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**ECONOMIC TEXT
AND ACQUISITION OF ECONOMIC KNOWLEDGE:
A SCHEMA-THEORETIC INVESTIGATION**

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ABSTRACT OF THE DISSERTATION

Economic Text
and Acquisition of Economic Knowledge:
A Schema-Theoretic Investigation

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Economic texts are notoriously inadequate in challenging students to learn economic content or in promoting the scientific method of thinking about economic problems. One possible reason is that authors of economic text have failed to incorporate into their products the latest knowledge from the field of cognitive science about the nature of the reading process. One such new development is schema theory which posits that reading is a process of constructing meaning based on the

reader's prior experience - general and topical - and the inferences about the text that are possible as a result of that experience. Three levels of reading comprehension have been identified: (1) *textually-explicit*, i.e. reading comprehension that depends on a literal reading of the text; (2) *textually-implicit*, i.e. comprehension that calls for inference based on ideas and data presented in the text; and (3) *conceptually-implicit*, i.e. comprehension that requires inferences that go beyond the ideas and data expressed on the printed page. It is hypothesized that students of economic science may experience problems especially with inferential, that is, textually- and conceptually-implicit, reading comprehension processes.

The present study is designed to elucidate the interrelated components of a complex target schema (Price Elasticity of Demand) and to examine students' ability to draw inferences described above. A random sample of 40 first-year Marmara University students who fulfilled the English language requirements were pretested on an author-constructed test designed to elicit their prior knowledge of components of the target schema.

Subsequently, the students read an expository passage about Price Elasticity of Demand explaining the relationships among the constituent propositions. A posttest consisting of items calling for all three levels of reading skills (textually-explicit, textually-implicit, and conceptually-implicit) was then administered and the data were analyzed to determine the relationship between prior knowledge of topic and student ability to draw inferences. Individual students' prior knowledge structures were depicted graphically to ascertain the resemblance to the structure predicated by the author.

The results of the study suggest that when teachers of economics and authors of economic texts present topics that are built on and complement students' various types of prior knowledge and facilitate inference, they may make economic texts more comprehensible and thus efficient.

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CHAPTER I

INTRODUCTION

Recent studies show that the public understanding of economic knowledge is generally inadequate, even among students who have just completed an introductory economics course" (Walstad and Soper, 1988; Soper and Brenneke, 1981; Walstad and Watts, 1985). These authors have found that a vast majority of such students remain seriously deficient in important economic concepts such as scarcity, inflation, monetary policy, economic growth, and international trade.

In the United States, a call for creating a better sense of the nature, power, and limitations of economic knowledge among high school and university students has found its reverberation in the pages of scholarly publications, especially the Journal of Economic Education, and in the reports of a number of national committees of prominent economists and educators

such as the Joint Council of Economic Education (JCEE), the National Advisory Committee, and the National Task Force. These efforts culminated in the establishment in the United States the Developmental Economic Education Program (DEEP) which aims to make economics a mandatory course for high school students.

The JCEE is understandably heartened by the results of some preliminary studies which have concluded that the level of economic literacy of the general public could be raised significantly by exposing students to economic knowledge while they are in high school. According to these studies, by proper training and curriculum development, students' attitude toward the subject of economics and their test scores in this subject could be improved substantially (Becker, Helmberger, and Thompson, 1975 and Walstad and Soper, 1982).

Unfortunately, however, these studies are characterized by an inordinate emphasis on the outcomes of learning as extracted from the student's short-term memory. As such, they "...provide little information about *why* outcomes are as they are and *what* might be done to alter these outcomes" (Hansen, 1988: 15. Emphasis added.)

The present study takes a decidedly different approach. It focusses on the process of learning and probes the student's long-term memory in order to isolate certain cognitive variables that seem to be conducive to effective learning. "Effective" learning is defined as a successful anchoring of economic knowledge presented in the classroom in the knowledge base that already exists in the long-term memory of the student.

This researcher finds that most of the students in their introductory economics class are intimidated by the subject. Whether or not economics is inherently difficult is beside the point. What is important is that most students perceive economics as too demanding. This researcher has observed that most first-year university students, despite a palpable effort to lift the "exact" meaning of the target model (say, the PRICE ELASTICITY OF DEMAND) depicted on the blackboard by the instructor and expounded in the textbook by the author, come up with responses that do not match the formal propositions made in the presentation.

Three cognitive arguments offer some explanations as to what may cause *multiple interpretations* of a formal model under study. They are the (1) linguistic, (2) mental models, and (3) schema-

theoretic arguments. These approaches are all geared toward making sense of the learning process in terms of students' *existing* mental structures. This study subscribes to the third, the schema-theoretic perspective, because, unlike the other two, which offer *descriptive* insights only, it permits some *predictive* insights into what propositions of the formal model presented on the blackboard will be "effectively" learned, that is, comprehended and retained in the long-term memory of the student.

This study has emanated from first-hand observations of this researcher as regards to first-year students of economics. More specifically, the researcher has observed that:

-- Students of other related subjects, say, sociology or political science, who are given an assignment are, as a rule, encouraged to make *their own* interpretation of the particular topic presented in the class and elaborated in the text. In contrast, economics students are urged to get the *right answer*. As a result, most students read their economic text vicariously in order to derive the correct answers attributable to the topic under study.

-- Economic knowledge is more technical than knowledge presented in other social sciences. To compensate for this, introductory economic material has been pushed down to pre-university level in order to make it "understandable" to first-year university students. Due to the extremely technical nature of the subject matter, textbooks present economic knowledge as broad concepts and fail to convey a sense of immediate application of this material to actual economic problems.

-- Declarative knowledge continues to dominate the economic education process. The conventional economic text lists one special term after another without a conscious effort to tie them together in a coherent whole. Many students have remarked that the economic text sometimes seems senseless to them, and not because they lack an adequate level of reading ability.

-- The textbook continues to be the pivotal tool in a typical introductory economics class and a small number of commercially successful economic texts dominate the field. But, hard data are lacking as to the appropriateness of these books in effectively promoting economic literacy among young citizens. This is unfortunate. For, since the textbook continues to be the primal educational tool in the economics curriculum,

teachers of economics and administrators of economics programs could make important differences in the educational lives of economics students who rely so much on textbooks by selecting the "right" book for them. Yet, criteria for selecting the best economic text remain to be developed.

Economic Illiteracy in the 1980's

Economic illiteracy entails dire consequences for any society. It is recognized that economic efficiency

...requires not necessarily superior scientists, engineers, and managers, but educated workers who are skilled with materials, technology, and quantitative data: who can absorb and propagate applied science, and who can communicate and cooperate with one another for the individual as well as the corporate and national goods (Walberg, 1983, p. 24).

The concrete effects of economic illiteracy have already made themselves felt in the United States. By 1980, many industrialized nations, particularly Japan, overtook the U.S. in international markets, apparently, inter alia, as a result of the relative strength of their

work force in mathematical, scientific, and economic knowledge. A new awareness is now creeping in the U.S. into the nation's consciousness and saps its self-confidence:

Particularly galling was the fact that the Japanese were outdoing [the U.S.] in the manufacture of high tech products that we had viewed as American monopolies. Experts began to suggest that an inadequate system of math and science education was at the root of our inability to compete effectively... Japan is doing much better than the United States in realizing the goal of having all students learn science, mathematics, [and economics] (Benderson, 1984, pp. 1-2).

What is the remedy for this situation? What is needed is a total realignment of the extant perspective on economic education. The new perspective should presuppose some understanding of why economic knowledge is worth knowing and why mastering certain fundamentals of economic knowledge is not beyond the capacity of an ordinary student. We must begin by recognizing that economics is not a settled thing, a collection of formulas that wait to be committed to memory, that once learned will be possessed forever. Economic literacy is but an aspect of literacy more generally and a necessary part of general learning (Graubard, 1983, p. 243).

If the term economic literacy is taken in the functional sense --that is, as the ability to read and understand economic material so as to be able to use it when needed-- then it follows that introductory economic texts should not address only students who plan to become professional economists. These texts and should be written in such a manner as to guide all students who take the introductory economics class

to observe, hypothesize, experiment, and speculate about different conceptions of the subject matter at hand, and occasionally comprehend some of the history of major...[economic] ideas (Atkin, 1983, p. 177).

An economic text that is committed to this philosophy is perhaps the exception rather than the rule. The few bestsellers that command the field are clearly designed to serve the needs of students who are headed for economics-related careers.

It has been argued that the problem exists partly because these texts are dominated by the needs of post-graduate economic curricula. The influence is said to flow:

...from the top down....Graduate courses usually set the tone for much is done in [introductory] level....Put in other terms, the

system is one of successive filtering, until only the majors, and later only the graduate students, are left. Such a system may be necessary at the [graduate] college...[but] instruction at the lower level must serve a different function. It must address a far wider range of population, and foster a far broader spectrum of interest (Pallrand and Lindenfeld, 1985, pp. 49-50.)

Many of the existing textbooks in economics are

developed on the premise that economic knowledge accrues by the addition of successive units, consisting, in effect, in the accumulation of a large number of discrete facts. As they stand, conventional economic texts are clearly designed to serve the needs of students who are headed for economics-related careers. As such, they fail to generate in the reader a fair measure of individual dialectics and integral discovery which may lead the vast majority of noneconomics-oriented students to effective assimilation of economic knowledge.

To achieve this goal, two interrelated and complementary conditions must be met. First, students must possess the prior knowledge that may help them decipher new (and often unfamiliar) economic information presented on the printed page. Second, economic texts must be written in ways designed to facilitate such comprehension. To address both these concerns, it is necessary to be familiar with certain developments in

psychologists' understanding of the cognitive processes involved in reading comprehension.

Reading Comprehension and Economics

In the United States, despite some efforts to create "new" introductory courses, "traditional" courses continues to dominate the economics curriculum. The economic education process is characterized by an inordinate emphasis on content which is presumably *codified* in the assigned textbook. The economic textbook is seen as the "most fitting medium" to transmit "all" the economic facts, concepts, principles, and theories with which a "economically literate" person is expected to be familiar (Strahan and Herlihy, 1985).

Paradoxically, the passion for including every important economic idea in the text leads to trivialization of all ideas. Economics classes, especially the introductory ones, then

become like cooking courses with simple recipes and predictable outcomes..... Current syllabi and textbooks already verge on the silly in trying to do too much...as if it were possible to

inoculate students against ignorance and forgetfulness with one "shot" of essential [economic] facts" (Wiggins, 1987, p. 11).

Considering that the textbook continues to be

the pivotal tool of the educational process in most schools, it is readily apparent that improvement in teaching economics is contingent on an increased ability of students to read texts and learn from texts. The two factors are often confounded. Cognitively-oriented studies investigating the processes involved in reading have revealed some of the reasons for the wide individual differences in students' ability to read texts and learn from them, that is, to draw the right inferences from what is expounded in the printed page.

As for the differences in ability to read, studies have shown that they do exist and may cover a ten-year range in a typical class (Singer, 1977). As for the differences in the ability to draw inferences, the range may be even wider. Yet most introductory economic texts make no provision for these two-fold differences:

Some students read at the eighth-grade level but their texts are at [university] level in difficulty or higher. Or their

reading abilities may be at the same level as the general difficulty level of the text but the students lack the specific ability to learn from the text in a particular content area: they may not have the specific skills for interpreting graphs or charts..., comprehending symbols and manipulating them..., or transforming and applying formulae. These students do not have deficiencies, or defects, or disruptions; they have a difference, a mismatch between their abilities and the demands of their assigned texts (Singer and Donlan, 1985, p. 9).

Studies show that while differences in ability

to read texts among students tend to decrease as they progress through educational ladder, the range of differences in drawing inferences from the text tend to increase (Singer, 1977). The increase occurs because, in contrast with "learning to read," which is a *finite* learning process mastered by 95 percent of students before they finish high school (Bloom, 1971), "learning from text" is an *open-ended* process that continues to develop unevenly among individuals throughout life. The ability to learn from text is influenced by, and in turn influences, a number of cognitive factors, particularly the capacity for drawing inferences. Consequently, the gap between the two groups of students, economics- and noneconomics-oriented, is likely to become greater rather than narrower later in life.

Cognitively-Based Economic Education
and Economic Literacy.

Students of economics know only too well that their performance will be judged by whether they "correctly" memorized certain answers or applied a prescribed algorithm to generate a "correct" solution. Aware of this requirement, they take economic text in the most literal sense; that is, they duly search it for a sentence that contains the correct answer.

The student who tries to improvise an answer reveals, with characteristic hesitation and the broken constructions of ordinary spoken English, that he has failed to work thoroughly on the text, and the response is greeted with disapproval (Atkin, 1983, p. 179, citing Stake and Easley, 1978).

Is this happening because economics is inherently difficult? It has been observed that most students avoid economics as much as they can (Jackson, 1983). The aversion might not be entirely unwarranted. Economics is very specialized and, in the manner that it is ordinarily presented in the classroom and in the textbook, quite abstracted from the reader's ordinary life experiences. As such, learning economics requires much more concentration and perseverance on the part of

the student than acquiring other kinds of knowledge (Walberg, 1983).

Whether or not economics is inherently difficult is beside the point. What is important is that most students perceive economic education as too demanding (Jackson, 1983). Students are particularly intimidated by the economic textbook, even when the assigned passage is within their verbal reach. Yet, despite their effort to lift the exact meaning of the text, students usually come up with responses that do not match the formal statements made in the text. Three cognitive arguments, linguistic, mental models, and schema theory, offer some explanation as to what factors seem to contribute to this outcome. It should be noted at the outset that all these arguments are interrelated because they are all geared toward making sense of the reading comprehension process in terms of the reader's existing mental structures. This inquiry subscribes to the third, the schema-theoretic perspective, because, unlike the other two, it permits some prediction as to what propositions made in the written economic passage will be comprehended and retained in the long-term memory of the reader.

1. The Linguistic Argument. Chomsky holds that the divergence between the factual text and the interpreted text occurs because not all the necessary cues for retrieving information about the formal model may be included in the "surface structure," that is, the way in which words are put together to convey a particular message. The reader resorts to "deep structure" to complete the picture. Especially when surface structure is ambiguous, a person's understanding of a written passage relies on implicit inferences drawing upon his or her knowledge about the context. The sentence:

They are eating apples.

is an example used by Chomsky and frequently cited by others. The "surface structure" of this sentence is ambiguous because it can be generated from a variety of "deep structures," depending upon whether the event is taking place, say, in a greengrocer's shop or the monkeys' feeding time at the zoo (Chomsky, 1968).

This argument can be directly extended to reading and comprehending economic material. Economic texts are seldom self-contained and unambiguous. Much information is left out either because some prerequisites

are thought to have been learned previously or simply because economic knowledge has been expanding so rapidly that the surface structure cannot contain it all. As a result, students of economics have no choice but to refer to deep structure, not only to generate a correct response to an economic problem but also to interpret the problem. Thus, they often reach multiple interpretations of the text, each interpretation reflecting the different deep structure of the reader.

2. The Mental Models Argument. Readers are known to develop "subjective models" in their mind of the unfamiliar concepts formally presented in a text. These "mental" models help readers to internalize the "target" model, that is, the model that the author intends to be learned (Norman, 1983). Mental models take place in learning even when students strive to consciously curb subjective interpretations. In other words, even when an economics student looks earnestly for an algorithm, a rule, a procedure that he could use to generate an appropriate solution to the problems presented at the end of the chapter, he cannot effectively preclude mental models since these problems. To make things worse, these models are often inconsistent with the target model since they reflect the student's own perceptions, experiences,

and judgments that are acquired *ad hoc* and may be at odds with the target model which may be based on a certain *a priori* assumptions. Mental models argument thus provides an answer as to why a given economic text might be interpreted differently by different students. The inference is that the efficacy of the economic text will then depend largely on how closely the mental models formed by the student correspond to that of the author.

3. The Schema-Theoretic Argument. This theory hypothesizes about the nature of "schema" which are comparable to "mental models" in many respects (Rumelhart, 1976). Schemas are "chunks" or "units" of information that are organized in an individual's mind around a specific concept and possible applications of that concept. Schemas refer to activated elements in the permanent memory that serve as a framework for analyzing, assimilating, and accommodating the fresh information that comes from the exterior world. As such, a schema is but an *informal* model about the nature of the events, objects, or situations that we face, or, in the case of reading a text, a model of the situation *formally* depicted on the printed page (Rumelhart, 1976. Emphasis added.)

To comprehend the message contained in a written discourse, readers tap their permanent memory: it is there that schemas are organized. A correct understanding of a written discourse largely depends on how well the data, facts, concepts, and generalizations presented in the text fit the reader's schematic system. This, in turn, depends on how the reader's prior knowledge is constituted and organized.

Prior knowledge encompasses knowledge of the topic, content, form, and appropriate operational skills (Pearson and Johnson, 1978). That is, a schema contains not only statements about the important features of a concept, but a menu listing the functions of that concept and the rules for its selection. Economic texts often render unfamiliar situations, and the student may not have relevant schemas to organize and interpret the incoming information (Kintsch and Van Dijk, 1978). This may provide a tentative answer to why students draw different conclusions of the statements presented in the economic text: prior knowledge is a function of the reader's personal experiences, and therefore, multiple interpretations of the formal model is unavoidable.

This researcher adopts the schema-theoretic perspective in investigating the question why students in

an introductory economics class reach different conclusions about the formal model presented in the text. Schema theory offers a perspective that complements and advances the insights provided by the linguistic and mental models arguments. For, it affords to these basically descriptive approaches a good measure of predictive power. As will be discussed in the subsequent sections, schema theory-oriented research has demonstrated that once the reader's prior knowledge is ascertained, predictions can then be made about what parts of the new knowledge presented in the written discourse will be assimilated by the reader and what parts will not (Pichert and Anderson, 1976). This finding has great relevance to this study which directly addresses this issue.

Schema Theory and Learning from Text.

For the past fifteen years, the topic of reading comprehension has been dominated by schema theory. The main premise of schema theory is that reading comprehension is a result of the interaction between the reader's prior knowledge and the ideas embedded in the text being. A person's prior knowledge is stored--although the mechanisms of both the storage

and retrieval of information are not yet precisely understood-- in schemas. A schema includes all the information that an individual has experienced personally or, alternatively, learned vicariously about an object.

To say that the reader has acquired a coherent understanding of a written passage is to say that the reader has either related the target information to a preexisting schema in permanent memory or successfully modified a compatible schema to accommodate that new information (Anderson and Pearson, 1984). This point was implicit in Horn who stated fifty years ago that the author of the text

...does not really "convey" ideas to the reader; he merely stimulates him to construct them out of his own experience. If the concept is...new to the reader, its construction more clearly approaches problem solving than simple association (1937, p. 134).

Similarly, both in his professional writings (1948) and in his suggestions for teachers, Gray recognized the necessity of engaging students' prior knowledge before reading (Anderson and Pearson, 1984). A more explicit formulation was advanced in the 1960's by Ausubel who argued that in meaningful learning, already-

known general ideas "subsume" or "anchor" the new information found in texts (1963). Similarly, Flavell, in interpreting Piaget's theory of developmental psychology, explained that equilibrium is maintained because accommodatory acts are continually extended to new features of the environment which are assimilated insofar as they fit into existing mental structures (1963).

Cognitive scientists who subscribe to the

schema-theoretic perspective warn that schemas are not synonymous with "concepts." They liken schemas rather to "scripts" in that schemas are much broader than concepts which include only the abstract, definitional properties of objects. A schema includes many other components. Some of these components are universal and definitional, but others are quite particular and idiosyncratic. It is the richness and diversity of the schema that allows for deeper comprehension on the part of the reader. In other words, the more one brings to the printed page (in terms of elaborate schemas) the more information one is able to draw from the text. Prior knowledge is thus seen as the most important prerequisite to comprehension. Authors must, of necessity, continuously assume a great deal of prior knowledge, both general and topical, on the part of the reader.

The fact that readers are able to draw networks of inferences on the basis of relatively little concrete information relieves the author of spelling out a vast amount of detail which might destroy the flow of the narrative. By the same token, the kinds of inferences readers are liable to draw assure added significance. Analysis of readers' comprehension protocols begins with the distinction between responses that do not require inference and those that do.

Schema theory applies to all forms of understanding, such as listening to conversation, listening to a lecture, responding to music, reading an article in a scientific journal, in short, any process in which the individual assimilates "new information," broadly defined, to existing schemas. Schema theory would appear to be particularly relevant to science. We may further hypothesize that the difficulties many students experience in understanding text are attributable to the fact that their existing schemas are poorly elaborated, if they exist at all. Many economic textbook authors, in gearing their products to aspiring economists and assuming their readers to have schemas they do not, preclude the possibility of understanding in a large proportion of their readers (Pearson and Johnson, 1978; Bean, Singer, and Cowen, 1985). Nor do such

authors typically suggest how teachers may develop the requisite schemas in their students (Marshall and Glock, 1978; Tierney and Cunningham, 1984).

What is the relevance of all this to the present study? As mentioned previously, despite their efforts to lift the "exact" meaning of the text, most students in an introductory economics class come up with responses that do not match many propositions made in their assigned text. First, students often do not recall some of the important statements made in the reading passage. Second, they "recall" some statements that are not made in the text. Third, when students actually "recall" a statement from the written passage, what they recall is but an *interpretation* of the factual statement. This researcher believes that schema theory will provide substantial help in explaining what causes the divergence between the target information contained in the printed page of an economic text and what is actually comprehended and retained by the reader of that text.

To the knowledge of this researcher, there are no previous schema theory-oriented studies done in the field of *economic* education. The relationship between science prose and learning, however, has constituted the basis of a large number of studies; but they have not

adopted the schema-theoretic perspective. In other words, these studies ignore the role that old information plays in the acquisition. They focus, instead, on traditional questions such as whether there is a relationship between recall performance and general readability of science text (Berry and Lee, 1982) or average length of words used (Foss and Hakes, 1978). In other words, these studies (1) emphasize the short-term product of learning and (2) concern themselves with the formal properties (that is, the structure, the content, etc.) of the text.

Research based on schema theory differs from

traditional research in that it focusses on the process of learning and demonstrates how long-term memory both contributes to the learning process and is, in turn, modified by it. When the reader confronts a passage containing new information, schemas stored in long-term memory are activated in an attempt to relate the new information to what is already known. The process ends with the encoding of new information into long-term memory to form new schemas which are stored for future use. The retrieval process is usually "top-down," proceeding from general framework stored in permanent memory to the target model presented in the printed page (Bobrow and Norman, 1975). In other words, two kinds of

prior knowledge are brought into play: general knowledge and topical knowledge related to the subject matter of the passage--the latter being especially important in economics where much of the material is specific to a topic and probably unfamiliar to the reader. The main goal of this inquiry is, precisely, to show how prior topical knowledge affects the assimilation of new economic knowledge.

Recently, the schema-theoretic emphasis has shifted toward the structure and organization of a text, that is, how data, facts, concepts, and generalizations are presented. For, as it has been found that the textual format may well determine which schemas or which parts of a schema are likely to be activated. Accordingly, schema theorists, in recent years, have begun to pay much more attention to what has come to be known as "considerate" text. This movement recognizes that, since most students are unlikely to make the inferences required to weave the information given in a text into a coherent overall representation, the text should be written with a conscious aim to assist the reader to form such a coherent representation (Anderson and Pearson, 1984). This means that authors of science texts should incorporate into their product some of the insights provided by schema theory. One method to make

an unfamiliar or technical text more "considerate" is to construct relevant analogies and to carefully show the learner how elements in the text map on to elements of the formal model (Mayer, 1983). Another technique is the use of adjunct or inserted questions. Mayer (1977) showed that when questions were inserted in a passage, performance on a final test which covered the same material was improved.

Schemas and Inference

Schema theory identifies four distinct yet interrelated types of inference.

1. Activation of Schemas. The first is the process of activating a relevant schema by picking up explicit or implicit cues from the text. For example, upon reading a passage stating:

People often make the mistake of assuming that those who produce or sell "vital necessities" such as food can get away with charging almost any price they choose

will decide that the passage deals primarily with Price Elasticity of Demand, and not, for example, Shift in the

Demand Function. Consider that the passage does not actually mention that it deals with Price Elasticity of Demand. Yet, the appropriate schema is still invoked, provided, of course, that the reader already possesses such a schema.

2. Instantiation of Slots. The second kind of inferencing¹ is instantiating. Through this process, new information is related to a particular slot or slots *within* the selected schema. For example, upon reading further in the same passage that

Food has a good claim to the title "vital necessity." But the relevant fact is that no one buys *food*: what they buy is a kilogram of minced beef, or potatoes, or rice

a particular slot, "Substitute Goods" within the schema "Price Elasticity of Demand" is instantiated.

3. Assignment of Default Values. The reader may resort to a third type of inferencing and assign default values in cases where specific information is missing. For example, although the passage may not specify that there may be many substitutes to minced beef, or potatoes, or rice, this aspect will be inferred by the reader based on prior knowledge.

¹. The verb, of course, is to infer; however, "inferencing" has become standard usage in the field of schema theory.

4. Drawing Inferences Based on Lack of Knowledge. The last type of inferencing occurs where a conclusion is drawn based on lack of knowledge. This kind of inferencing has the logic:

If X were true I would know it were true. Since I do not know X to be true, it is probably false (Anderson and Pearson, 1984, pp. 269-70).

In the present illustration, the reader might, for instance, assume that there may exist excellent substitutes for specific food commodities, and hence demand curves for various food items must be quite elastic and that if this were not so for a particular food item then the passage would have mentioned the fact. This kind of inferencing makes schemas "smarter," that is, both cost-efficient in terms of required informational inputs and adaptable to a host of unforeseeable future situations:

As a general rule, people are unlikely to include in their schemata knowledge [in the negative] form...There are infinitely many things that are not true of any given type of event. Thus, it seems unreasonable to suppose that what is not true of a type of event [will be]

"directly stored" (Anderson and Pearson, 1984, pp. 270).

In addition to the question of what kinds of inferences readers make during comprehension, a further question emerges as to when these inferences are made --at the time of initial encoding or at the time of retrieval? The first question needs further elaboration which will be attempted in the next section. As to the second question, evidence is provided that inferences important for a coherent understanding of the text are made at the time the text is read (Goetz, 1979; Kintsch, 1974; Singer 1980, among others). This finding has important consequences for the present inquiry. If the teacher is aware of the prevailing schema among the students in his or her introductory economics class on the one hand and the target schema that underlies the assigned reading on the other, he or she may then try to bring the two schemas closer together and thus facilitate the assimilation and accommodation of new scientific information.

Schemas and Assimilation and Accommodation
of New Knowledge

Schemas are capable of almost infinite elaboration, and hence, by definition, are semifinished products. Their fabric contains many holes. But this is beneficial, for their incompleteness gives them a dynamic nature. As will be recalled from the discussion of the four types of inference above, when a written discourse supplies information that fits some of the empty slots in a relevant schema that information is "instantiated," that is, accepted by the individual as significant. Information that is instantiated will facilitate and enrich comprehension. But if, after the reading of a passage, these slots still remain unoccupied, comprehension will be incorrect or at least incomplete. The reader will disregard the unassimilated information, deeming it irrelevant to overall understanding.

Once it is understood that what produces incorrect comprehension of a written discourse is a deficiency in readers' schemas rather than their linguistic skills (Anderson, Spiro, and Montague, 1977), an answer is provided to the overriding question that informs this inquiry, that is, why a given science text is comprehended differently by readers who have a

comparable level of general literacy. In addition, schema theory offers a degree of predictability as to what statements, concepts, or procedures are more likely to be learned from the written passage, provided that the investigator has some idea about the reader's prior knowledge, especially his topical knowledge.

Schema Modification

Although schema theory holds that learning is a function of prior knowledge, this should not be construed as a conclusion that information that is incongruous with the reader's schemas will never be assimilated. As was discussed in the section dealing with inferencing, schema modification is likely to take place when the reader confronts an unfamiliar text. However, the schema modification process is slow and complicated, and not always conducive to the "desired" equilibrium, that is, "correct" comprehension of the target information.

To reiterate, one of the reasons target information is not successfully assimilated is that many readers do not possess a relevant schema to be activated. For example, a student in an introductory economics class

may not have a schema for the target information
DECLINING MARGINAL UTILITY. Perhaps, conceivably, a
relevant schema (say, SATIATION) may exist, the student
may not be able to relate the target information to it.

The second problem is posed by Anderson, Spiro,
and Montague, who find that most students:

...possess relevant schemata but [do]
not know how to bring them to bear.
They [are] not facile at changing
schemata when the first one tried
proves inadequate...In other words,
[these students] get stuck in
assimilating text to inappropriate,
incomplete, or inconsistent schemata
(1977, p. 378).

Numerous schema theory-oriented studies
demonstrate that even when most students have the
relevant schema, it is incomplete or beset by many
misconceptions (Finley, 1983, 1985). In this case, it is
not the "absence" of schemas but the incongruity between
the pre-existing schemas and the target information that
hampers the acquisition of new knowledge. There is
substantial evidence in schema theory literature that it
is indeed differences in schematic structure and
inferencing --and not differences in memory capacity,
control mechanisms, or age-- that account for an
incorrect understanding of text (Nicholson and Imlach,

1981; Omanson, Warren, and Trabasso, 1978; Pearson, Hansen, and Gordon, 1979). From this evidence follows a disquieting prospect that, because the prior knowledge of economics-oriented students and noneconomics-oriented students is radically different, students who fall in the second group may never attain economic literacy.

Anderson and Pearson found it "ironic" that in order for a student to learn a target system he or she must already possess a suitable "...mental 'home' or else that he or she has modified an existing mental home in order to accommodate that new information" (1984, p. 255). Recognizing the consequences of this paradoxical requirement, the present inquiry surveys schema theory research to discern in what way the schema-theoretic perspective can effectively contribute to increase the level of economic literacy.

CHAPTER II

REVIEW OF SCHEMA THEORY RESEARCH

To reiterate, the basic premise of schema theory is that reading comprehension depends largely on the reader's prior knowledge and inferential ability rather than language skills (Brown, 1977; Nicholson and Imlach, 1981; Pichert and Anderson, 1976; Rumelhart, 1976, 1977, 1980). Prior knowledge, in turn, is composed of general knowledge, knowledge of operational skills, and knowledge of topic.

The main line of research in schema theory concerns the central role that inferencing plays in the assimilation of new information. Early studies consistently show that general literacy is a necessary but not sufficient condition for a coherent comprehension of written discourse (Anderson, 1978; Anderson, Stevens, Shiffrin, and Osborn, 1978; Pearson and Johnson, 1978). These studies demonstrate that the instantiation

hypothesis is generally valid. That is, when readers encounter new information on the printed page, they are likely to infer spontaneously and store schematically appropriate propositions contained in the text. Hence, reading comprehension is achieved by filling the slots of appropriate schemas with particular instances provided in the prose passage.

Effective Learning and Prior Topical Knowledge

Among the three forms of prior knowledge, general, operational, and topical, prior knowledge of the topic emerges as the most relevant determinant of reading comprehension (Anderson, Spiro, and Anderson, 1978; Pearson, Hansen, and Gordon, 1979; Ribovich, 1979). Accordingly, an assessment of students' prior topical knowledge appears to be a precondition for making informed instructional decisions (Hare, 1982). This schema theory-oriented inquiry concentrates on the effect of prior knowledge of topic on acquisition of new information.

Preassessment of students' topical knowledge as the basis for subsequent teaching strategies has been the subject of considerable research. These studies lend

some evidence that students' extant knowledge of a given topic can not only be measured but also effectively regressed to reading comprehension (Hare, 1982; Langer and Nicolich, 1980; Stevens, 1980). Langer (1980) shows that qualitative measures of topical knowledge, such as free word association based on key content words taken from a target passage, may serve as good predictors of whether students will be able to construct meaning from the particular passage. Qualitative measures of prior topical knowledge seem to constitute a useful supplement to prior knowledge scores that are quantitatively arrived at, such as the ones devised by Pearson, Hansen, and Gordon (1979). The present study will make use of both qualitative and quantitative measure of prior topical knowledge developed by these and other researchers.

Schema theory-oriented research generally

concludes that because not all target information is presented explicitly in the assigned text, students should be encouraged to infer meaning from the printed page by using their prior knowledge (Dewitz, Carr, and Patberg, 1987). "There is little doubt that readers make bridging inferences extensively during reading to form connections between text elements and to integrate the text with the knowledge base" (Whitney, 1987, p. 300). And, one may add, there is little doubt that these

elaborative inferences that come from prior knowledge go far beyond the text itself.

Comprehension and Explicitness of the Text

The Pearson and Johnson (1978) study is particularly helpful in clarifying some of the issues concerning the nature of elaborative inferences. When the text is totally self-explanatory and self-contained, ability to read is the only condition to acquire reading comprehension. The reader is likely to attain textually-explicit comprehension by merely lifting the meaning of the text without having to draw elaborative inferences. More commonly, however, the assigned passage requires that the reader make at least one step of logical or pragmatic inference by driving the data presented in the text to generate a response to a question that also comes directly from the text. If this process has been completed successfully, the reader is said to have attained the textually-implicit comprehension level.² But most texts require that readers muster supplementary information from their own prior general or topical knowledge to fully assimilate the target information. If the reader has achieved this task successfully, he or she

² Pearson and Johnson (1978) refer to this kind of reading comprehension as data-driven comprehension for the obvious reason.

is said to have attained the conceptually-implicit comprehension level.³ This is achieved when a reader is able to give an answer:

...that had to come from prior knowledge...to a question that is at least related to the text (that is, there would be no reason to ask the question if the text were not there). It is similar to [textually-implicit] comprehension in that an inference is involved; however, it is different in that the data base for the inference is in the reader's head, not on the page (Pearson and Johnson, 1978, p. 162).

In other words, conceptually-implicit reading comprehension calls for the ability to read beyond the written passage, and this ability is often invoked since authors rarely put all the information in the text (Reder and Anderson, 1980).

This framework runs the risk of suggesting that a given text may aim to elicit just one of the foregoing reading comprehension levels. In reality, the reader makes inferences at all three levels of reading comprehension and refers both to prior general and/or topical knowledge even when reading seemingly self-explanatory texts, that is, texts that purportedly does not require inferencing ability.

³ Some authors seem to favor the term scriptally-implicit.

Consider the following passage:

As a firm increases production of one good (automobile) it must sacrifice increasing amounts of an alternative good (tractor) to produce each additional unit. The *real* cost of producing either good, therefore, is not the amount that must be spent on it. The real cost is the amount of the *alternative* good that must be sacrificed. This concept is known as *opportunity cost*.

The passage may seem self-explanatory in that it is constructed mainly on textually-explicit propositions. Yet, on closer scrutiny, one may detect some propositions that may require serious inferencing on the part of the reader. To illustrate, it appears likely that while most students will have no difficulty in answering the question:

1) Is the following statement true or false?

The *real* cost is the amount of the *alternative* good that must be sacrificed.

by simply lifting the answer from the text most students will have to make a textually-implicit inference to answer the question:

2) Is the following statement true or false?

An *increasing* amount of one good has to be sacrificed to obtain each additional unit of the other.

The correct response is hidden somewhere in the text, and to locate it students have to take at least one logical step before giving the answer.

Finally, consider the question:

- 3) Why does an *increasing* amount of one good have to be sacrificed to obtain each additional unit of the other?
- a) The factors of production are not all *equally* suitable for producing two types of goods.
 - b) It is *always* more costly to produce additional units of output.
 - c) Economic resources are scarce and they have *different* prices.
 - d) The statement is wrong. Actually, a *decreasing* amount of one good needs to be sacrificed.

To answer the question correctly, the student must have the previously acquired notion that even though economic resources may be substitutable within wide limits for a given production process, these resources are relatively more efficient in some uses than in others. Thus, as a firm tries to increase its production

of good x, it must take increasing amounts of resources out of good y. This information is not supplied in the text. The reader must use general knowledge or knowledge embedded in another schema --say, "Factors of Production"-- to correctly choose answer A.

This finding has direct applicability to this inquiry which subscribes to the notion that a reader's mental representation is an emergent product of the interaction between text-based information and pre-existing knowledge.

Available Methods to Improve Reading Comprehension

Another line of schema theory research that is applicable to this study concerns the methods aiming to improve the comprehension of written material. One such method is "priming," that is, providing suitable schemas before assigning an unfamiliar text. There is evidence that when a schematic representation of a narrative text is made available to students (say, by drawing it on the board) the students achieve a more coherent understanding of the reading than when such a device is not used (Hoffman and Crone, 1985; Pearson and Johnson, 1978). Similarly, when a text uses "analogies" that are in

conformity with the reader's existing prior knowledge, it facilitates learning (Bean, Singer, and Cowen, 1985; Vosniadou and Ortony, 1983). This finding may constitute an important step toward a "considerate" text whose characteristics are examined in Marshall and Glock (1978) and Tierney and Cunningham (1984).

It should be borne in mind, however, that the three methods presented above deal with material related to natural science rather than economic science. Consequently, they might not be directly applicable to the present inquiry. Nevertheless, two natural science-oriented studies (Finley, 1985 and Lloyd, 1985) seem to provide useful insights for this study. Lloyd (1985) demonstrated that when some key slots of a target schema were determined and integrated with the actual schema of the students through student/teacher interaction, higher comprehension scores were obtained. Similarly, Finley (1985) found that in order to make use of the schema-theoretic principle, students' prior knowledge must be ascertained.

More specifically, according to Finley, in order to teach more effectively, teachers need to know the answers to the following questions:

- 1) [Are] there certain propositions that most students share with respect to a topic?
- 2) [Are] there different groups of students whose members share distinctive sets of propositions?
- 3) [To] what extent is the students' [prior] knowledge of a subject idiosyncratic? (1985, p. 697)

Finley's tentative answers to these questions are important for the present study. If, indeed, most students do share approximately the same prior knowledge of topic, then the chances for developing effective curriculum and instruction that account for students' prior knowledge will be improved. Conversely, if students' prior knowledge of topic is found to be totally idiosyncratic, then the task will become impractical (Finley, 1985, p. 697).

Finley discovered that all students in his sample ($n = 395$) students shared a "correct" conception of the "empirical" aspects of the target model which was the best transfer phenomenon. More than 90 percent of

6.52 propositions per student. However, Finley found that these propositions that were not made in the text tended to fall within a small number of clusters.

Other instructional strategies are offered by schema theory. Cunningham (1982), for one, suggests that GIST⁴, a procedure that aims at improving students' abilities to comprehend the gist of the paragraph, can, in a relatively short period of time, lead students to compose more accurate gist statements for paragraphs they have not seen before than they would be able to after equal exposure to the same training paragraphs and equal time spent composing. Another strategy deals with metamemorial processes such as summarization and self-generated questioning. Early studies (Flavell and Wellman, 1977) suggest that these processes could indeed enhance comprehension of expository material. More recently, it has been found that students who were instructed in summarization rules and self-generated questioning wrote significantly more succinct recall protocols at the end of the instruction (Bean, Singer, Sorter, and Frazee, 1983).

Still other studies aim to improve reading comprehension by making a better use of analogies and

⁴Generating Interactions between Schemata and Text.

metaphors. A number of studies indicate that adult readers routinely apply knowledge previously learned in one domain to generate new knowledge pertaining to another domain through analogical reasoning (Carbonell, 1981; Hayes and Tierney, 1982; Rumelhart and Norman, 1981). Vosniadou and Ortony (1983) show that elementary school children too resort to analogy as a mechanism for transferring knowledge from an old to a new domain, especially when they are assisted in doing so. The study demonstrates further that some analogies have more facilitative power than others. For example, the medicine/water analogy worked better for some first graders than the medicine/food analogy. While some students concluded that "food is needed to make the poison that kills the germs" others concluded that "medicine is like water that pours on [the germs] and they don't expect it. They will be pushed back by water and...will go down the drain" (Vosniadou and Ortony, 1983, p. 78).

Similarly, Baldwin, Luce, and Readence (1982) found a high correlation between subjects' ability to comprehend the target model and their knowledge of the standard interpretations of well-known metaphors and similes. The implication of their study is that, while the interpretation of a metaphor may be useful in

achieving correct reading comprehension, the reader must be reasonably knowledgeable about the salient characteristics of the particular metaphor.

Reading Comprehension and Text Structure

Another line of schema-theoretic research which is relevant for the present study concerns the relationship between the structure of the text and reading comprehension. Through much of the past 15 years of research on reading comprehension it has been consistently found that familiarity with the structure of the text is an important determiner of the retention and recall of information from the written passage (Meyer, 1975, p. 43). Familiarity with text structure influences not only how much is recalled, but also what is recalled (Haynes and Hare, 1983). Readers who are aware of the structure of an expository text are able to recall more sub- and superordinate propositions than those who, being unaware of the text structure, proceed randomly and inefficiently to retrieve what they can. The latter readers will be clearly handicapped in their deployment of appropriate strategies for retention and recall (Hare and Smith, 1982) while the former readers will have at their disposition a "design metaphor" which will serve as a flexible evaluative guide to unfamiliar texts (Beers,

1987; Koenke, 1984). Familiarity-unfamiliarity with text structure is equally important in recalling from both high- and low-knowledge passages (Kapinus, 1982).

Reader's Interest and Reading Comprehension

Finally, the effect of the reader's interest on reading comprehension has formed the basis of some schema theory-oriented research. That people's interests affect their reading comprehension was demonstrated empirically in educational research many years ago (Bernstein, 1955). But, with the advent of schema theory, the question that emerges is whether the motivational value of a personally interesting topic is equal to the effect of prior knowledge on reading comprehension (Pearson and Johnson, 1978). Weber (1979) found that interest and prior knowledge were, in fact, operating jointly in affecting reading comprehension; however, Weber found the strength of the prior knowledge factor to be much greater. Osako and Anders (1983) were able to measure the effect of interest on comprehension by controlling for prior knowledge. They found that interest in the topic was only a marginal predictor of how well the students would comprehend expository texts.⁵

⁵It should be stressed, however, that the subjects in Osako's and Anders's study were instructed to carefully read the passages and the questions that followed. As a result, the subjects probably consciously suppressed the effect of their

Osako's and Anders's finding is relevant to the present study in that even if personal interest is suppressed in learning science prior topical knowledge and task orientation may compensate for it. In fact, Osako and Anders note that in most school and testing situations students are required to read texts regardless of their interests:

The task demands require that students overcome their interests in order to understand the texts that they confront....The ultimate test of the effect of interest on comprehension is that if students do not read texts that do not interest them, then obviously no comprehension can take place. However, if texts are actually read, as indicated in this study, other factors besides interest may be operating (Osako and Anders, 1983, p. 59).

Readers' "interests" in the topic should not be confounded with their "perspectives" on the subject. According to the "selective attention hypothesis," which has dominated most of recent research in reading comprehension, some elements provided in the text are identified by readers as "important." As a result,

personal interests. Anderson, Mason, and Shirey (1984), meanwhile, showed that when interest was evoked reading performance improved significantly. In fact, they found that "...interest and the quadratic of interest accounted for 16 times as much variance as readability" (1984, pp. 31-32).

readers apply increased inference processing toward those elements (Goetz, Reynolds, Schallert, and Radin, 1983). This hypothesis questions an alternative one, the so-called "slot-filling hypothesis," which maintains that schemas constitute fixed structures into which new information is incorporated without serious inferencing. The "slot-filling" hypothesis, which is a direct descendant of Ausubel's (1963, 1969) concept of "ideational scaffolding," is subsequently elaborated by Alba and Hasher (1983), Craik and Lockhart (1972), and Locksley, Stangor, Hepburn, Grosovsky, and Hockstrasser (1984). The latter hypothesis is still widely used, although some recent studies seriously question it.⁶ These studies are based on the basic premise that inferences that take place during reading go far beyond a simple "activation" of pre-existing schemas. Readers obviously first try to assimilate information into a pre-existing schema. But if a fitting slot is not found, schema "construction" may take place (Whitney, 1987). In other words, instantiation is a pervasive process that includes not only the filling-in of specific slots but also processes that help create new schematic structures (Dreher, 1985; Whitney, 1987).

⁶ See Beers (1987) and Whitney (1987).

As mentioned previously, while reading a prose passage, a person typically identifies some text elements as schematically important and allocates extra attention to their processing.

This extra attention results in the better learning and recall of those schematically important text items. For example, a prospective homebuyer would be expected to pay greater attention when reading text elements that refer to the condition of a home and its need for repairs (e. g., plumbing, roof) or the desirability of the location of the house (e. g., distance to nearest school) than to comments about the occupation of the previous owner [which would interest a real estate agent] (Goetz, Reynolds, Schallert, and Radin, 1983, p. 501).

Accordingly, schema theory must be able to account for flexibility in the use of inferences and distinguish between "activation," that is, filling-in certain slots in an appropriate schema, and "construction," which may be the final effect that the new information has caused in the knowledge base of the reader.

ne necessary flexibility is obtained when
we abandon the notion of schemata
as...generic knowledge structures and
instead consider comprehension as a schema
assembly process...Schemata may best be
conceptualized as structures compiled ad

hoc to fit current demands, rather than as the pre-existing chunks described by Schank and Abelson (1977). Such a conceptualization makes the knowledge base more adaptable to unfamiliar events, and thus more flexible. It also incorporates our ability to update knowledge so that our system is dynamic rather than static (Whitney, 1987, p. 306).

Concluding Remarks to Chapter II

This is not to say that reading comprehension is a totally idiosyncratic process. Research shows that, in a classroom environment, active comprehension can be augmented by proper inference training. Carr, Dewitz, and Patberg (1983), Gordon (1980), and Hansen and Pearson (1980) demonstrate that students' inferential comprehension of expository text can be improved significantly by adopting a specific strategy that facilitates elaborative inferential processing. The strategies that were suggested range from making the reader more consciously aware of clues in the text (Gordon, 1980) to employing a modified "cloze" procedure that was demonstrated to help the reader understand the organization of the target information (Carr, Dewitz, and Patberg, 1983). Similarly, Hansen and Ahlfors (1982) relied on "evoking instances from prior knowledge" and incorporating these instances into the target information while Hoffman and Crone (1985) opted for the "component

building" strategy whereby the students explored four different procedures and chose a particular one over the others. Singer and Dolan (1982) and Sundbye (1987), in addition, applied the "question generation strategy" to induce elaborative inferences in students. Singer and Dolan (1982) find that by asking inference questions that elaborate the text, the inference load can be reduced significantly without having to make the text more explicit. Students who underwent inference training generally showed that they could apply these skills not only to comprehending the text at hand but also to previously untaught texts (Dewitz, Carr, and Patberg, 1987).

The teacher input in inference training cannot be discounted. Roehler and Duffy (1984) warn that the success of an inference strategy ultimately depends on the teacher. To get the most out of an inference training strategy, the teacher should (a) carefully explain the purpose of the particular procedure; (b) model its use, (c) provide ample practice and feedback for the students, and (d) encourage the independent transfer of these skills to new learning situations. The teacher may then progress from teacher-monitoring toward self-monitoring. By introducing materials that advance in difficulty from simple examples to problems that

demand access to information across the text as well as background knowledge, the teacher may eventually raise the comprehension level of the students to a significant degree.



CHAPTER III

THE STUDY

Despite the important contributions made by schema theory to the analysis of the interplay between old and new knowledge, a full model of reading comprehension is yet to be constructed. Nevertheless, the basic processes underlying reading comprehension have been effectively characterized by the proponents of schema theory. The present study addresses itself to one such process, namely, the relationship between prior topical knowledge and reading comprehension.

Goals of the Study

Two important schema-theoretic arguments have prompted the researcher to undertake this task. One argument is that new information is

...learned and remembered...precisely because there is a niche for it. It follows that one schema can provide slots for more of a certain fixed body of information than other schemata. If the knowledge domain were specified, it should be possible to make qualitative as well as quantitative predictions about just which details will be learned [by the reader] (Anderson, Spiro, and Anderson, 1978).

The present study attempts to determine which aspects of the selected schema are likely to be assimilated given the reader's prior topical knowledge applicable to the new information.

The second argument is that:

It is unlikely that alternative interpretations among students...would be entirely idiosyncratic. Students have...common educational and

personal experiences; it is likely that among students in a class there would be limited number of schemata related to a particular topic (Finley, 1983, p. 249).

This study attempts to determine which aspects of the selected schema are idiosyncratic in an introductory economics class and whether there is a dominant "informal" schema.

Specifically, the study examines the unique contribution of students' prior topical knowledge of Price Elasticity of Demand to comprehending new relevant information on the same topic. More generally, the study aims to demonstrate that:

(1) if students' prior knowledge of an economic topic is ascertained, it becomes possible to predict the extent of the target information that will be assimilated by the student;

(2) while prior topical knowledge among students of economics tends to be idiosyncratic, it is not unique for each student. It seems likely that in a given economics class homogeneous clusters of relevant schemas will exist.

This research attempts to provide some evidence that both arguments are valid. Accordingly, it aims to demonstrate that, with appropriate schema-theoretic inputs from the author of the text and the teacher who adopts the text, the students will "hang" the new information appearing in the text on the scaffolding that already exists in their mental structure.

Hypothesis

Formally stated, the hypothesis of this study is:

H₁ : The more an economics student's pre-existing schematic structure is congruous with the target schema underlying new information presented in the text the greater the likelihood that the student will assimilate that new information.

If this hypothesis is confirmed, the inference would then be that teachers of economics and authors of economic textbooks may make economic texts more informative and enjoyable by presenting economic topics that are built on and complement students' prior knowledge and facilitate inferences. In this way, they

may contribute to more effective dissemination of economic information and hence to improved economic literacy among students.

Sample

The subjects in this study are 40 introductory economics students, chosen randomly from the population of an English-language economics program. The subjects have either completed the English-language preparatory program or they have qualified to start the economics curriculum directly because they had previous satisfactory exposure to English.

Research Instruments

The study uses two research instruments. The first is a battery of true/false and multiple choice questions probing students' prior topical knowledge of Price Elasticity of Demand. The instrument, which is termed Prior Topical Knowledge Inventory (PTKI), is presented in Appendix A. The questions are formulated in such a way that they elicit textually-explicit,

textually-implicit, and conceptually-implicit inferences. The questions are mixed at random in order to minimize boredom in case a student gets stuck in any one section.

The second instrument is comprised of an expository passage formally introducing the target information Price Elasticity of Demand (presented in Appendix B). This instrument is used to develop a Post-Reading Inventory (PRI).

To ascertain whether the reading produced any modification in the schematic structure of the students, first, each subject's "pre-existing" Price Elasticity of Demand schema that was determined by his or her PTKI score (out of 20 questions). This score was then compared to his or her "post-reading" score (PRI) after being exposed to the reading passage dealing with Price Elasticity of Demand and answering 23 questions germane to the passage. These questions included the 20 original questions plus three questions presented as questions 21, 22, and 23 in the following section.

Constructing Pre- and Post-Reading Schemas
from the Subjects' Responses

This section illustrates how the responses supplied by the subjects to the questions contained in PTKI and PRI were used to determine, respectively, their pre- and post-reading Price Elasticity of Demand schemas. For brevity, the illustration concerns the development of a subject's post-reading schema only.

The question:

- 21) If you were to come up with a title for this passage, what would it be?
- A. Demand and Supply of Consumer Goods
 - B. Price Elasticity of Demand
 - C. Economic Problems and Solutions
 - D. Demand for Automobiles

helped determine whether the subject was able to achieve the first kind of inferencing, namely, to successfully activate the relevant pre-existing schema Price Elasticity of Demand.

Other questions helped determine whether the subject could activate particular slots and interrelationships in the pre-existing schema Price Elasticity of Demand. For example, the following

question helped determine whether the subject could successfully instantiate the relevant slot PERCENTAGE CHANGE IN QUANTITY DEMANDED:

22) If the price of a pair of shoes drops from \$25 to \$20, the quantity of 10.000 pairs of shoes sold in a particular economy is expected to be (other things remain constant)

- A. less than 10.000 pairs
- B. more than 10,000 pairs
- C. remain at 10.000 pairs
- D. cannot be determined from the information

Other questions helped determine whether the subject could instantiate appropriate causal and transformational interrelationships among relevant slots. For example, the question:

23) Consider a "straight line" demand curve and identify which of the following is correct

- A. The slope of the demand curve equals the demand elasticity.
- B. The slope of the demand curve varies as you move along the demand curve.
- C. The elasticity of demand varies as you move along the demands curve.
- D. None of the above.

probes whether the subject has a coherent notion of the relationship between the two magnitudes, that of the

slope of the demand curve and the price elasticity of demand. Finally, for each subject a post-reading schema has emerged. By comparing each student's pre- and post-reading schemas it can be determined whether the reading of the passage caused satisfactory schema modification. The next section presents the analysis of data and the results that were obtained.



CHAPTER IV

ANALYSIS OF DATA AND RESULTS

For each subject, the following data were obtained:

- (1) a PTKI score that measured the subject's overall prior topical knowledge of the schema Price Elasticity of Demand; and,
- (2) an overall post-reading comprehension score (PRI) based on the subject's responses to 23 questions that were contained in PRI.

The analysis concerned the testing of the first hypothesis by inferential-statistical analysis. This was achieved by adopting the Spearman rank-order correlation method. The Spearman test was expected to determine whether there was a correlation between a student's ranking in prior topical knowledge of solar

activity (as measured by the PTKI score) and his or her ranking in reading comprehension (as measured by the PRI score). A strong correlation between the two rankings was expected to lend evidence to the hypothesis that a science student's ranking in prior topical knowledge was a good predictor of his or her ranking after reading text incorporating relevant material.

Results of the Testing of the Hypothesis.

The first hypothesis was that the more an economics student's pre-existing schematic structure was congruous with the target schema underlying new information presented in the text, the greater the likelihood that the student would assimilate that new information. This hypothesis was strongly supported by the Spearman rank-order correlation test which yielded $r^s = 0.8125$ significant at $p > 0.0001$. An r_s of such magnitude implies that a subject's ranking in prior topical knowledge is one of the most important determinants of his or her ranking in reading comprehension of science text. In fact, the square

of this rank-order coefficient is $r_s^2 = 0.6609$, which implies that about sixty six per cent of the variation on the comprehension post-test is statistically accounted for by prior topical knowledge as measured by the PTKI. Hence, it can be suggested that economics educators should encourage students to bring out rather than suppress their own conceptual model of the new information presented in the printed page. In this way, economics students may be led toward a better integration of the two sets of information, the one that is to be learned and the one that was previously learned.

A comparison of the average PTKI and PRI scores indicated that the difference between the two scores was highly significant ($p < 0.0001$). This finding supplies evidence that, on the average, subjects have significantly improved their prior knowledge of Price Elasticity of Demand after reading the relevant passage.



CHAPTER V

CONCLUSIONS AND IMPLICATIONS

Summary and Discussion

Schema theory posits that reading is a process of constructing meaning based on the reader's prior knowledge and ability to draw inference. It identifies three kinds of prior knowledge, general, operational, and topical, and ties them to three levels of reading comprehension, textually-explicit, textually-implicit, and conceptually-implicit. This research focused only on the contribution of topical prior knowledge to comprehending new relevant information and the role that inferencing plays on facilitating the comprehension process of a relevant new written economic knowledge. To achieve this goal, the study ascertained the pre-existing Price Elasticity

of Demand schema that prevailed in members of an introductory economics class and examined its effect on the understanding of a fairly complex target schema on the topic.

The hypothesis of the study was strongly supported by the data. It was demonstrated that (1) if students' ranking in prior knowledge of a economic topic were ascertained, it would become possible to predict their ranking after exposure to relevant new information.

The results of the study suggest that when teachers of economics and authors of economic textbooks present specific topics that are built on and complement students' prior knowledge and facilitate inferences, they may make economic knowledge contained in the text more conducive to effective learning.

Educational Implications

Although the "back to basics" movement of the past fifteen years has produced significant gains in

making introductory textbooks more comprehensible to the uninitiated, the majority of students are shown to remain deficient in higher level thinking skills needed to comprehend advanced text (Becoming a Nation of Readers, 1984; Kirsch and Jungeblut, 1986). To remedy this situation, authors of economic textbooks should consider incorporating into their products the latest contributions coming from the direction of cognitive science, especially from schema theory-oriented research.

This research lends some help in this regard by providing evidence that substantial improvement can be achieved without downgrading the important role that the textbook plays the economics curriculum. Since both hypotheses of the study were demonstrated to be valid, the inference is then that a single-textbook strategy could still be appropriate for an introductory economics class, provided, however, that it is congruous with the principal characteristics of the dominant schematic structure among the students. There are various single-textbook strategies available to the classroom teacher (such as directed reading activities, glosses, reading- and learning-from-text guides, inquiry, and the project method) that might be tailored

in consideration of the general characteristics of the prevailing schema.

The process that takes place between the author and the student -- with the teacher intervening as a boundary expander and schema elaborator -- may be beneficial for all the parties involved. The teacher, by plotting individual students' schemas, can readily learn where these schemas are deficient. Also, the author who gleans from the teacher the principal characteristics of the dominant pre-existing schema in a science class is likely to take those characteristics into consideration. Thus, the likelihood of producing a more "considerate" text would be expected to increase. It seems that the strategy of making the text more considerate will prove more effective than an alternative strategy to make economic texts more "explicit" as suggested by Spiegel and Wright (1983) and Rice, Dolan, and Brown. (1981). Such attempts may only make the text more bland, no guarantee that, in the absence of relevant schema(ta), correct comprehension will be generated.

Future Research

This study attempted to demonstrate that authors of economic texts can make important changes in the educational lives of economics students by incorporating into their product the latest contributions of schema theory-oriented research. Coupled with effective teacher input, the economic text may then help the majority of the country's students to achieve a satisfactory level of economic literacy.

Both authors and teachers should be aware that economic texts often contain empty slots which are expected to be filled by the reader through elaborative inferencing. This is making too heavy a demand on the reader's attention and time during reading (Sundbye, 1987). The need for alleviating this task is obvious and the application of schema theory in this regard seems appropriate.

However, it should also be recognized that schema theory may have a serious shortcoming stemming from its main corollary that new knowledge cannot be acquired unless the reader already possesses an appropriate schema. This corollary entails dire

consequences for the majority of young citizens who may be illiterate of the most economic models presented to them in written form. In order to afford schema theory more relevance, future researchers should strive to demonstrate how readers actually cope with texts that present unfamiliar knowledge. Hence, the approach that is needed is to study how schemas are constructed rather than how pre-existing ones are simply instantiated.

It may seem at first glance that a fruitful avenue for future research on reading comprehension may be to integrate schema theoretic insights with decision sciences to create computer models simulating the acquisition of new knowledge. In fact, recent research indicates that developments in the schema theoretic approach have had a considerable impact on Artificial Intelligence research (Whitney, 1987). Care must be taken, however, in pursuing this line of research not to push the "machine" metaphor too far. Minsky (1975), for example, warns that the very terminology of schema theory implies inflexibility. Slots, default values, activation, etc., suggest an unwarranted mechanistic approach.⁷ Therefore, the machine metaphor, although

⁷Although this research attempted to point out the dynamic qualities of schemas.

undoubtedly affording schema theory substantial precision to describe the structure of knowledge, may lead to a misconception that there is a finite foundation of human knowledge. The task to put these criticisms to rest lies with proponents of schema theory. Fortunately, there is sufficient evidence that future research will help "humanize" the machine metaphor and effectively relate the human learning process to the environment in which it takes place (Beers, 1987).





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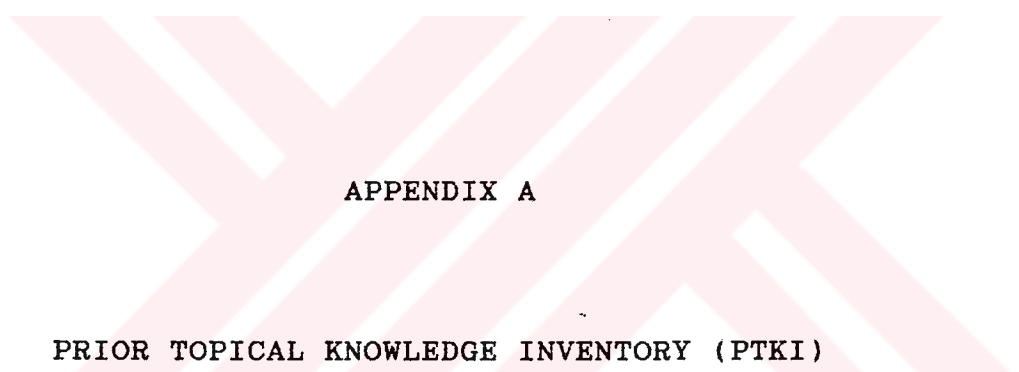
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APPENDIX A

PRIOR TOPICAL KNOWLEDGE INVENTORY (PTKI)

Name of the student: _____

Class: _____

Date: _____

GENERAL DIRECTIONS:

This booklet contains 20 questions. Read each question carefully and think before answering. You may find some questions to be more difficult than others. Try to do your best and answer all of the questions: you will find ample time to answer all of them.

Thank you very much for your cooperation and participating in this research study.

Circle the best answer:

1) The price elasticity of demand for a good is an attempt to measure:

- a. consumer response to a price change
- b. the change in the amount purchased resulting from a change in consumer income
- c. the change in the price of a good resulting from a change in the cost of production
- d. the variability of price (for any good) over a period of one year

2) The law of demand predicts that when the price of a good changes, the quantity demanded changes in the opposite direction. The concept of *elasticity* of demand is an attempt to measure:

- a. whether or not the law of demand holds for a particular good
- b. the direction of change in the quantity demanded as the price increases
- c. *how much* the quantity demanded will change in response to a given change in price
- d. the *change in demand* resulting from a change in the price of a good

3) If a large change in the price of a particular good causes a relatively small change in the quantity purchased:

- a. the demand for that good (for the price change given) is said to be elastic
- b. the demand for that good (for the price change given) is said to be inelastic
- c. it will be difficult to make a profit from the good
- d. we can conclude that consumers are not acting rationally

4) For which of the following goods is the demand curve likely to be more elastic?

- a. water for a desert dweller
- b. insulin for a diabetic
- c. a new Ford automobile for a traveling salesman
- d. matches

5) Price elasticity of demand depends on:

- a. the availability of substitutes
- b. the percentage of an individual's budget that a particular good takes up
- c. time
- d. all of the above

6) As a general rule, demand curves:

- a. become more elastic with time
- b. become more inelastic with time
- c. become unitary elastic with time
- d. exhibit a fixed coefficient of elasticity over time

7) The short-run coefficient of elasticity for gasoline is likely to be:

- a. greater than one
- b. equal to one
- c. less than one
- d. none of the above

8) A completely inelastic demand curve:

- a. would be a straight line with a slope of -1
- b. would be a straight line with a slope of $+1$
- c. would be a vertical line
- d. would be a horizontal line

9) A demand curve that has a coefficient of elasticity of infinity:

- a. would be illustrated by a horizontal line
- b. would be illustrated by a vertical line
- c. cannot theoretically exist
- d. would run contrary to the law of demand

10) A straight-line demand curve (one with a constant slope) will be:

- a. unitary elastic at each and every point
- b. elastic above the midpoint, but inelastic below the midpoint
- c. elastic
- d. inelastic

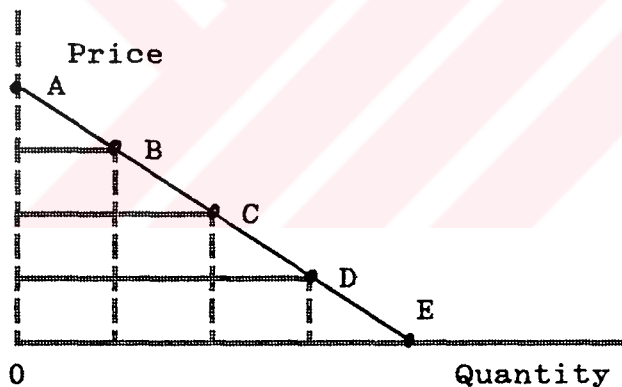
11) A straight-line demand curve with very steep slope will have a coefficient of elasticity:

- a. greater than one
- b. less than one
- c. equal to one
- d. that changes at every point along the entire length

12) The elasticity of demand for any good will be more elastic:

- a. the more substitutes there are for the good
- b. the larger the portion of one's budget the good requires for its purchase
- c. the fewer substitutes there are for the good
- d. the more time that is allowed for adjustment to a given price change

Refer to the following diagram to answer questions 13 and 14:



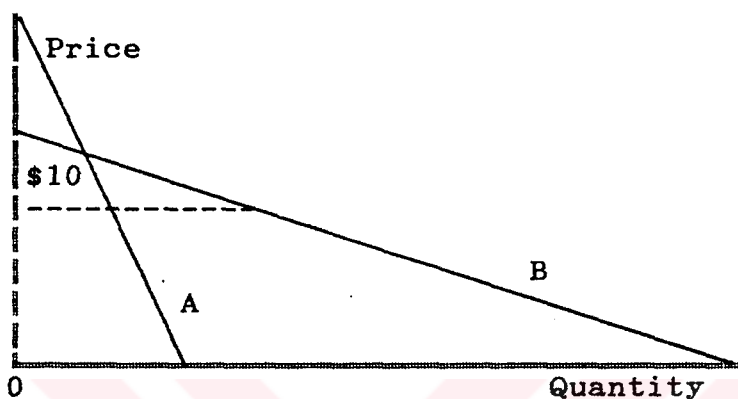
13) In the diagram above, total revenue would be maximized by setting the price equal to point:

- a. A
- b. B
- c. C
- d. D

14) In the diagram above, D represents a point on the demand curve where:

- a. demand is infinitely elastic
- b. the coefficient of elasticity is equal to -1
- c. the demand is inelastic
- d. the coefficient of elasticity is greater than -1

Use the diagram below to answer question 15:



15) In the diagram above, which of the following is true if the price is \$10 per unit?

- a. both demand curves are elastic at this price
- b. demand curve A is less elastic than demand curve B at this price
- c. demand curve A is more elastic than demand curve B at this price
- d. both demand curves are inelastic at this price

16) Whenever price and total revenue change in the same direction, demand is:

- a. infinitely elastic
- b. completely inelastic
- c. inelastic
- d. unitary elastic

17) As a business executive interested in raising your total revenue, you should never increase your price if:

- a. the demand curve for your product is a straight line
- b. the demand curve for your product is not a straight line
- c. you are already charging a price above the midpoint on a straight-line demand curve
- d. you are already charging a price that is below the midpoint on a curved demand function

18) Henry Ford believed in the early 1900's that if his revolutionary assembly-line production technique could reduce the price of automobiles enough, he could become a wealthy man. He must have believed that the demand for automobiles in the 1900's was:

- a. unitary elastic
- b. price elastic
- c. price inelastic
- d. income inelastic

19) Your company produces cardboard boxes using in shipping fresh fruits. Last year your price for the cardboard boxes was \$80 per 100 boxes, and your total revenue last year was \$60,000. This year, you increased your price to \$92 per 100 boxes, and your total revenue for the year turned out to be \$52,000. This suggests that the demand for your product is:

- a. highly seasonal in nature
- b. stable but subject to minor yearly variations
- c. price elastic
- d. income elastic

20. When Mr. Walter's income increases by 10 percent, he increases his expenditures on theater tickets by 20 percent. Mr. Walter's demand for theater tickets is:

- a. price inelastic
- b. price elastic
- c. income elastic
- d. income inelastic

This concludes the test. Thank you for your time.

APPENDIX B

READING PASSAGE

Why is it necessary to determine "...the amount by which people increase or decrease their purchases when the price changes?" Economists think this is an important relationship with many useful applications. They have even invented a special phrase, *price elasticity of demand*, that summarizes this relationship.

This is an appropriate name. Elasticity means responsiveness. If the amount of any good that people purchase changes substantially in response to a small change in price, demand is said to be elastic. If, conversely, a very large price change results in little change in the quantity purchased, demand is inelastic.

Price elasticity of demand is defined precisely as *the percentage change in quantity demanded divided by the percentage change in price*. Thus, if a 10 percent increase in the price of eggs leads to a 5 percent reduction in the number of eggs sold, the elasticity of demand is $5\% / 10\% = 0,5$. To be completely accurate, it is *minus* 0,5, since price and quantity purchased vary inversely. But for simplicity economists ignore the minus sign and treat all coefficients of elasticity as if they were positive.

Whenever this coefficient is greater than one --that is, the percentage change in quantity purchased is greater than the percentage change in price-- demand is said to be inelastic. Whenever the coefficient of elasticity is less than one, which means that the percentage change in quantity purchased is less than the percentage change in price, demand is inelastic. (When, do you think, the coefficient of elasticity is equal to one?)

You can begin to familiarize yourselves with the uses of this concept by asking whether demand is elastic or inelastic in each case below:

CASE 1) "Wholesale trade is a competitive business: we would lose half our customers if we raised our price by as little as 2 percent."

CASE 2) "People aren't going to buy much more salt no matter how far we cut the price."

CASE 3) "This theater's total receipts would actually increase if ticket prices were cut by 20 percent."

CASE 4) "It's strange but true. Wheat farmers would gross more money if they all got together and burned one-quarter of this year's crop."

Let us apply the concept of elasticity of demand to solve the above problems.

CASE 1) It is the elasticity of demand that determines whether or not this businessman can add to his money receipts by raising his prices. He will be motivated to raise his prices only if he is facing an inelastic demand for his goods.

CASE 2) This particular businessman is evidently facing a highly elastic demand: a 2 percent increase in price will generate a 50 percent decline in quantity demanded. The coefficient of elasticity is 25. And that makes it difficult for him to raise his prices.

CASE 3) The theater's total receipts are the product of the unit price of the ticket and the number of spectators who buy those tickets. The percentage change in quantity demanded is greater than the percentage change in price, so demand is elastic. But don't jump to the conclusion that the theater will always be in a better financial position, given the elastic demand, when it lowers its ticket prices. True, this means larger total receipts; but a larger attendance also means larger costs. The theater management must decide in such a case whether the addition to total receipts will be larger than the addition to total costs.

CASE 4) Like Moliere's famous M. Jourdain who realizes that he spoke prose for forty years, farmers may make a good use of demand elasticity without ever having heard the term. Farmers can, sometimes, gross more money while selling less wheat. In those cases, demand would have to be inelastic. The only difference is that we have been assuming so far that the price was set first (by the seller) and the buyers just reacted to it. But, in some industries such as agriculture, it would be more appropriate to assume that the quantity available for sale determines the price.

An important point is that all goods mentioned above have substitutes and that substitution occurs whenever prices change. Demand curves are rarely inelastic in the absolute sense.