is possible to show how the method described fits into the model.

The methods selected for analysis in this thesis cover a wide range of outcomes and vary greatly in their characteristics. The methods described are:

1. Lecture  
2. Direct Instruction  
3. Programmed Instruction  
4. Concept Attainment  
5. Concept Mapping  
6. Role Playing  
7. Jigsaw  
8. Guided Design  
9. Non-Directed Learning  
10. Group Investigation

Each method is described in sufficient detail to establish the necessary background to give the reader an understanding of the method and its use. Wherever possible, the works of the original developers of the method were used as the primary references. This description is followed by a recapitulation of the method in terms of the interactions occurring. Specifically, the nature of teacher-learner interactions, learner-learner interactions, and learner-environment interactions were sought. Lastly, the classification of the method in the typological model is given.

To reinforce the concept of information mapping, some information maps of selected methods are provided. The maps are provide for Direct Instruction, Non-Directed Learning, Programmed Instruction, and Group Investigation. These methods were selected because it was felt they would show the greatest differences thereby accentuating the ideas presented.
The lecture method of teaching is one of the oldest and most widespread means of teaching. It is derived from the premise that presenting an audience with information through reasoning or emotions will effect changes in their behaviour (Broadwell, 1980). It is founded upon the view that learning is a process of accumulating knowledge, and the teacher is the expert who can give that knowledge to the student (Hyman, 1970).

There are several uses for a lecture. It is a method to transmit factual information from the teacher to the learner. It is also a means for providing students with models. A teacher can overtly demonstrate his thought patterns as he works his way through a problem. It should provide inspiration and challenge to the learner (Swartz, 1983). It can be used to integrate information from many sources to give the student a more complete understanding of the subject. It can also be used to introduce students to new topics, presenting background material and terminology (Check, 1983).

The essence of a good lecture is good delivery (Highet, 1950). A good delivery requires the teacher to pay attention to several details. He must have a good opening statement to capture attention, and a distinct voice with good tone. The lecturers should be well groomed with good posture, and a
"presence". He should have enthusiasm, a positive attitude, and a sense of humour to inspire students. He should also make use of instructional media aids (Highet, 1950; Check, 1983).

The role of students is that of listener. A student comes to a lecture unknowledgeable and takes notes of what the lecturer says, thereby accumulating knowledge. The lecture may be supplemented by outside readings (Broadwell, 1980; Swartz, 1983) to make the lecture more meaningful.

Proponents of lecturing have stated that lecturing is useful for developing listening skills (Hyman, 1970). To accomplish this end, it is suggested the lecturer make use of techniques such as contradiction or false conclusions in his presentation. The object is to make contradictory statements in the hope that students will have been listening and be able to spot them.

To get students more involved in lectures, another technique that has been suggested is the use of questions. The students are permitted to ask the lecturer questions or visa versa. This permits a limited amount of interaction and feedback between the lecturer and the student. However, this is not always practical for large groups of students.

To summarize, the underlying philosophy of lecturing is that teaching is a process of information dissemination. The teacher is an expert whose role is to inform students of what he knows.
The nature of teacher-student interaction is directive. Messages are of the type "exchange" and "advise". The teacher presents materials to the students to learn. Student-student interactions can be classified as individualistic because the students do not interact with each other during the course of a lecture. However, an atmosphere of competitiveness may be fostered by the use of "testing to motivate" and "grading on the curve". Because the students do not interact with each other during the course of a lesson, the lecture is not competitive. There is no opportunity for the learners to be cooperative. Student-environment interaction is of the form of indirect observation. Access to information is provided through the teacher's lecture with possible outside readings designated by the teacher.

The information environment in the lecture method is highly structured and of low complexity. The information is organized for the student and presented to him.

The teacher is the primary director of all interactions in the classroom. The exact techniques the teacher uses to control the interaction between students and the teacher are not specified. The teacher directs interactions among the learners by psychologically isolating students from each other. The students are discouraged from interacting with each other. The teacher directs the learner's interaction with the environment by preselecting the information and
trying to get students to focus their attention upon the presentation of the information. The students have no control over the flow of information in the classroom.

The primary outcomes of lectures are Information Processing skills and Information Retrieval skills. The student acquires knowledge and sees some thinking skills modelled. Evaluation of these outcomes is in the form of examinations of subject matter.

The categorization of Lecturing in the typological model of methods is of the classification Information/Convergent/Teacher-Mediated (I/C/T).

Method Name: Lecture

Nature of:
Teacher-Learner Interactions (TLI): directive
Learner-Learner Interactions (LLI): individualistic
Learner-Environment Interactions (LEI): indirect observation

Teacher direction of:
Classroom Environment: suitable for a many-to-one learning situation
Learner-Learner Interactions: psychological isolation to deter interaction
Learner-Environment Interactions: focusing student's attention upon teacher's presentation and deter distractions
Teacher-Learner Interactions: focusing student's attention upon teacher's presentation and deter distractions

Learner Direction of:
Learner-Learner Interactions: none
Learner-Environment Interactions: none

Structure of the Environment: High Structure and Low Complexity
Primary Outcomes: Information Processing and Retrieval Skills
Secondary Outcomes: undetermined at this time
Categorization: I / C / T

Figure 12. A Summary Chart of the Lecture Method
Direct Instruction

Direct Instruction refers to a method of teaching that is highly structured and sequenced. It is teacher-centred with objectives very clear to everyone. There is a very clear academic focus.

It is based on the assumption that every child can achieve and do well in school, if he/she receives adequate instruction. Conversely, if that learner fails, it is the result of failure in instruction (Engelmann, 1980). Success in instruction is accomplished by explicitly communicating to the students what is to be learned, and teaching only what is to be learned. A good Direct Instruction programme explicitly states what the students must do and how. Unambiguous communication is accomplished by specification of exactly what the teacher is to say. The presentations are to groups or a whole class, and there is a rapid presentation of many tasks. The groups respond in unison to a signal, such as the teacher clapping her hands or a verbal cue. Individual assessment comes from individual performance of the task. Steps are taken to provide the teacher with an opportunity to correct responses, and positive reinforcement is both necessary and beneficial.

The research basis for Direct Instruction is found in studies investigating content covered and student achievement. The research has found that there is a

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significant relationship between content covered and gains in student achievement on tests, a much larger relationship than for variables of teacher behaviour (Rosenshine, 1979). Additionally, student attention and time on-task yields higher correlations with gains of student achievement than did variables of teacher behaviour (Rosenshine, 1979).

The emphasis in Direct Instruction is on the clarity of the instructional message. The intended meaning of teaching will only be conveyed to students if there is only one intended possible interpretation. If students are to learn a concept, the only way they will learn that concept is if they cannot possibly interpret the meaning in any other way. To achieve this precise communication of meaning, teaching consists of two phases. The first phase involves showing precisely what the concept or discrimination is, and how it works. To do this, the teacher must provide examples of the concept to allow for discrimination, and these examples must be structured in such a manner as to allow for only one possible interpretation. In the second phase, the concepts are expanded and practice is provided in a wide range of contexts. The general description of the teaching process is:

a) clarifying the objectives so everyone understands what is to be learned.
b) teach to groups (or classes) rather than individuals
c) elicit responses from group in unison according to some cue
d) start with low level cognitive objectives and gradually work up to higher level objectives
e) provide opportunity to practice
To illustrate examples of a concept to which learners are to respond, the teacher creates a sequence of discriminations. There are three basic types of discriminations:

a) choice response discriminations (yes/no responses);
b) production response discriminations (simple one or two word responses from students);
c) sentence relationship discriminations (students must answer in sentences questions of the how or why type).

Strategies of a Direct Instruction programme are, in effect, sequences of the three types of discriminations put together to form a sequence to which the learner responds. Each topic has its own individual sequence, or routine. A routine is well designed if all instances of that topic follow the same routine. The objectives are low level cognitive objectives and questions are of low order (Rosenshine, 1979). This is clearly illustrated in the example of Direct Instruction being used in a science lesson. After the initial teaching has taken place, the activities are expanded to include a wider variety of examples and differing contexts. Similarly, additional practice is provided - what is taught is used. The only reason for teaching something is that it is needed for clarifying a situation. Once the discrimination has been mastered by the student, the student can be guided through less structured applications of the concept.

The clarity of instruction, teacher-centredness, and structuring of Direct Instruction are illustrated in the following example of introduction to addition (Engelmann, 1980):
Example

<table>
<thead>
<tr>
<th>Equation</th>
<th>Teacher Wording</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 + 1 =</td>
<td>My turn.</td>
</tr>
<tr>
<td>14 + 1 =</td>
<td>What is the answer? 5.</td>
</tr>
<tr>
<td>15 + 1 =</td>
<td>What is the answer? 15.</td>
</tr>
<tr>
<td>5 + 1 =</td>
<td>What is the answer? 16.</td>
</tr>
<tr>
<td>6 + 1 =</td>
<td>Your turn. What is the answer?</td>
</tr>
<tr>
<td>9 + 1 =</td>
<td>What is the answer?</td>
</tr>
<tr>
<td>5 + 1 =</td>
<td>What is the answer?</td>
</tr>
<tr>
<td>1 + 1 =</td>
<td>What is the answer?</td>
</tr>
<tr>
<td>16 + 1 =</td>
<td>What is the answer?</td>
</tr>
<tr>
<td>8 + 1 =</td>
<td>What is the answer?</td>
</tr>
<tr>
<td>3 + 1 =</td>
<td>What is the answer?</td>
</tr>
<tr>
<td>12 + 1 =</td>
<td>What is the answer?</td>
</tr>
</tbody>
</table>

To summarize, the underlying philosophy of Direct Instruction is that learning takes place only when the concepts and skills are explicitly taught. That is, the objectives are specifically stated and there is a clear academic focus.

Teacher-student interactions can be generally classified as being directive - messages are primarily of the "exchange" and "advise" type with some secondary interactions being in the "agree" and "disagree" categories. The teacher explicitly presents the student with the information (skills and concepts) to be learned. When students respond, the teacher corrects if incorrect (disagree) and provides reinforcement (agree).

The interaction between students can be categorized as individualistic. Although the students respond as a group, they do not interact with each other. Achievement of one
student's objective is not at the expense of others achieving their objective.

The interaction between the learner and the environment is direct. Initially the student has no direct contact with the environment - he gets his information from the teacher. The teacher selects from the environment and conceptually organizes the material for the learner. After the learner has been presented with the information and has provided the appropriate response, he is given the opportunity to interact more directly with the environment by practicing what he has learned.

The information environment is highly structured and low in complexity. The teacher selects the information the student is to interact with. Because of this, the content is very narrow in scope and there is little room for divergence. The students are locked into convergent responses.

The focus of teacher direction of interaction between students and the environment is highly directive. The teacher explicitly states what the student is to do and reinforces the student's behaviour as he interacts with the information. The direction of interaction between students is similar to that of the lecture method. The students are discouraged from interacting with each other, and each student is expected to respond in the same manner as the others. Because students do not interact with each other,
there is no student direction of student-student interactions. Similarly, because the teacher functions in a directive manner, the students have no direction over their interactions with the environment. The teacher directs the classroom environment to facilitate a many-to-one teaching situation, but must also allow for responding to student responses at the same time.

The primary learning outcome from the use of Direct Instruction is Information Processing Skills and Information Retrieval Skills. As discussed earlier, the presentations are at a low cognitive level and the main focus is on learning concepts. The categorization of Direct Instruction in the typology of methods model would place Direct Instruction in the Information/Convergent/Teacher-Mediated category (1/C/T).
Method Name: Direct Instruction

Nature of:
Teacher-Learner Interaction (TLI): directive
Learner-Learner Interaction (LLI): individualistic
Learner-Environment Interaction (LEI): direct observation

Teacher Direction of:
Classroom Environment: a many-to-one teaching situation with provision for reinforcing student responses.
Learner-Learner Interactions: students are discouraged from interacting with each other.
Learner-Environment Interactions: explicit statements of objectives achieved by explicit instruction by teacher and directed practice
Teacher-Student Interactions: use of cues to control responses.

Learner Direction of:
Learner-Learner Interactions: none
Learner-Environment Interactions: none

Structure of the Environment: High Structure and Low Complexity
Primary Outcomes: Information Processing and Retrieval Skills
Secondary Outcomes:
Categorization: 1 / C / T

Figure 13. A Summary Chart of Direct Instruction.
A Direct Instruction Lesson

1. A many-to-one teaching situation with provision for reinforcement
2. Teacher uses cues to elicit student responses
3. Explicit statement of objectives achieved by directed practice
4. Discourage learner-learner interaction
5. Learner direction of interaction with each other - none
6. Learner direction of interaction with the environment - none

Figure 14. An Information Flow Map of Direct Instruction.
Programmed Instruction grew out of the work of two early and mid-century scientists, Sidney Pressey (1920's) and B.F. Skinner (1950's). Programmed Instruction is based upon the Principles of behavioural psychology (stimulus-response theory). These principles are (Lysaught and Williams, 1963):

a) the more quickly reinforcement follows the desired behaviour the more likely the behaviour will be repeated;
b) the more often reinforcement occurs the more likely the behaviour will be repeated;
c) absence or delay of reinforcement will weaken the probability of the desired behaviour being repeated;
d) reinforcement can be used to gradually modify behaviour.

Programmed Instruction works by presenting a stimulus (an item of material to be learned) to which the student makes a response. The student then receives immediate feedback and reinforcement. Note that instruction stops until the student makes his response.

A course in Programmed Instruction is presented as a series of short units. Each unit is comprised of a series of frames. Each frame is an item. The student reads each frame and makes a response to the frame. The basic rules in creating a programme are (Fry, 1963):

a) each response must be reinforced immediately;
b) only overt responses are learned;
c) errors have an adverse effect on learning;
d) progress must take place in small successive steps;
e) aids to learning should be gradually withdrawn.
A programmed course is built upon these rules. The student is presented with a single item of material to be learned (a frame). He makes a response which is immediately reinforced by receiving feedback as to whether or not the response is correct. If the response is correct, the student proceeds to the next frame and is presented with another item of material to be learned.

There are three types of responses commonly found in Programmed Instruction (Buchanan, 1969):

a) constructed response - the student creates the response such as filling in a blank;

b) discriminatory response - the student chooses a response from given alternatives such as multiple choice questions;

c) faded letters - a letter(s) of a word are left out and the student must fill in the appropriate letter(s).

After reading each frame, the student either chooses an answer from the list provided, fills in the missing letter(s), missing word(s), missing number(s), or symbols.

Most frames (or items) are constructed according to the pattern of rule-example-response. A definition or rule is presented which the student reads. This is followed by an example. Often, in the example the student is required to make a response.

Most programmes are designed as linear programmes meaning the student starts at the beginning and follows a progressive sequence to the finish. However, programmes may also allow for branching. Branching refers to deviations from the main Programme for some specified reason, usually because the

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student's ability exceeds the programme's immediate capabilities or visa versa. There are four types of branching - review, remedial, skipping, and cueing. If a student has a frequency of inappropriate responses (incorrect answers) below a certain level (such as 95%) the programme may call for review or remedial work. In review, the student merely repeats the section on which he received the low score. In remedial work the student is referred to a sub-section of the programme for an alternate instructional sequence and additional practice. If the student's performance is extraordinary, he may skip a section of the programme (skipping). Or alternatively, if the student enters an incorrect response, a hint may be provided to simplify the task (cueing).

An example of a series of frames similar to a Programmed Instruction course is taken from Miller (1983). The topic is educational objectives:

"Keep the answer in the right-hand column covered until you have filled in the blank in the left-hand column.

1-1 Educational objectives are statements of the goals that teachers have set for their students. The goals that teachers set for their students are called an/a ______ educational objective _________.

1-2 When a teacher says that she wants her students to be able to write an anti-pollution petition, she has stated an/a ______ educational objective _______.

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1-3 A coach states that he wants his players to be able to make seventy-five percent of their free throws, he has formulated an educational objective.

1-4 If a music teacher states that she wants her students to enjoy all kinds of music, she has stated an educational objective.

The role of the teacher in Programmed Instruction is that of a facilitator. The teacher does not deliver instruction to the students, but provides individual tutoring as needed. Because the programme provides instruction, the teacher can devote his time to counselling, guiding, assisting, and stimulating learners. The teacher can also spend time preparing, modifying, and evaluating existing programmes (Lysaught and Williams, 1963).

To summarize, the underlying philosophy of Programmed Instruction has its foundations in behavioural psychology. It operates on the principle that a student who is given immediate feedback to responses will learn more effectively.

The nature of interaction between the teacher and the student in Programmed Instruction may be described as being facilitative. Messages are at the "support" and "advise" levels with some behaviour at the "exchange" level. The teacher acts as a tutor for slower learners, providing individual assistance as needed. It is through interaction with the programmes themselves that learning occurs.
The nature of interaction between the learner and the environment is in the form of direct observation. The learner interacts with the environment through materials prepared in advance by the teacher (or curriculum designer). In this interaction, the student makes responses to some stimuli provided by the material. The nature of interaction between learners themselves is individualistic. The achievement of goals by one person does not affect another person's chances at achieving his objectives. The structure of the environment is high, and low in complexity. The environment is pre-arranged for the student and the student's only contact with it is through the programme.

The teacher directs the interaction between students and the environment by using carefully constructed programmes. The environment is carefully constructed to allow the students to make responses to stimuli. These responses tend to be highly convergent. The teacher directs the interaction among learners by using individual programme workbooks and individual CAI programmes, encouraging students to work individually rather than cooperatively. By providing access to workbooks and computer terminals (or other teaching machines) the teacher is also directing the classroom environment. The students do not exert any direction over their interaction with each other, or their interactions with the environment.
The primary outcomes of Programmed Instruction are Information Retrieval and Information Processing skills. It involves recognition, remembering, interpreting, comparing, classifying, imitating, inferring, and generalizing. Secondary outcomes from Programmed Instruction include Self-development. Advocates of Programmed Instruction claim improvements in self-esteem and self-confidence among learners exposed to the method.

Programmed Instruction has been successfully utilized at all levels of education from elementary to college, and in all subject areas (Calvin, 1969). No special requirements are needed to implement Programmed Instruction, although a great deal of effort is needed to design a unit of programmed material. Evaluation is of the form of subject matter tests and standardized achievement tests.

Programmed Instruction can be categorized as being Information/Convergent/Teacher-Mediated (I/C/T) in the classification system of the typological model.
Method Name: Programmed Instruction

Nature of:
Teacher-Learner Interaction: facilitative
Learner-Learner Interaction: individualistic
Learner-Environment Interaction: direct observation

Teacher Direction of:
Classroom Environment: provide access to computers and workbooks
Teacher-Student Interactions: unspecified
Learner-Learner Interactions: encouraging individual work by providing
individual workbooks and computer terminals.
Learner-Environment Interactions: utilization of workbooks and computer
terminals to provide stimuli

Learner Direction of:
Learner-Learner Interactions: none
Learner-Environment Interactions: pacing of responses

Structure of the Environment: High Structure and Low Complexity
Primary Outcomes: Information Processing and Retrieval Skills
Secondary Outcomes: Self-Development
Categorization: I / C / T

Figure 15. A Summary Chart of Programmed Instruction.
A Programmed Instruction Lesson

- Teacher-Student Interaction 
- Student Interaction Among Students 
- Individualistic

Interaction between Student and Environment

Information Sources: $A_1, A_2, A_3, \ldots, A_m$

Information Environment: $X_1, X_2, X_3, \ldots, X_n$

Feedback Pattern: Not Shown

1. Provide access to computers and workbooks.
2. Teacher direction of teacher-learner interactions - unspecified
3. Utilization of computers and workbooks to provide stimuli
4. Encouraging individual work by providing individual computers and workbooks
5. Learners direction of interaction with each other - none
6. Learners pace responses to stimuli

Figure 16. An Information Flow Map of Programmed Instruction.
Concept Attainment

Concept Attainment is a teaching method developed by Joyce and Weil using the work of Bruner as a basis (Eggen, Harder, and Kauchak, 1979). It uses inductive reasoning to teach concepts pertinent to some subject matter by presenting a large number of exemplars, both positive and negative. The emphasis in Concept Attainment is to reduce teacher verbalizing and utilize the examples to present the concepts.

A concept can be defined as an abstraction of a series of observations or experiences (Eggen, Harder, and Kauchak, 1979). According to Bruner, a concept is comprised of five components: name, exemplars (positive and negative), attributes, attribute values, and a rule (Joyce and Weil, 1980). The name refers to the name that is given to the concept. The exemplars are examples of what is and what is not the concept. The attributes and attribute values are the essential characteristics the object or idea has to cause it to be a member of the group constituting the concept. The rule is a statement specifying the attributes of the concept.

The teaching process of Concept Attainment is relatively simple. Planning consists of four steps (Eggen, Harder, and Kauchak, 1979). These are identification of concepts, selecting exemplars, sequencing exemplars, and selection of media of presentation. The actual teaching process consists
Joyce and Weil (1980) have suggested three possible variations of Concept Attainment. In the first variation, the teacher presents examples of the concept and asks the student to hypothesize a rule and state the attributes. The students generate hypotheses, test them, and the teacher confirms or rejects them. The students then generate examples.

In the second variation the teacher presents unlabelled examples to the students (the examples are not labelled as positive or negative examples of the concept). The students then proceed as above, generating and testing hypotheses, and having the teacher confirm or reject those hypotheses. The third variation is very unstructured in the sense that students must locate and label the concept rather than have it presented to them. They must identify the attributes and evaluate the adequacy of the concept as defined by its attributes.

An example of the first two variations of the Concept Attainment method is as follows (Eggen, Harder, and Kauchak, 1979):

To teach the concept "reptiles", the following sequence of exemplars may be used. Accompanying pictures would be quite valuable, and may substitute for words.

1. Turtle Yes
2. Cow No
3. Alligator Yes
4. Chicken No
5. Snake Yes
6. Salamander No
7. Lobster No
8. Toad No

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From this list, the students are guided into identifying the attributes of the concept and synthesizing the classification rule. If the concept is correctly identified they should be able to classify unlabelled examples correctly.

An example of the third variation of the Concept Attainment method comes from Joyce and Weil (1980). The concept investigated is that of criminality.

Example A
It has been traditional to impute to the criminal certain distinctive and peculiar motivations, and physical, mental and social traits and characteristics. Historically, crime has been ascribed to innate depravity, instigation of the devil in constitutional abnormalities, mental deficiency, psychopathology, and many other conditions inherent in the individual. Criminals have been thus set off as a distinctive class, qualitatively different from the rest of the population.

Example B
The delinquent careers of the brothers had their origins in the practices of the play group and games with which they became associated as children. The initial acts of theft were part of the undifferentiated play life of the street. From these simple beginnings, the brothers progressed, by social means, to complicated, more serious, and more specialized forms of theft. The situation in the home community not only failed to offer organized resistance to this development, but there were elements which encouraged it and made any other course of action difficult.

The procedure for analyzing concepts in unorganized materials involves locating the concept (by reading the two passages), identifying the attributes used, discussing the adequacy and appropriateness of the attributes, and comparing the examples to other passages.
To summarize, the basic philosophy of Concept Attainment is "one example is worth a thousand words". The most efficient way of learning a concept is by examining many examples of what is and what is not the concept. It is important to note that this method can only work for teaching a concept. It will not work for facts or problem-solving (Eggen, Harder, and Kauchak, 1979).

The nature of teacher-student interactions may be classified as being directive. Messages are of the "advise" and "exchange" type, with some secondary behaviour of "disagree" for the first two variations (Concept Attainment I and II). For Concept Attainment III the teacher's behaviour is facilitative - messages are of the "support" and "advise" type. For Concept Attainment I and II the teacher prepares examples in advance and explicitly presents the information to the students. The teacher gives the information to the students. In Concept Attainment III the teacher presents the examples to the students but it is much less teacher directed. The students discuss among themselves in groups rather than having the teacher tell them the answer after they make their hypotheses.

For Concept Attainment I and II, the nature of interaction between students themselves is individualistic. The students work by themselves without having any great influence on others achieving their goals. In Concept Attainment III, the students can work alone or in groups, as
is suggested by Joyce and Well (1980). If the students work alone, the interaction is classified as individualistic. If the students work in groups, the interaction is cooperative.

The interaction between the student and the environment is limited and direct. The material is presented to the student rather than having the student collect the observations. The classifications of what is and is not the concept are predetermined by the teacher for Concept Attainment I and II. For Concept Attainment III the material is still presented to the student but the learner has more of an opportunity to work with it than in the first two variations.

The information environment ranges in its structure and complexity. Concept Attainment I and II are highly structured and low in complexity with little room for divergence. The teacher preselects from the environment and conceptually organizes it for the learner. Concept Attainment III is more moderately structured with some room for divergence. Although the material is preselected, it is not conceptually organized for the learner by the teacher.

In Concept Attainment I and II, the teacher directs teacher-student interaction and learner-environment interaction by having the students focus upon what she is saying and the prepared materials. In Concept Attainment III, this is not necessarily the case. The students focus upon the information rather than the teacher. This is
accomplished by having a pre-specified objective and
directing the analysis of the information. The teacher
directs learner-learner interaction by encouraging individual
work, or in the case of group work (Concept Attainment III),
cooperation. The teacher may become involved in mediating
group conflicts in such instances.

The students have no direction over learner-learner
interaction and learner environment interactions for Concept
Attainment I and II, and situations of Concept Attainment III
which does not utilize group work. If group work is
utilized, student direction of learner-learner interaction
and learner-environment interaction is unspecified.

The primary learning outcomes from Concept Attainment are
Information Processing skills. Learners practice classifying,
generalizing, and hypothesizing. According to Joyce and Weil
(1980) the emphasis of the lesson should be placed on
discussion of the thought processes involved in identifying
the concept, rather than the concept itself. If Concept
Attainment III is used secondary outcomes are personal skills
as learners practice evaluating and critical thinking (as
above, the emphasis of the lesson is upon the thought
patterns involved to identify and define the concept).
Furthermore, if group work is utilized, secondary outcomes
will be communication skills, and to some extent leadership/
Participation skills.
From these outcomes, Concept Attainment I and II can be classified as being Information/Convergent/Teacher-Mediated (I/C/T) in the typology model. Concept Attainment III can be classified as being Information/Divergent/Teacher-Mediated (I/D/T).

There are no special preparations or introductory activities for implementation of Concept Attainment I and II (as some methods do). It is recommended that Concept Attainment I and II be used before Concept Attainment III (Joyce and Weil, 1980) so students have an understanding of the thought processes involved and can work more effectively.

Name of Method: Concept Attainment

Nature of:
Teacher-Learner Interaction: directive
Learner-Learner Interaction: individualistic
Learner-Environment Interaction: direct observation

Teacher Direction of:
Classroom Environment: unspecified
Teacher-Student Interactions: through use of examples
Learner-Learner Interactions: encouraging individual work except in group work where may involve mediating group conflicts and task focussing.
Learner-Environment Interactions: pre-selecting materials and pre-specifying objectives and tasks

Student Direction of:
Learner-Learner Interactions: none if individual work is utilized; if group work is used, then unspecified.
Learner-Environment Interactions: none (Concept Attainment I and II)
unspecified (Concept Attainment III)

Structure of the Environment: High Structure, Low Complexity (I & II)/Low Structure, High Complexity (III)

Primary Outcomes: Information Processing Skills
Secondary Outcomes: Understanding (for Concept Attainment III)
Categorization: I / C / T (Concept Attainment I and II)
I / D / T (Concept Attainment III)

Figure 17. A Summary Chart of Concept Attainment.
Concept mapping is a method of learning old knowledge and generating new knowledge by examining concepts and the propositions linking concepts together. It is a method of externalizing concepts and propositions. Students can see the structure and meaning of the knowledge they seek to understand. It provides for teachers and learners the opportunity to experience a shared meaning of knowledge (Novak, 1981; Novak and Gowin, 1984). It can be successfully utilized in many grades ranging from elementary school (Novak and Gowin, 1984) to college level (Arnaudin, Mintzes, Dunn, and Shafer, 1984).

The concept map is an application of Ausubel's learning theory. This theory suggests that it is best to start with the most general concepts of a discipline so these may be used to anchor or subsume new concepts and knowledge (Novak, 1981). Meaningful learning occurs when students can relate ideas to one another and to existing conceptual schemes (Donovan, 1983; Malone and Dekkers, 1984). Concept mapping allows students to relate what they already know to new knowledge and what they are currently learning.

A concept map is a hierarchical representation of the concepts and propositions. It illustrates the sub-ordinate and super-ordinate relationships between concepts as suggested by the propositions (see figure 18).
Implementing Concept Mapping is relatively simple. The steps involved are (Donovan, 1983):

a) identify the concepts involved
b) decide upon the relative importance of each and rank them
c) put the concepts onto a piece of paper and add the propositions linking them

A Concept Map for Water

This can be done in one of two ways. The teacher can provide the concepts and the students can create the propositions, or the students can identify the concepts and create the propositions. If the students are able to identify the concepts from observation (reading texts or performing experiments) then the learning will be of greater meaning.

Another option the teacher has is to use Concept Mapping as
either an individual activity or as group work. Given the resource material (texts, books, filmstrips, cassettes, or even the concepts themselves) the student (or the group) would proceed to search this material to find the concepts, and formulate the propositions. The student (or group), having created the propositions, would then proceed to create the concept map.

To summarize, Concept Mapping is a method of teaching which is based upon the proposition that meaningful learning occurs when links between old and new ideas can be established and incorporated into existing conceptual schemes.

The nature of the interaction between the teacher and the learner is primarily facilitative. Messages are of the "support" and "advise" type, with some secondary interaction of the "exchange" type. The role of the teacher is to present the problem, and facilitate learning. The teacher should encourage and motivate students. She should give suggestions and guidance to students who seem to be going astray or having difficulty.

The interaction between the students is either cooperative or individualistic, depending upon whether or not group work is utilized. The interaction between the students and the environment is direct observation. The students interact directly with the information to manipulate it into meaningful formats. The students gather the data to identify
the concepts, find definitions, and create or find propositions.

The teacher directs learner-learner interactions in one of two possible ways. If group work is utilized, the teacher directs learner-learner interaction by setting task objectives (finding concepts and then mapping them) and acts as a mediator of group conflicts. At the same time she is encouraging on-task behaviour. If group work is not utilized the teacher directs learner-learner interaction by encouraging individual seat-work.

Teacher direction of learner-environment interactions can vary. If the teacher chooses to present concepts to the students and have them find the relationships between those concepts, the teacher is directing the learner-environment interactions by pre-selecting the information. If the teacher has chosen to let the students identify the concepts and map them, then there is minimal direction of student-learner interaction. The teacher directs this interaction by specifying a task and allocating resources to assist students in completing the task.

Student direction of learner-learner interaction is of one of two possibilities. If individual seatwork is chosen then there is no student direction of learner-learner interactions. If group work is utilized, student direction of learner-learner interaction involves focusing upon on-task behaviour and resolving group conflicts.
Student direction of learner-environment interaction is unspecified. However, if the teacher is using the variation of Concept Mapping in which students must identify concepts and propositions, then student direction of learner-environment interaction takes the form of planning methods of completing the task.

The primary learning outcome from Concept Mapping is understanding. The students generate their own meaning for the knowledge they learn, and reflect upon that meaning. The secondary outcomes are at the Information Processing skills level and Information Retrieval skills level. If group work is utilized, Communication skills will also be secondary outcomes.

The only special requirement needed to implement Concept Mapping is a set of activities designed to orient students with the method (Novak and Gowin, 1984). These activities help students understand what Concept Mapping is and their roles in the method, thereby making the lessons proceed more efficiently. Additionally, to facilitate the identification of concepts, Concept Attainment would be an activity to enable students to function within the method of Concept Mapping more effectively.

Evaluating a learner's performance in Concept Mapping involves examining the hierarchy. A student's score is determined by the number of levels in his hierarchy and the number of valid propositions made (Novak and Gowin, 1984).
From the nature of the interactions involved and the types of outcomes promoted, Concept Mapping can be categorized as Personal/Divergent/Student-Mediated (P/D/S) in the typological model.

Method Name: Concept Mapping

Nature of:
- Teacher-Learner Interactions: facilitative
- Learner-Learner Interactions: individualistic or cooperative
- Learner-Environment Interactions: direct observation

Teacher Direction of:
- Classroom Environment: access to resources
- Teacher-Learner Interactions: unspecified
- Learner-Learner Interactions: encouraging individual work or mediating group conflicts, task focusing
- Learner-Environment Interactions: pre-selecting the information or specifying the task and allocating resources

Student Direction of:
- Learner-Learner Interactions: none (individual work) or resolving group conflicts
- Learner-Environment Interactions: planning methods of completing the task assigned otherwise unspecified

Structure of the Environment: Low Structure and High Complexity
Primary Outcomes: Understanding
Secondary Outcomes: Information Retrieval and Processing, Communication
Categorization: P / D / S

Figure 19. A Summary Chart of Concept Mapping.
Sociodrama - Role Playing

Sociodrama (or Role Playing) is a teaching method designed to help learners explore human relations through enactments of problem situations. It gives them the values, attitudes, behaviours. It then gives the learner an opportunity to modify them intelligently (Shaftel and Shaftel, 1967).

The steps involved in implementing Role Playing in the classroom are (Joyce and Weil, 1980; van Ménts, 1983):

a) identifying the problem and interpreting the story;
b) explaining the role playing method;
c) analyzing roles and selecting players;
d) setting observation tasks and beginning role playing;
e) discussion of observed enactment and debriefing;
f) possible re-enactments of the problem with different solution.

A problem is presented to the students. This problem, as mentioned earlier, is designed to get learners to explore their feelings and values. Such a problem may involve an open-ended social conflict of some sort. After the problem has been clearly identified, the roles in the story are discussed. The class then proceeds to assign some students to act the part of the characters in the problem. The remaining students are designated as observers with observation tasks assigned to them. After the participants have enacted the problem and proposed solution, a discussion is held concerning what has transacted. The students discuss their feelings, attitudes, and perceptions of the parts they
played, and the situation they observed. If other solutions
to the problem had been proposed (either now or earlier), a
re-enactment may occur based upon these solutions.

The teacher utilizing Role Playing functions as a
facilitator (Shaftel and Shaftel, 1967). The teacher must
create an atmosphere or climate that encourages frank and
open expression of ideas and feelings from the learners. The
teacher presents the students with the problem and allows
them to enact the solution by encouraging them, questioning,
guiding, and focusing their experiences to the interactions
occurring.

An example of the type of problem role-playing is
suitable for, consider the following case provided by
Wohlking and Gill (1980).

The Case of the Complaining Customer: Role A
Role of Courtney King, Department Store Manager.

You are the manager of the town's largest department
store. You are seated at your desk, when someone who is
apparently a customer has just entered your office.

The Case of the Complaining Customer: Role B
The Role of Sandy Mason, Customer.

You have been shopping in your town's largest department
store. You were looking at some clothing when a clerk came
over to you and asked if he or she could offer any help. At
that time, you declined. You browsed around some more, then
decided on an item of clothing that you wanted.
At this time you went over to the same clerk who previously
offered you some help but who was now involved in putting
away some boxes. You said that you now needed some help.
The clerk then said, "Are you sure you want help now?" You
feel that both words and tone were unjustified.
You have shopped in this store for over ten years and you
have never received treatment like this. You decide that you
are going to speak to the store manager. You are upset, and
you feel that the clerk should be reprimanded.
As the scene opens, you have just walked into the manager's
office.
This problem is useful to prepare students for dealing with certain kinds of problems involving human encounters. In this instance, the role playing technique is useful to teach managers how to handle customer complaints. The emphasis is on interpersonal communications with a "here's what to do in this situation" approach. The role playing technique is used to simulate the problem situation and can be termed Role Playing I.

Shaftel and Shaftel (1967) have presented a collection of problem situations that place a greater emphasis on feelings, attitudes, and values. The approach is one of "What would you do?" rather than "Here's how to do it." The problem situations are open ended problems designed to place the role players in a conflict situation, such as facing a decision of doing what is felt to be morally right versus what the peer group wants the role player to do. A simple example might be finding a sum of money in a wallet. The wallet contains a large sum of money and the owner's name and address. The group wants to keep the money but you think it should be returned. Role playing in this context is more of the form of socio-drama than a simulation, and useful for values clarification exercises. This can be termed Role Playing II.

The philosophy of Role Playing is that by acting out problem situations, students can explore their feelings, attitudes, and values. They can examine behaviours that occur in inter-personal relationships and modify their own
behaviour accordingly.

The nature of the interaction between the teacher and the learner is facilitative. The teacher's behaviour can be classified as primarily being in the "support" and "agree" categories, occasionally functioning in the "advise" category.

The nature of interaction between learners can be described as both individualistic and cooperative. The learners must work together to enact a situation and arrive at the solution. At the same time, the emphasis is on values and attitudes which also suggests individualism is the focus of learner-learner interactions. The nature of the interaction between the learner and the environment is direct observation. The problem is a real problem and the learners react directly to each other - the situation is a simulation of reality. The structure of the environment is low, and the complexity is high.

In Role Playing, the teacher directs the interaction between the learner and the environment by establishing problem situations, and specifying what elements of the problem situation should be identified and examined as the enactment occurs. The teacher sets up a problem and says "Here's what we should be looking for."

The teacher controls learner-learner interactions in a similar way. By pre-defining the roles of the actors, the teacher is directing the interactions between the actors. For those learners who are observers, the teacher directs the
interaction among them by encouraging individual observation, and providing a list of things to observe (promoting on-task behaviour).

Student direction of the interactions is undetermined. Students who participate in the acting in Role Playing have some direction over learner-environment and learner-learner interactions. They can control the events of the enactment, determining what is said and done during the enactment within the limits imposed by the teacher. The observers, on the other hand, have no direction over the interactions occurring.

The primary outcome of Role Playing I is Information Processing with some Understanding. The emphasis is on simulating interpersonal skills in those situations where humans encounter each other in the course of daily interaction. In Role Playing II, the primary outcome is self-development. The focus is on reflection of values, attitudes, and feelings of the self, and modifying them if necessary. Secondary outcomes of both variations include Communication skills.

There are no prerequisites to using Role Playing other than an explanation of the method to the students. It can be used successfully at all grade levels and subject area.

The classification of Role Playing I in the typological model of teaching methods is Personal/Convergent/Student-Mediated (P/C/S). For Role Playing II the categorization is Personal/Divergent/Student-Mediated (P/D/S).
Method Name: Role Playing

Nature of:
Teacher-Learner Interactions: facilitative
Learner-Learner Interactions: individualistic
Learner-Environment Interactions: direct observation

Teacher Direction of:
Classroom Environment: allowing for enactments to occur
Teacher-Learner Interactions: unspecified
Learner-Learner Interactions: pre-defining roles, providing observation lists, encouraging on-task behaviour and individual work for observers.
Learner-Environment Interactions: pre-defining roles, providing observation lists.

Student Direction of:
Learner-Learner Interaction: undetermined for actors none for observers
Learner-Environment Interaction: undetermined for actors none for observers

Structure of the Environment: Low Structure and High Complexity
Primary Outcomes: Self-Development
Secondary Outcomes: Communication, Information Processing and Retrieval

Categorization: P / C / S (for Role Playing I)
P / D / S (for Role Playing II)

Figure 20. A Summary Chart of Role Playing.

Jigsaw

Jigsaw is a teaching method developed by Elliot Aronson and colleagues at the University of Texas, Austin. It was developed as a result of a racial crisis in the Austin school system (Aronson and Goode, 1979; Aronson, Blaney, Stephan, Sikes, and Snapp, 1978). The method is designed to place
students into situations of mutual interdependence, situations where the only chance for success comes from cooperation. Learners who try to function in a competitive or individualistic manner will meet with failure.

The fundamental premise of Jigsaw is that every learner has a vital piece of knowledge to contribute to the success of the group. In the traditional classroom, there is one expert (the teacher) with twenty learners. In the jigsaw classroom, this is changed to many experts and fewer listeners. Creating experts is accomplished by dividing the class into groups of four to six persons. Each person in the group is responsible for learning a section of the subject matter and teaching it to the other members of the group. Each "expert" in the group meets with "experts" from the other groups who are learning the same subject matter. These experts help each other to learn the material they must teach to the other members of their respective groups and ways in which this might be accomplished. They then return to their respective groups and commence teaching the other members of the group. It is suggested (Aronson and Goode, 1979) that students spend 20 minutes of a one hour class in expert groups and 40 minutes in the jigsaw group, with five minutes at the end for discussion of problems.

A jigsaw group is comprised of four to six members of diverse abilities and ethnic backgrounds. Each group has a group leader who is pivotal to the success of the group. The
group leader is responsible for coordinating the organization of the group, assuring all members participate, keeping the group on-task, and serving as a liaison between the teacher and the group. The teacher addresses the group through the leader rather than the group itself. Because of this structure, it is recommended that the leaders receive extra training (Aronson et al., 1978). It is also suggested that the first group leader keep his position for two to three weeks, after which time a new leader is elected. Each member of the group should have an opportunity to function as leader, with a recommended term of one week, or more.

The role of the teacher is facilitative, but in a manner different than other methods such as Guided Design or Non-directed learning. The teacher primarily structures the information environment - the subject matter the students will learn and the activities they will undergo in learning them. She structures the environment by giving students their instructions (objectives and key content material) on activity cards prepared in advance. Behavioural problems are handled by the group leader. If a pupil is not attending to the task at hand, the teacher approaches the group leader about the problem and may suggest alternatives to the leader to remedy the situation.

The following description of a Jigsaw classroom is provided by Aronson et al. (1978):

For the colonial unit Ms. Taylor had prepared jigsaw activity cards for each particular topic. Lisa passed a
card to each person: Mark, Kevin, Amy, Nicole, Jon, and herself. The cards suggested ways that each student could help focus discussion on important issues and directed the student to additional resource information, such as reference books and, for the students who had difficulty reading, tapes. Performance objectives accompanied the material to help the student know specifically what must be presented. For example, the student teaching about Puritism found on the card 'Each member of your group should be able to name two colonies in which Puritism was found.'...Ms. Talyor had mimeographed the resource material that accompanied each card so that the students could promptly begin work on their presentations.

Because of the complex nature of Jigsaw, it cannot be implemented into the classroom without some preliminary activities. These activities are team-building activities designed to introduce learners to the method of Jigsaw. Team building activities show learners the necessity and importance of cooperation and introduces them to appropriate behaviours and roles needed to function in a Jigsaw group.

To summarize, the underlying philosophy of Jigsaw is cooperation. Learners are placed into situations in which success can only be achieved through cooperation. Additionally, learners (especially children) are placed into situations where they come to realize they are responsible for their own success in learning. In this way students develop an attitude to learning built on mutual development and self-initiation.

The nature of interaction between the student and the teacher is facilitative. However, this interaction is greatly reduced. Interaction with students takes place through the group leader. The teacher may make suggestions
to the group leader to make group activities more productive.

The nature of interaction between the learner and the environment is through indirect observation. Students interact with the subject matter via activity cards prepared in advance by the teacher. These activity cards specify the key subject matter to be learned by the student and subsequently taught to the other members of the jigsaw group. The nature of the interaction between students is cooperative. Individualistic or competitive behaviour is undesirable and will not produce successful results.

The structure of the environment is not specified but indications from readings (Aronson, 1978; Aronson and Goode, 1979; Slavin, 1983) are that the environment is moderately high in structure and low in complexity. The information is preselected by the teacher and placed on information cards for the students to read. From there, the students go to their Jigsaw groups and teach that information to the other students.

The teacher directs the interaction between learner and the environment by providing activity cards. Each card contains information pertaining to what is to be taught (both content and performance objectives), and suggestions of ways of presenting the material. The teacher does not direct the interaction between learners other than creating a situation where the only possible chance of success is through cooperation. Any further interaction the teacher has with
the students is conducted through the group leader. Similarly, the teacher directs teacher-learner interactions through the group leader. The teacher directs the classroom environment by providing arrangements conducive to group work, and access to any necessary resources.

The students do not directly control their interactions with the environment. The teacher supplies activity cards with instructions for each student. The learners do direct their interactions with each other. This is accomplished through the group leader. The group leader is responsible for directing the group's activities.

The primary outcomes of Jigsaw are social skills and personal skills. Students practice leadership and participation, communication, and self-development. Research shows that Jigsaw is very effective in raising self esteem, particularly among minority groups. Secondary outcomes include Information Retrieval and Information Processing skills. Evaluation in the Jigsaw method is in the form of subject matter quizzes. Pre-requisites to implementation are team building activities (Aronson et al., 1978). The categorization of Jigsaw in the typology model of methods is Social/Convergent/Teacher-Mediated (S/C/T).
Method Name: Jigsaw

Nature of:
Teacher-Learner Interaction: facilitative
Learner-Learner Interaction: cooperative
Learner-Environment Interaction: indirect observation

Teacher Direction of:
Classroom Environment: provision for group work and access to resources
Teacher-Learner Interactions: through the group leader
Learner-Learner Interactions: through the group leader
Learner-Environment Interactions: provision of activities containing content, objectives, and suggestions for presentation.

Student Direction of:
Learner-Learner Interactions: group leader directs the group to focus on the task, and help mediate conflicts.
Learner-Environment Interactions: none, except for the presentation of information to the group.

Structure of the Environment: High Structure and Low Complexity
Primary Outcomes: Leadership/Participation, Communication, Self-Development
Secondary Outcomes: Information Processing and Retrieval
Categorization: S / C / T

Figure 21. A Summary Chart of Jigsaw.

Guided Design

Guided Design, developed by Wales and Stager (1977), is a teaching method to promote problem-solving and decision-making in the classroom. It is based on the assumption that students who work through an ascending order of well-designed problems and actively seek solutions to problems will be better educated and intellectually stronger. By focusing on both decision making and knowledge acquisition, knowledge
becomes a tool of the active mind seeking solutions to problems (Wales and Stager, 1977).

A Guided Design programme is built upon a series of open ended problems. Students, working in groups of four to eight, try to arrive at a reasonable solution to the problem. Each problem is designed in such a manner that students must apply the subject matter they are learning to arrive at a solution.

The subject matter is learned in various ways. Some programmes divide class time between lectures and group discussions (Zacharakis-Jutz, 1983). Others suggest devoting all class time to group work and discussion, leaving students responsible for learning the subject matter on their own outside of class, through text readings and extra readings (Goldberg and Shuman, 1984). After gathering information (learning the subject matter) the students meet and try to solve the problem.

Guided Design is built upon the decision-making process. Open ended problems are provided to make learning more realistic in the sense that there are no black and white solutions. Different opinions and values influence problems and solutions. Students must learn to think on their own, gather information, make value judgements, communicate with others, and make decisions to arrive at a solution to a problem in the real world.
The decision-making process has 13 steps (Wales and Stager, 1977). These are:

a) identify the problem
b) state the goal of the decision-making process
c) gather information relevant to the problem
d) analyze each component of the problem
e) generate possible solutions
f) identify constraints and assumptions
g) choose a solution after examining options
h) analysis of chosen solution
i) preparation of a detailed synthesis of solution
j) evaluation of solution against some criteria
k) recommendations are made
l) implementation of plans
m) monitor results

Students are taught these steps of the decision-making process before Guided Design is implemented. Wales and Stager (1977) have devised an introductory activity "The Fishing Trip" to acquaint students with decision-making.

The Guided Design programme consists of a series of instructions and feedback. The first lesson starts with a description of the problem situation and the role the students are to take. After students have identified the problem and stated the goal, they are given an instruction. Upon the completion of the instruction they are given feedback. The programme then continues with an alternating sequence of instruction and feedback. A good programme has a story line that flows through the entire project. The story line should be relevant, and should incorporate as many of the decision-making steps as possible. Each instruction should be labelled with the appropriate decision-making step.
and the instructions should be concise and clear so learners can understand them. The students, having worked through an instruction, are given feedback. The feedback is a statement of how an expert in this field would have dealt with the instruction. The students compare their results with that of the expert, not for correctness, but for appropriateness and feasibility.

As an example of a problem that might be used in Guided Design, consider the following problem that might be discussed in a biology class, an environmental studies class, or physical sciences class. The problem centers upon the topic of acid rain and the effect it is having upon the ecology.

You are a research scientist working for a company well known for its research in agricultural pathology. Today you have just received a letter from the Ontario Maple Syrup Producer's Association expressing concern over the large number of trees that are dying. The letter points out that the vast numbers of trees that are dying are causing many farmers and producers to lose a lot of money. A similar letter was received last week by the counter part of the OMSPA in Quebec. They are also concerned about the rapid decline of the maple forests. They have come to your organization for help.

The problem in this example is maple trees are dying and there is no given explanation. The students must research the problem further and try to come up with a reasonable solution by going through the steps of the decision making process outlined earlier. As they proceed with each step, the teacher gives them the necessary feedback to help them.
compare their answers with that of the expert. In this case the expert might be a scientist from the University of Guelph who has studied the problem. His contention is that maple die off is caused by acid rain and would follow a set procedure to show this is the case. This procedure constitutes the feedback steps of the problem. The instruction steps would guide them towards the next stage.

The role of the teacher is to prepare the project materials - the instructions and the feedback materials. The teacher controls the pace of the lesson keeping all groups working on the same instruction. She moves from group to group answering questions about subject matter, encouraging participation, and seeing that groups are on the right track. The teacher functions as a facilitator (Stonewater, 1980).

Guided Design has been used primarily at the college level, but indications are that it can be used at the upper elementary level (Wales and Stager, 1984). It has been used in many subject areas from science courses (Goldberg and Shuman, 1984a; 1984b) to a teaching moral judgement making in a unit on Nazi Germany (Zacharakis-Jutz, 1983). It has proven to be well accepted by students (Miller, Givens, and Breyer, 1984; Goldberg and Shuman, 1984a) and indications are that it is at least as effective in academic gains as traditional instruction, though not as much material may be covered (Goldberg and Shuman, 1984a).
The role of the student is to function in a group, working with others to gather information (learn subject matter), and implement the decision-making process to solve some problem. One student acts as the group leader to facilitate participation from all members and coordinate between the teacher and the group. Another student acts as a recorder to keep track of the group's decisions (Goldberg and Shuman, 1984a). All students are responsible for learning subject matter as designated by the group and instructions.

To summarize the underlying philosophy of Guided Design is that learners can be taught to be socially realistic problem-solvers by engaging in the decision-making process. Students who learn subject matter and apply it to an open-ended problem will be intellectually stronger.

The nature of interaction between the teacher and learner is primarily facilitative. Messages are of the "advise" and "support" type, occasionally functioning in the "exchange" category.

The nature of interaction between students is primarily cooperative. The students work in groups to solve the problem. The interaction between the learner and the environment is direct observation. The student gathers data and looks for his own information (guided by the teacher's suggestions) and manipulates it into a form suitable to solving a problem.
The teacher directs learner-environment interactions by helping students locate resources, questioning, and providing answers to questions. The teacher also provides instruction and feedback materials which serve to guide the students through the problem-solving process. The teacher directs learner-learner interaction by encouraging on-task behaviour. Direction of teacher-student interaction is not specified. Direction of the classroom environment involves provision for group work, and access to a large array of resources.

Students direct learner-learner interaction by focusing on solving the problem given, and utilizing group management skills. The students direct learner-environment interactions by identifying the problem, reporting a possible solution, gathering data, and planning a solution. The instruction and feedback materials provided serve to guide the students.

The structure of the environment is highly complex, and low in structure. The students essentially find their own way through the information environment (following suggestions by their teacher).

Evaluation in Guided Design is in the form of subject matter examinations (Wales and Stager, 1977; Goldberg and Shuman, 1984). Additional activities that can be used within Guided Design include Concept Mapping, CoRT Thinking, Synetics, and activities involving interaction with various media.
The primary outcome of Guided Design is critical thinking and decision-making as problem-solving strategies (Understanding). Secondary outcomes would be Social skills, namely Leadership/Participation and Communication. Also Information Retrieval skills would be developed. The method is, to a large degree, student-mediated and divergent. Therefore, Guided Design is classified in the typological model as being Personal/Divergent/Student-Mediated (P/D/S).

Method Name: Guided Design

Nature of:
Teacher-Learner Interaction: facilitative
Learner-Learner Interaction: cooperative
Learner-Environment Interaction: direct observation

Teacher Direction of:
Classroom Environment: provision for group work and access to resources
Teacher-Learner Interaction: not specified
Learner-Learner Interaction: mediate group conflicts to promote on-task behaviour
Learner-Environment Interaction: provision of instruction and feedback materials to guide students; provision of resources; encourage information finding.

Student Direction of:
Learner-Learner Interaction: using group management skills to work cooperatively
Learner-Environment Interaction: identifying problems and finding feasible solutions through information gathering.

Structure of the Environment: Low Structure and High Complexity
Primary Outcomes: Understanding
Secondary Outcomes: Leadership/Participation, Communication, and Information Processing and Retrieval Skills
Categorization: P / D / S

Figure 22. A Summary Chart of Guided Design.
Non-Directed Learning

Non-Directed learning is a method of teaching developed by Carl Rogers (1983) to promote "whole person" learning. The emphasis of Non-Directed learning is on personal development through the creation of self-initiating learners and facilitating self-actualization. It aims to develop confidence and self-esteem in learners through a classroom climate of trust and mutual respect.

Teaching as the imparting of knowledge (or information transmission) is a reasonable aim of teaching in an unchanging environment. However, modern man lives in an environment that is constantly changing. This means the aim of teaching should be the facilitation of learning - learning how to learn (Rogers, 1983).

The basis of the facilitative approach to learning is founded in certain attitudinal qualities existing in the interpersonal relationship between the teacher and the learner. These attitudinal qualities include:

a) a genuineness on the part of the teacher to be herself;
b) accepting and respecting the learners for who they are and what they feel;
c) empathetic understanding.

To achieve facilitative learning, the teacher must change her focus of planning from what the teacher thinks is appropriate for the students to learn to a focus of planning for what the students want to learn, are interested in, or
think is important. Having identified the students' interests or what they want to learn, the teacher's role becomes one of helping students locate the resources for answering the questions in ways that will be meaningful to them. The facilitator of learning focuses on problems that are real to the students yet relevant to the subject matter. She provides an abundance of resources, both media resources (texts, films, or laboratory equipment) and community resources such as experts and human resources working in the classroom (other students) and community. Contracting is introduced as a means of setting goals to give students directions and provide a means of evaluating the work of learners (Rogers, 1983). Also suggested are encounter groups, facilitator-learner groups, and peer-tutoring.

As an example of a Non-Directed Lesson, consider the following description of the structure for one course (Rogers, 1983):

There are several aspects of the course which will be required. These are as follows: I wish to have a list of the readings you have done for the course turned in before the end of the course with an indication of the way you have read the book...in other words, what is wanted is an honest account of what you have read and the depth to which you have read the material you covered. ...The second requirement is that you write a paper, which may be as brief or as lengthy as you wish, about your own most significant personal values and the ways they have changed or not changed as a result of this course....A third requirement is that you turn in to me a statement of your own evaluation of your work and the grade you think is appropriate. This should state (a) the criteria by which you are judging your work; (b) a description of the ways in which you have met or failed to meet those criteria; and (c) the grade that you think appropriate to the way you have met or failed to meet your own criteria.

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To summarize, the underlying philosophy is every student, if given freedom, can undertake self-initiated learning. The psychological climate of the classroom, as determined by the characteristics of the teacher, is the most important factor influencing a student's learning. A teacher who is genuine, accepting, and interested in the learner will promote such a climate. A teacher who is not, will not promote whole person development.

The nature of the interaction between the teacher and the student is non-directive. Messages are primarily of the classification "support" and "agree" with secondary emphasis being of the classification type "advise" and "exchange". The teacher's primary role is to support the student in his quest for learning. The teacher locates resources and guides the student to the resources. She counsels him through learning.

The nature of student-student interaction is either individualistic or cooperative as the teacher and students see fit. The learners are free to learn on their own or may work in groups. Rogers (1983) has indicated that encounter groups and peer-tutoring are effective methods of facilitating learning in a non-directed learning environment. The nature of the interaction between the students and the information environment is of the form of direct observation. The learner interacts directly with the information environment according to her interests and needs with some guidance from the teacher. The environment is
unstructured and highly complex which promotes a very large degree of divergence in the classroom. The teacher provides resources for students to utilize at their discretion. The students interact with the information environment through their own problems rather than trying to solve one the teacher has constructed.

The teacher directs the interactions in the classroom by letting the students direct themselves. The teacher does not tell the students what to do, or how to do it. What the students do is their own decision, as is how to do it. The teacher directs teacher-learner interaction by being honest, open, and genuine -- the essence of the teacher's behaviour in Non-Directed Learning. The direction of the classroom environment in Non-Directed Learning involves the provision of a great deal of resources pertaining to the students' needs and interests.

Student direction of learner-learner interaction and learner-environment interaction is the heart of Non-Directed Learning. The students plan their own activities and carry them out. If group work is what students want, then they are responsible for directing the actions and activities of the group.

The primary outcome of the Non-directed method of learning is Self-Development. The secondary outcomes include Understanding and Information Processing skills and Information Retrieval skills. If group encounters,
facilitator-learner groups, or peer-tutoring is utilized, then secondary outcomes will also include some social skills, particularly communication skills. Evaluation of these outcomes is accomplished by assessing contracts, self-evaluation, and fulfillment of requirements set by the teacher.

Non-directed learning can be categorized as being Personal/Divergent/Student-Mediated (P/D/S) in the classification system suggested by the typology model of teaching methods.

Method Name: Non-Directed Learning

Nature of:
Teacher-Learner Interaction: non-directive
Learner-Learner Interaction: individualistic or cooperative as needed
Learner-Environment Interaction: direct observation

Teacher Direction of:
Classroom Environment: provision of resources to suit students' needs
Teacher-Student Interaction: being honest, genuine otherwise unspecified
Learner-Learner Interaction: non-directive
Learner-Environment Interaction: non-directive

Student Direction of:
Learner-Learner Interaction: group management skills as needed, otherwise none. At student's discretion.
Learner-Environment Interaction: responsible for their own activities

Structure of the Environment: Low Structure and High Complexity
Primary Outcomes: Self-Development
Secondary Outcomes: Understanding, Information Processing and Retrieval, Communication, Leadership/Participation if groups used
Categorization: P / D / S

Figure 23. A Summary Chart of Non-Directed Learning.
A Non-Directed Lesson

Figure 24. An Information Flow Map of A Non-Directed Lesson
Group Investigation

Group Investigation is a teaching method designed to provide students with diverse learning experiences (Kagan, 1985) beyond learning information. Like Guided Design, Group Investigation allows students the opportunity to plan the events for their learning. They are presented with a problem and the group must coordinate the plans to find a solution to the problem.

Group Investigation requires students progress through six steps in the course of completing the task. These steps are (Sharan and Hertz-Lazarowitz, 1979):

a) identifying the topic and organizing research groups;
b) planning the learning task;
c) carrying out the investigation;
d) preparing a final report;
e) presenting the final report;
f) evaluation.

A topic is presented to the students and sub-divided into several smaller topics. The class is divided into groups according what topic they are interested in researching. For example, if the class were to study Eskimos, some sub-topics might be religion, demography, art, and social-community life. Each group would study one of these aspects, and a student would work in the group studying the aspect he is interested in.

Having chosen groups, each individual group begins to plan the learning task. The groups plan what they want to study
about the topic, how they are going to study it, and for what reasons (Sharan and Hertz-Lazarowitz, 1979). They also establish the role of the members of the group in completing the project, and the interactions among the group members.

Having established a plan the students proceed to gather information to meet the requirements of the learning task. They utilize multi-media sources such as filmstrips, video cassettes, audio cassettes, books, magazines, experiments, and human resources. This information is discussed among the group members and an attempt is made to try to fabricate many points of view, and find a workable solution to a problem that may exist in the subject area.

The last stages of Group Investigation involve preparing and presenting a final report on the topic investigated by the group. Presentations may take several forms such as reports, videotapes, skits, or exhibitions.

The role of the teacher in Group Investigation is that of a facilitator. Her job is to provide resources for the students to use in their investigation, to assist with problems, give guidance on locating resources, and mediate intra-group conflicts.

To summarize, the underlying philosophy of Group Investigation is that students should (and can) work together to help each other investigate and learn.

The nature of the interaction between the teacher and the learner is categorized as being facilitative. Behaviour is
classified as being in the "advise" and "support" modes. The teacher guides students in their learning.

The interaction between students is cooperative in nature. The students work together to create a plan for study, then implement it. The nature of the interaction between the learner and environment is direct observation. The learners find their own information, make their own observations, gather their own data, and analyze it in their own way (under the auspices of the teacher).

The teacher directs learner-environment interaction through facilitation. The teacher guides the students through their investigation by allocating resources and suggesting alternatives if students have difficulty. The teacher directs the learner-learner interaction by mediating group conflicts and focusing on on-task behaviour. The classroom environment must be structured to accommodate group work, and adequate resources should be provided.

Students direct learner-environment interactions by planning the investigation. They decide what is to be investigated and how. The students direct learner-learner interaction by using group management skills in the planning and investigating of their desired topic.

The structure of the environment is low, and the complexity is high. The information environment is open for the students to explore as they require.
The primary outcomes from Group Instruction include Leadership/Participation and Communication (Social). The emphasis is on the group planning and execution of a learning task. Secondary outcomes are Self/Mutual Development, Understanding (Personal), and Information Retrieval (Informational).

Although no prerequisites have been suggested, team building activities like those suggested for Jigsaw would help the students understand and utilize the process of cooperation more effectively. As well, an activity such as "The Fishing Trip" from Guided Design would help students understand the problem-solving process and make their work more elaborate.

Evaluation in Group Investigation takes the form of subject matter tests, behaviour observation checklists, evaluation of finished reports.

The categorization of Group Investigation is of the classification Social/Divergent/Student-mediated (S/D/S) in the typological model of methods.
Method Name: Group Investigation

Nature of:
Teacher-Learner Interactions: facilitative
Learner-Learner Interactions: cooperative
Learner-Environment Interactions: direct observation

Teacher Direction of:
Classroom Environment: provide for group work and provide resources
Teacher-Learner Interaction: not specified
Learner-Learner Interaction: focus on on-task behaviour and mediate
group conflicts
Learner-Environment Interaction: provide guiding suggestions and
direction as students need it

Student Direction of:
Learner-Environment Interaction: plan and carry out investigations
Learner-Learner Interactions: group management skills to keep the
group moving towards its task.

Structure of the Environment: Low Structure and High Complexity
Primary Outcomes: Leadership/Participation, and Communication skills
Secondary Outcomes: Self-Development, Information Retrieval,
Understanding skills
Categorization: S / D / S

Figure 25. A Summary Chart of Group Investigation.
A Group Investigation lesson

Figure 26. An Information Flow Map of Group Instruction.
Summary

To summarize, ten methods of teaching have been described in terms of its characteristics determining the flow of information in the classroom. These characteristics are summarized and charted in Figure 27. From analysis of this chart and analysis of the descriptions of the ten methods of teaching provided, the strengths and weaknesses of the model can be discussed.
A Summary Chart of Teaching Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Teacher-Learner Interactions</th>
<th>Learner-Learner Interactions</th>
<th>Learner-Environment Interactions</th>
<th>Teacher-Environment Interactions</th>
<th>Student Direction of Interactions</th>
<th>Environmental Structure</th>
<th>Primary Outcomes</th>
<th>Secondary Outcomes</th>
<th>Categorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>D</td>
<td>I</td>
<td>I</td>
<td>O</td>
<td>7</td>
<td>11</td>
<td>7</td>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>Direct Instruction</td>
<td>D</td>
<td>I</td>
<td>O</td>
<td>D</td>
<td>27</td>
<td>11</td>
<td>16</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>Programmed Instruction</td>
<td>F</td>
<td>I</td>
<td>O</td>
<td>D</td>
<td>4</td>
<td>12</td>
<td>13</td>
<td>17</td>
<td>None/Unspecified</td>
</tr>
<tr>
<td>Concept Attainment</td>
<td>D</td>
<td>I</td>
<td>D</td>
<td>O</td>
<td>8</td>
<td>13</td>
<td>14</td>
<td>18</td>
<td>None/Unspecified</td>
</tr>
<tr>
<td>Concept Mapping</td>
<td>F</td>
<td>1 or Co.</td>
<td>D</td>
<td>O</td>
<td>4</td>
<td>13</td>
<td>14</td>
<td>19</td>
<td>None/Unspecified</td>
</tr>
<tr>
<td>Role Playing</td>
<td>F</td>
<td>I</td>
<td>D</td>
<td>0</td>
<td>4</td>
<td>14</td>
<td>15</td>
<td>20</td>
<td>None/Unspecified</td>
</tr>
<tr>
<td>Jigsaw</td>
<td>F</td>
<td>Co</td>
<td>O</td>
<td>D</td>
<td>9</td>
<td>9</td>
<td>19</td>
<td>3,6</td>
<td>24</td>
</tr>
<tr>
<td>Guided Design</td>
<td>F</td>
<td>Co</td>
<td>O</td>
<td>D</td>
<td>4</td>
<td>14</td>
<td>21</td>
<td>3,6</td>
<td>25,26</td>
</tr>
<tr>
<td>Non-Directed Learning</td>
<td>N</td>
<td>1 or Co.</td>
<td>D</td>
<td>O</td>
<td>10</td>
<td>N</td>
<td>N</td>
<td>3</td>
<td>25,26</td>
</tr>
<tr>
<td>Group Investigation</td>
<td>F</td>
<td>Co</td>
<td>O</td>
<td>D</td>
<td>4</td>
<td>14</td>
<td>22</td>
<td>3,6</td>
<td>25,26</td>
</tr>
</tbody>
</table>

**Codes:**
- D = Directive
- F = Facilitative
- N = Non-Directed
- I = Individualistic
- C = Co-operative
- D = Direct Observation
- O = Indirect Observation
- C = Convergent
- D = Divergent
- T = Teacher-mediated
- S = Student-mediated
- I = Informational
- P = Personal
- S = Social
- HC = High Complexity
- LS = Low Structure
- LC = Low Complexity
- HS = High Structure
- IP = Information Retrieval Skills
- IS = Information Processing Skills
- U = Understanding
- SD = Self-Development
- LP = Leadership/Participation
- Comm = Communication

1. For a many-to-one teaching situation
2. For a many-to-many teaching situation
3. Access to resources, computers, with provision for reinforcing responses and workbooks
4. Unspecified
5. Access to resources, computers, with provision for reinforcing responses and workbooks
6. Provision for group work
7. Allowing enactments to occur
8. Use of examples
9. Through group leader
10. Focus student attention upon teacher presentation, deter distractions
11. Discourage interaction
12. Providing individual workstations
13. Encourage individual work
14. Mediate group conflicts and promote task focus
15. Predefine roles, provide observation lists
16. Explicit statement of objectives, explicit teacher instruction
17. Use of workbooks/computers for stimuli
18. Preselct materials
19. Specify tasks, allocate resources
20. Predefine roles, provide observation lists
21. Provision of feedback and instruction materials
22. Provide suggestions and direction as needed
23. Pacing of responses
24. Through group leader
25. Group management skills
26. Problem solving through information gathering and planning activities
27. Use of cues for student responses

Figure 27. A Summary Chart Describing Ten Teaching Methods
Chapter 4: Discussion and Conclusion

In the preceding chapters, a plan was outlined to accomplish two goals. In accordance with the three postulates proposed in Chapter 1 and Chapter 2, an attempt was made to show: a) the existing methods of teaching can be categorized according to their primary outcomes based upon their information attributes; and b) the existing methods of teaching can be described in terms of the interactions occurring within the classroom, forming an information flow map. The model of teaching discussed here has obvious strengths and weaknesses, and raises several important and interesting questions.

Advantages of Results

The categorization of the teaching methods using the typological aspect of the model of teaching (Chapter 2) has yielded some interesting results. From Figure 28 it is seen that the ten teaching methods have been placed into six distinct categories. That is, of twelve possible cells, only six have been filled. This should be expected because the typological stage of the teaching model is a macro-classification system rather than a micro-classification scheme. It identifies groups of methods suitable for achieving similar outcomes at a macro level. For example, if the teacher has decided to focus upon personal skills she has
Categorization of Teaching Methods

<table>
<thead>
<tr>
<th>Categories</th>
<th>Lecture</th>
<th>Direct Instruction</th>
<th>Programmed Learning</th>
<th>Concept Mapping</th>
<th>Role Playing</th>
<th>Jigsaw</th>
<th>Guided Design</th>
<th>Non-Directed Learning</th>
<th>Group Investigation</th>
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</thead>
<tbody>
<tr>
<td>Informational/Convergent/Teacher-mediated</td>
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<td>Informational/Convergent/Student-mediated</td>
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<td>Personal/Convergent/Student-mediated</td>
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<td>Personal/Divergent/Student-mediated</td>
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<td>Social/Convergent/Teacher-mediated</td>
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</tbody>
</table>

Figure 28. Categorization of Methods by Outcomes

four methods to choose from - Concept Mapping, Guided Design, Non-Directed Learning, and Role Playing among those considered here. The teacher can then choose among these four methods, or others with similar characteristics, the method will meet the desired objectives most effectively.
From the information in Figure 27 and Figure 28, the premise may be established that the teaching methods and the categories of classifying teaching methods of the typological model are ranked in an ascending order from most structured to least structured. To clarify, the methods of Lecture and Direct Instruction are highly structured and teacher-mediated. On the other hand, the methods of Non-Directed Learning and Group Investigation are student-mediated and less structured. This suggests that if the goal of teaching is to move a student from a situation of high structure and high dependency upon the teacher to a situation of low structure and low dependency upon the teacher, methods can now be identified to accomplish this goal in gradual increments by progressively following the hierarchy.

Furthermore, learning can be considered to consist of four stages (Powell, 1984):

a) Emmersion
b) Fluency
c) Application
d) Adaptive Implementation

If a teacher utilizes the "lower order" methods, information skills methods, initially and gradually implements "higher order" methods, the transition from Emmersion to Adaptive Implementation should have occurred. In general, the sequence would follow the pattern from information to personal to social outcomes, from teacher-mediated to student-mediated, and from convergent to divergent methods.
By considering classroom events in terms of information interactions, a system for uniquely classifying teaching methods seems to have been developed. Figure 27 (Chapter 3) depicts a summarization of the discussions in Chapter 3. From Figure 27, it is seen that the ten methods described are unique in their characteristics. Some are similar in nature but none are exactly the same. This becomes the realization of the three postulates stated in Chapter 1 and Chapter 2.

The ability of the model to uniquely classify methods of teaching enables extensions of this classification system to be made. If a teacher is functioning in a particular manner and decides to change one particular aspect of the activities of the classroom, the model enables prediction of the effect of the ensuing changes. An information map (or information interaction aspects of the model) could be used to suggest what the behaviour of the teacher and students would be like after the changes are made. The typological aspect of the model suggests what the learning outcomes should be.

The model of teaching presented in this thesis appears to unify a highly diversified field of knowledge. The model contains elements of the ideas of Mosston, Kauer, Powell, and Gagne and Briggs. The model of teaching brings together the areas of educational theory, curriculum theory, learning theory, instructional design, and learning theory, and appears to make implementation of these theories in a practical manner more feasible and efficient.
To further elaborate, Figure 29 illustrates the process of teaching from an overview. The flowchart presents teaching from the perspective taken in this thesis.

Starting from the top of the chart, the teacher makes a series of decisions concerning the desired outcomes of the lesson. Subsequently, this determines the nature of the interactions occurring within the classroom. Alternatively, starting at the bottom of the chart, the teacher makes a series of decisions about the nature of interactions which are to occur in the classroom. Subsequently, this determines the types of learning outcomes achieved in the lesson.

As a unified model of teaching, the model presented here can affect the teaching process by providing alternative ways for teachers and researchers to think about teaching. In the design of a lesson plan, a typical lesson plan may follow the pattern of introduction, presentation, review, and application. The model of teaching suggests that this be changed to involve consideration of the types of interactions desired in the classroom, and the objectives to be achieved through those interactions.

Shortcomings of the Model

The model of teaching presented in thesis has some shortcomings which might be overcome through further refinement of the model and further research. One such area where the model falls short is in discussing the current state of the
A Flow Chart of the Components of the Teaching Process

Figure 29. The Teaching Process.
learner. Future refinements of the model should include the state of the learner as a variable. The state of the learner would include his interests, needs, abilities, motivation, and learning style. The relationship between learning and these variables is fairly well established and should be accommodated for in future research.

The function of the variable "learner state" has a place in the model. Intuitively, this variable would appear in two places. First, the state of the learner would need to be examined to determine the techniques the teacher wishes to employ in directing the interactions in the classroom. Second, the state of the learner will determine how the learner interacts with the environment - through concrete or abstract means.

Other refinements that will need to be made involve examination of the descriptors of teacher-learner interaction and learner-environment interaction. At present, teacher-learner interactions are described as being directive, facilitative, or non-directive. However, in examining Figure 16, it is seen that teacher-learner interactions are facilitative for both Programmed Instruction and Group Investigation. The question that arises is "Is the teacher's behaviour the same for Programmed Instruction as it is for Group Investigation?" "Is being a facilitator for Programmed Instruction the same as being a facilitator in Group Investigation?"
A similar criticism arises for the descriptors of learner-environment interaction. Currently, these are described as being indirect observation or direct observation. However, these two terms may not be specific enough to describe adequately what the student will be doing when he interacts with the environment. "Is direct observation for Programmed Instruction the same as for Group Investigation?" From the descriptions provided in Chapter 3, this is not the case. Hence the descriptors need to be expanded. A better set of descriptors might be receiving/gathering data, interpreting data, and manipulating data.

In addition to the possibility for refinement, the unified model of teaching presented in this thesis has implications for further research.

This thesis proposed a unified model of teaching based upon the theoretical perspective of previous researchers and authors. From previous research, descriptors of the various interactions occurring in the classroom were proposed. This suggests the proposal for an empirical study to examine the correlation between theory and practice. To clarify, an empirical study could be conducted to determine the exact nature of classroom interactions as proposed by the model of teaching. Such a study would involve training a group of teachers in the use of the various methods described in Chapter 3. Subsequent observation would be conducted to
establish the exact nature of the interactions constituting each method, enabling descriptors to be refined.

Another field for further research involving the unified model of teaching involves applications in artificial intelligence. The unified model of teaching can be used to form the knowledge base for an expert modelling system to assist teachers and researchers in decision-making. Expert systems are computer systems built upon the knowledge and processes used in a specific area. When a computer is programmed with the rules and knowledge of that discipline, the computer can function like a decision-maker. In this capacity, the computer can be used as a consultive tool for the teacher or researcher. A teacher can specify the nature of the desired outcomes, the type of subject matter, and the state of the learner. The computer uses the rules and information in its knowledge base to make recommendations as to suitable methods and activities, and suggest the nature of interactions to be established. The teacher may implement the recommendations, or modify them according to her needs. To implement this model as an expert system, a much more extensive list of possible teaching methodologies than studied here would need to be classified within the model.

Conclusions

The purpose of this thesis was to propose a viable and workable unified model for determining teaching strategies.
To accomplish this, a definition of a model of teaching was established. Having done this, three postulates were proposed as the basis of the model. These postulates were developed from the perspective of information flow and interactions in the classroom. Using an information theory perspective, a model of teaching was developed.

To test the viability of the model, ten previously developed methods of teaching were examined using the proposed model. The results of this exercise showed the model to be useful for both categorizing the methods in terms of their outcomes and uniquely describing the methods in terms of the interactions occurring in the classroom. This supports the three postulates put forward in Chapter 1 and Chapter 2, and consequently supports the model of teaching itself.

With further refinement and additional research, the unified model of teaching proposed in this thesis could prove to be highly useful to both researchers and teachers. It can be used to give researchers a common framework from which they can conduct their studies. Similarly, it might provide teachers with the tool they need to select among alternative methods to achieve specific outcomes with particular students. In the end, it could prove to be a valuable and useful tool for educators.
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