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ABSTRACT

In a complex domain such as economics, elementary school students' knowledge of formal systems beyond their immediate experience is often too incomplete, superficial, and disorganized to function as schema or model. However, visual imagery is a good technique for teaching young children a network of 10 to 20 propositions and the relationships between those propositions in a single lesson with good recall and comprehension. In introductory lessons,u students are informed of objectives and they are shown how the content is applicable in authentic situations. Next, new information is presented in a memorable way. For example, a frequently used cue word or title is linked with a mnemonic device that prompts recall of a particular distinctive graphic feature in the mind. After explaining 8 to 10 propositions in this chained manner, the illustration is removed and students are prompted to process and practice material with guiding questions. The concept of the "Money Cycle Main Ideas" demonstrates the method. A number of observations, case studies, and quasi-experimental studies suggest promising outcomes resulting from the visual imagery approach. If students can remember images of all parts of a network of elements of an integrated system, the image appears to form a reconstruction and recall framework for subsequent lessons. A figure depicting the money cycle and a chart showing the fundamental relationships of economic knowledge are attached. (Contains 23 references.) (LH)

Imagery Teaches Elementary Economics Schema Efficiently

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Paper Presented at the Annual Meeting of
The American Educational Research Association
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When social studies was created, it was supposed to be psychologically scientific; neither behaviorists nor developmental stage theorists believed children could learn or reason with ideas in those days. Instead the child centered master planners who followed G.S. Hall's genetic stage theory proposed to "develop" good citizens by engaging them in activities that would shape or evolve them "naturally" to conform to traditional or utopian norms (Kliebard, 1986). Elementary social studies prospered until World War II, when both culture and psychology reversed. After the war Americans rejected master plans to mold children as totalitarian and recognized that powerful ideas in science and humanities had to be transmitted to the masses to improve lives and support free decisions. Real psychologists replaced the behaviorist and developmental theories that limited instruction to developmental activities with cognitive theories of development and learning that attributed thought to learned knowledge, ideas, and thinking strategies.

Thirty five years ago, Lawrence Senesh adapted to the new demands and theories, proposed a paradigm shift in elementary social studies curriculum, and illustrated his vision in Our Working World (Senesh, 1963). Senesh proposed that first graders could learn, understand and use a working model that integrated the basic concepts of economics into a working model much like the organized networks of powerful ideas psychologists today call a schema. Unfortunately, Senesh's curriculum was

ahead of its time and instructional technology. Developmentalists assumed the new curriculum was too difficult, and the activities Senesh proposed to elicit the ideas were not powerful enough to overcome their doubts. Only isolated concepts from the model were adopted into school practice; the vision of teaching an integrated framework of ideas to all children was shelved in the return to the developmental activities curriculum of the Great Society.

Of course cognitive psychology replaced older behaviorist and developmental stage theories (Parke et. al., 1994) that justified low academic expectations and shaping citizens with theories that suppose teachers can provide verbal rules and then guide pupils to learn and think with the new ideas. (Gagne', 1980; Anderson, 1990; Shunk, 1996, Vygotsky, 1963). The new field of instructional design demonstrated effective, elegant ways to teach verbal information, concepts and principles (Gagne' and Briggs, 1979), and studies of teacher behavior and student learning in elementary classrooms described teacher behaviors in high achieving classes (Brophy and Good, 1986) that correspond point for point with the instructional design model Gagne' deduced from theory (McKenzie, 1980).

Now the National Council for the Social Studies has issued curriculum guidelines that call for higher academic expectations and encourage teachers to teach heuristic or powerful ideas. Brophy and Allemaine (1996) in particular have noted the need for elementary teachers to teach networks of interrelated ideas and the relations between them. Integrated schema allow students to reason backward from an observation to a probable cause, or forward to a likely effect, or up to more abstract concepts and principles or down to examples or specific precedents, not simple isolated facts and concepts.

In a sense Senesh's idea that children should learn frameworks of ideas that will serve as a foundation for learning and encoding new

material, analyzing events, and solving problems is once again highly relevant, but this time the old pessimistic assumptions have been exposed and there are fewer restrictions that limit teachers. The problem now is to figure out how a teacher can teach a whole integrated network of ideas effectively enough to function as a foundation for later learning and a working model for problem solving to young children who come into class with only scattered bits of unorganized knowledge and limited study skills.

The purpose of this paper is to describe, explain and demonstrate a simple and powerful technique of using visual imagery to teach young pupils a network of ten to twenty propositions and the relationships between those propositions in a single lesson with good recall and comprehension. The author believes this technique is at least a first step in teaching the foundations of a new schema.

Cognitive Learning

Since 1960 developmentalists like Hunt (1962), Vygotsky (1963) Di Vesta (1982) and Parke et al, (1994), and learning theorists like Bruner, (1960), Ausubel, (1962), Gagne (1965), Anderson (1990) and Chi and Glaser, (1985) have agreed that children do learn and store different kinds of knowledge in organized mental networks social scientists call models and psychologists call schema. There is practically a consensus among psychologists that children and adults learn, store, draw on and use ideas from their schema to understand speech and text (Anderson, 1990); to encode new stimuli into useful long term memory (Gagne, 1985; Schunk, 1996) and to solve problems (Gagne, 1980, Chi & Glasser,1985; Schunk, 1996.)

Schema Organize Ideas into Useful Models

Conceptions vary slightly, but most psychologists agree that these mental models or schema consist of mental images, verbal facts such as case studies, stories or examples, standard classification rules called

concepts, and correlations or causal relations among concepts called principles, and, of course, the relations between the pieces. Presumably schema in poorly structured domains of "street knowledge" develop slowly by aggregation on a "hit or miss" basis as individuals perceive and process experiences from a variety of sources and discuss their perceptions and experiences with others. On the other hand, humanists, linguists and most cognitive psychologists, social cognitive theorists and probably most social constructivists suppose that denotations of similar networks of ideas must be shared among individuals within a "discourse" to allow communication, cumulative research and elaboration, and agreement on how particular variables interact to predict events. Thus one basic task of formal education is for teachers, who know the complex working models laboriously developed and used by specialists in highly structured domains, to lay out a foundation schema similar enough to common usage to allow students to comprehend that they read, analyze complex events and systems in conventional form, and draw inferences about causes and effects that would be plausible to other informed people. Even Vygotsky (1963) agreed that teachers must provide the verbal signs and symbols (words, concepts, principles) for students to internalize and use as tools of thought in his sociohistorical developmental theory.

In a complex domain like economics, elementary children come to school with some knowledge of common phenomena, but their knowledge of formal systems beyond their immediate experience is often too incomplete, superficial and disorganized to function as schema. For example the third grade children usually know that food comes from grocery stores, that machines and clothes they buy are made someplace, and that people build houses. Some have not related factories to farms and others have not related homes to farms or factories, or realize that farmers shop in grocery stores. Most know banks are places that keep

money safe, but fewer know they make loans, and some children have never known anyone who got a loan, capitalized a business or made or sold a product. Very few children have an organized network of ideas that explain how all these phenomena fit together. Social developmentalists like Vygotsky (1962), and cognitive learning theorists almost by definition Gagne' (1980) suppose the shortcomings in a child's schema and understanding are gaps in learnable knowledge and thus correctable by instruction, not some genetic, racial, social class, developmental or learning style defect inherent in the child, as Hall and the followers of his pessimistic stage theory assumed.

An organized schema in a new domain could begin as an experience where one lives through a complete meaningful process, as a novice teacher might begin to form a schema of teaching in an inner-city school by serving as an aid or student teacher. Many of us probably begin to form schema around a narrative story when enough familiar events are mentioned to string together a chain of images and events ... like reading the Iliad or Parkman's Oregon Trail forms a linked series of events; the skeleton provided by the narrative can later be elaborated on, added to, changed and expanded into increasingly elaborate schema that extend to Greeks or wars or epics, pioneers and so on.

Learning Schema

Decades ago, David Ausubel (1962) proposed that complex meaningful verbal information (like a description of the ideas and practices of Bhudism) could be taught and understood by verbal means if the new ideas could related to some similar pre- existing knowledge already stored as a complex model in the learners' mind (like ideas and practices of Christianity). Other verbal or visual devices might also be used to organize disparate ideas into a working model in a well structured domain if the terms used are already meaningful to students. An especially good

example of adult schema learning in a well structured domain from a diagram or concept map occurs when elementary teachers who have never taken an economics course learn the diagram that Lawrence Senesh (1963) developed and called the conceptual structure of economics and are guided through the way the conflict between unlimited wants and limited means necessitates ways to maximize potential ... like specialization ... which necessitates some exchange process like the market, and so on.

In all these cases, the more sophisticated learner brings extensive previously learned knowledge to the lesson, and the logical links and narrative constraints between meaningful elements forms a framework that is easy to remember and use to trace events backward and forward. As new related sources are read, the old story can be recalled and used to interpret or encode the new information. While teaching schema to children might be the same in principle, teaching even the base relations for a schema to young children with limited experience, limited abilities to read, and limited interest, attention and study skills in heterogeneous classes is more difficult that teaching more experienced and strategic adults.

It is impractical, frustrating and probably cruel to pretest uninstructed children's knowledge of a new domain before teaching anything, and if we could, differences in prior knowledge (in economics at least) would be so great that a single teacher might not be able to design and deliver enough individual lessons to patch all the different knowledge gaps without loosing of class interest or cooperation. Teaching isolated concepts does not necessarily teach the linking relationships that make the concept a functional element in the larger network. Young students probably will not try to remember or even think their way though the chain of complex facts that are delivered together. Furthermore, young children who might be able to learn a new schema if they tried might not

perceive the details in an experience ... especially one like a simulation game where those who do know the solution cognitively may benefit from practicing application of their knowledge but children who not know the trick to the solution and need most to learn the missing elements simply fail and learn a network of bad feelings about simulations (McKenzie, 1979).

Imagery Aids Complex Verbal Learning

Learning theorists Levin, Schriberg and Berry (1983) developed a method of using keyword mnemonics and mural- like pictures that integrate and symbolize verbal details into a single mental image students could use to encode and recall four facts about each of ten cities in a short period of time. This general method has been widely enough tested that there is no doubt that it "works" to produce remarkable recall. Belezzia says mnemonics of this general sort share many properties of cognitive schema, except that students can not reason across propositions very effectively with mnemonics. Whatever is going on in pupils' heads is active and productive; and the processes of imagery and organization of ideas into verbal "stories" are recognized as important learning strategies in Weinstein and Mayer's (1986) archival review of research on learning strategies.

Although the original intent of Levin's integrated imagery was apparently to enhance learning and recall of a few facts about each of many things, it is possible the method can be adapted to learn how many details interact in one system to form complex understanding of some particular phenomena. The author and his students have worked with and perhaps bent Levin's imagery technique, and combined it with principles of achievement motivation (Atkinson & Birch, 1978), verbal chaining and narrative learning (Gagne, 1985) for more than a decade. In fact, we find that elementary pupils who learn a "mural" image with explict logical

relations between propositions can reason backwards and forwards to trace events to causes or consequences, as Belezzia (1987) says students can do with schema. We believe the networks of ideas function enough like organized schema to lay meaningful foundations for new areas of study.

Assumptions

We believe one important task of elementary social studies is to help young children learn organized schema or working models of how events relate in new well structured domains. For example, whether one calls it economics or not, children should have an idea of how savings capitalize loans, loans buy equipment and raw materials that enable production of goods, which are sold to retailers who, in turn, sell to the public ... and that profits at each stage of the process not only buy consumer goods but pay off loans and become savings to capitalize new production.

We agree with Dewey and Vygotsky and more recent cognitive theorists like Anderson, Ausubel, Bruner, Chi, Gagne, Rothkopf and others that there are environmental conditions that enable new learning which teachers can affect in the instructional process, and with instructional design and teacher effectiveness research that effective teachers provide as much structure and guidance as necessary to insure the students attend and process the information more or less as the teacher intends. Thus we go many steps beyond low- structure discovery methods, and several steps beyond a lecture approach to teaching. We not only present an objective and provide a clear statement of the ideas to be learned, we also lead children through an appropriate study procedure we know will work to elicit successful content learning, which, incidentally, models study strategies that help children learn independently by modeling and guided practice at the same time.

Procedure

We suppose elementary students are not aware enough of economics to form structurally basic and achievable heuristic objectives, so in introducing lessons, we inform pupils of objectives from our adult knowledge of what educated people understand and use. Second, we show students when and how the content is worth learning in authentic situations to prove it's incentive value. Third try to elicit dissonance and focus motivation with prequestions students can not yet answer. Then fourth, we tell students in general terms which of several particular study strategies to use in order to make the days' learning easy and effective; in mural lessons we tell pupils to "memorize the mural as we explain it so they can visualize and draw it from memory". Each of these four teacher moves is highly supported by cognitive models of learning like Gagne's or Rothkopf's (1970), by achievement motivation theory (Atkinson & Birch, 1978), by social cognitive learning theory (Schunk, 1996) and by learning strategies research (Weinstein and Mayer, 1986).

Next, we try to present the new information in the memorable way Levin et al (1983) pioneered. We isolate a cue word or title that will appear often in text or speech, and link it with a mnemonic that prompts recall of a particular distinctive graphic feature in the mural (The "money cycle" starts rolling at the bank.") Then we display the bank graphic and explain as briefly and clearly as we can what happens at each step in the process. We try to build meaningful verbal links to chain chunks of events at one icon, to its consequence in the next step so there is a story structure verbal chain as well as a graphic to aid recall.

After explaining eight to ten propositions in this chained manner, we remove the illustration and ask three kinds of guiding questions to prompt students to process and practice material in specific ways. "When I say ("Money Cycle") what do you link it to in the picture?" prompts pupils to rehearse the mnemonic link that helps students locate the right scene from

many others in long term memory. Then, pointing at the spaces where respective items were in the graphic, we ask "What was here?". This spatial question cue prompts students to mentally visualize and reconstruct the image because there are no other hints or ways to answer the question except to visualize the now absent diagram. When the image seems to be in mind and available as a prompt to all students, we ask "Wh" questions to elicit explanations (comprehension) of what, why or how the step is performed, which, of course, assures reconstruction of the verbal information presented in the teachers' original explanation. To the extent that pupils successfully recall the mnemonic and images, they can answer questions, will feel successful and are willing to try more. Then we put the illustration up again and finish showing, telling and guiding practice as before.

Over the past decade, we have accumulated very convincing data in addition to Levin's, in a formal well controlled dissertation (Lind, 1986) and literally dozens of uncontrolled field tests by the author an numerous student teachers that elementary students from grade one on learn recall, and can explain networks of ten to fifteen propositions ... with class averages on post tests that average 93% correct. Rather than report these studies in detail, we believe we can demonstrate the effect more clearly and convincingly than we could with anecdotes or numbers by providing a lesson plan with the supporting graphic so readers can test the idea for themselves with their own students.

Demonstration

Money Cycle Main Ideas: People borrow money to start businesses, some extract and sell raw materials to manufacturers who make resources into goods and sell them to retailers, who market and sell to the public. People use income to buy the goods they need, pay off loans and save, and savings capitalize new loans.

Insert Fig 1 about Here

I. Objective: When asked to describe "the money cycle", students will describe a farmer getting a loan (at 10%) to buy a tractor, and promising to repay or forfeit land. The farmer buys the tractor and grows cotton and wheat, which are sold to food and cloth manufacturers. Bread and clothing manufacturers also get loans to buy start up equipment, make goods and sell their goods to retailers, who also get loans to capitalize their stores. The same steps are repeated in mining and manufacturing, and lumber and building. Then, when everyone has produced their goods, everyone takes their profits to buys goods, pays loans and save money in the bank, so the cycle can start over.

II. Learning Set:

A. Tell pupils the purpose of the lesson is for them to describe and draw at least fifteen steps from memory in the money cycle that shows how people get money to start businesses, to whom they sell their goods for profit, and what they do with their income to keep businesses going ... and be able to tell what would happen if a part of the cycle broke down.

B. Explain that knowing this story will help children to understand where money starts out, where it goes, how businesses work, and what can go wrong so they can understand adult talk and economic news, and someday they might set up their own business.

C. Tell pupils it costs $50,OOO for a farmer to buy a cheap tractor; ask for hands if anyone knows how a young person would get that much money to start a farm.

D. Tell pupils they all have a photographic memory so it will be easy to remember if they photograph the mural you are about to show with their eyes and remember where the parts are so they can draw it.

III. Mnemonic:

Tell pupils that when they hear the words "money cycle" or "loans", they should imagine the lady getting the banker to loan her money to start a cycle we will imagine in a circle like a bicycle wheel. Then show the OHT graphic and point out the lady getting a loan at the bank.

IV. Present Input:

A. Food

1. Explain the lady and her husband own some land and want to start a farm but don't have enough money to buy machinery like the tractor. So she asks the banker for a loan, and promises to pay all the money back plus $.10 extra for every dollar in interest so the banker can make a profit. The banker agrees, but adds that if she does not repay, he can take the land she owns in payment. The lady agrees, gets the loan, buys the tractor and (shift attention to the farm scene) she and her husband grow wheat and cotton ... which they want to sell to bread makers and clothes makers.

2. But the baker also needs money to pay for the wheat to make flour, and to buy milk, ovens, and packaging ... so the baker goes to the bank and gets a loan, promises to repay with 10% interest, or turn over his bakery to the banker. He bakes his bread and wants to sell it to the grocer.

3. But the grocer also needs money to buy food for the store and set up refrigerators and cash registers. so the grocery store owner also goes to the bank and gets a loan. promises to repay with interest or give up his building ...

B. Clothes

1. The same three things happen with selling cotton to tailors, 2. selling clothes to department stores.

V. Review Questions

Remove OHT and ask, When I say money cycle, what to you see in your memory that shows where the money starts.? (Point to the blank space where the bank was on the overhead.) Who is standing here? What does she ask for? What does she agree to pay back? What does the banker get if she breaks her promise to repay?

(Point at the now blank space where the farmer was on the overhead and ask (What was here in the picture.) Tell what he did! And , who does he want to sell to here (pointing at the baker's place in the space)?

What does the Baker need to get started? How does he get it? And who does he sell his bread to here (Pointing at the grocer's place.)

(Point to the Taylor's place and ask.) What was here? Repeat questions for tailor like those for the baker.

Then replace the mural and continue explaining:

VI Presentation # 2 Replace the overhead and continue to explain:

C. Machinery

Describe the same three steps where

1. Miners get loans for to buy equipment for mining and oil drilling.
2. Manufacturers gets loans to buy ore and machines.
3. And retailer/ garage mechanic gets a loan to buy parts and tools

D. Buildings

Repeat the same presentation procedure starting with the logger.

1. Loggers get loans to buy trees, saws and trucks.
2. Builders get loans to buy boards, and pay workers
3. Developers get loans to buy lots and houses.

(Optional. Review the minerals and lumber sequences with questions as before: Remove the graphic, point to the extractive industry space and ask what was here? Where did they get the money to start up. What did they produce> To whom did they sell .... here? (point to a space.).

E. Consumption

Replace the overhead and go on. Now, with the money he made, the farmer goes to buy groceries, clothes, gas, & puts a down payment on a home, pays off his loan and saves a little money at the bank.

Everyone else buys finished goods from everyone else, pays loans and saves in the same way.

VII Review Questions again, using the same three types of questions as before"

What does money cycle remind you of?

What was here (miner or driller) . How did he get the money to start up and what did he promise?

What was here (Factory or refinery) How did they et the money to start up?

What was here (Logger) Etc.

Then what five things did the farmer, and everyone else do with the money they took in?

VIII. If you are not sure of mastery, pair pupils into heterogeneous cooperative groups and have pairs draw or write up the cycle from memory.

Or

If you think students generally can visualize and explain the mural, ask probing questions about what chain reactions would happen if one or another of the elements experienced a disaster., (E.G., If a hail storm kills the farmer's wheat crop? What would the banker do with the land? What would happen to the baker? How might the baker get back into production? What would that do to his production costs? To his sales price to the grocer? What would happen if a panic occurred and all savers withdrew their savings from the bank ? What would happen to the banker if the government increased income taxes greatly on the money available for savings?

V Closure

Finally, Ask pupils to raise hands if they can "see" the picture in their memories. How many of them understand how the money cycle works. How many learned a lot?

Some Observed Outcomes

We have a number of observations, case studies and quasi - experimental studies that suggest a variety of promising outcomes. For example the author taught 48 propositions describing customs of six culture groups of Native Americans in a single fifty minute period in September and the teacher had the 11 year old students reconstruct the information the following day from memory. In March, the teacher gave an open ended test ("Describe as much as you can remember about Indians of the Eastern Woods, the Great Plains, the Great Basin, Southwestern Pueblos and North West Coast) and the average student was able to describe 40 propositions; the teacher reported that nearly all students reported the could still "see" the murals in their memory.

We have anecdotes and videotapes that illustrate body language and question answering behavior that imply intense observation and listening in intact six to twelve year old classes in urban, suburban and rural schools for periods of a half hour up to ninety minutes. The combination of a clear introduction, a clear procedure, a good, logical story (especially with colorful details), and the success on practice seem to reduce off- task behavior very consistently.

We have semester a project study in which high school students who were taught to remember and describe a graphic Civil War infantry engagement before reading the Red Badge of Courage reported they visualized the action and appreciated the horror and courage more than students who were not taught the pre- reading imagery lesson. We have several similar semester project reports that elementary grade students

who are taught "mural" lessons showing players, roles and relations in Three Branches of Government, or Austin City Government Services, or the flow of currency through The Money Cycle can typically answer both recall and inference questions about what would happen in one part of the system if a variable were changed in another part of the system several links away by mentally tracing effects across adjacent links. For example, with a little patience, some prompting, or some time for pairs to discuss answers, it is not uncommon that pupils will infer that a large tax increase would reduce savings, that reduced savings would raise interest rates, and higher interest would reduce loans and business expansion. We also think high achievers seem more likely to work with students who are typically low achievers as equals when the low achievers know the content.

Finally, we are aware of the traditional concern that teaching content directly may inhibit students from learning to learn for themselves. We have one reasonably well designed experimental dissertation (Lind, 1986) that compared three treatments of randomly assigned fourth graders that illustrate the opposite. A control group studied prose descriptions of four regions of Texas with isolated (cartoon box) illustrations, a second experimental group studied the same passages and was guided to memorize murals of each region composed of the same drawings as the control saw but integrated into a chained scene by the direct teacher centered method modeled in the money cycle. The third group was given the same prose passages and taught to convert the scene into a self-made mural as a study strategy, and practiced reading and constructing their own integrated images on three other regions. On a recall test after the fourth lesson, the second (prefab mural direct instruction) group scored higher than the other treatments on recall of previously studied information, presumably because the teacher made the learning easy. Then students from all three treatments were given a new prose passage with no illustration and a

blank sheet of paper, and told to "learn the new region description by their own best method for a quiz next week" as a test of strategy transfer. To our surprise, all students spontaneously drew illustrations like those they saw during treatments, and the second (prefab drawing) group scored significantly higher than the others, including the group that was trained to draw their own murals. Lind concluded the second group was motivated by their success on the prior lessons to learn the strategy ... and learned its focus was on learning, not drawing. Presumably the teacher modeling the strategy in organized content learning four times was effective enough to teach students how to use the learning strategy for themselves.

Importance

If students can remember images of all the parts of a network of elements of an integrated system, the image seems to form a meaningful framework that students can reconstruct and recall for subsequent lessons. With that network or model in mind, all students have a similar domain-specific foundation to build on when later lessons elaborate component concepts and principles into useful intellectual skills. Note that the five examples of "natural resources" and "extractive industries" (at the hub) of the money cycle, the five examples of "manufacturing" in the second ring (which are non -examples of resources), and five examples of "retail" services in the outer ring, (which are, of course, non -examples of resources and manufactured goods) will serve as examples in subsequent lessons on the respective concepts, which can be extended into principles that relate resources to goods, or goods to retail sales, ... or profits to sales and savings. Together, the mural provides many examples of labor, capital, and capital goods, and so on. More complex principles can then be added to show how shortages or demand can affect choice of goods, for example, or how non-producers (that could be added to the system) affect consumption, savings and subsequent capitalization.

If we are correct, the method allows teachers to accelerate instruction and fill in gaps in direct experience, and to teach memorable mental structures with some of the combined verbal and imagery qualities that come from experience. Again, we believe integrated imagery forms mental models that function like incipient schema.

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Figure 1

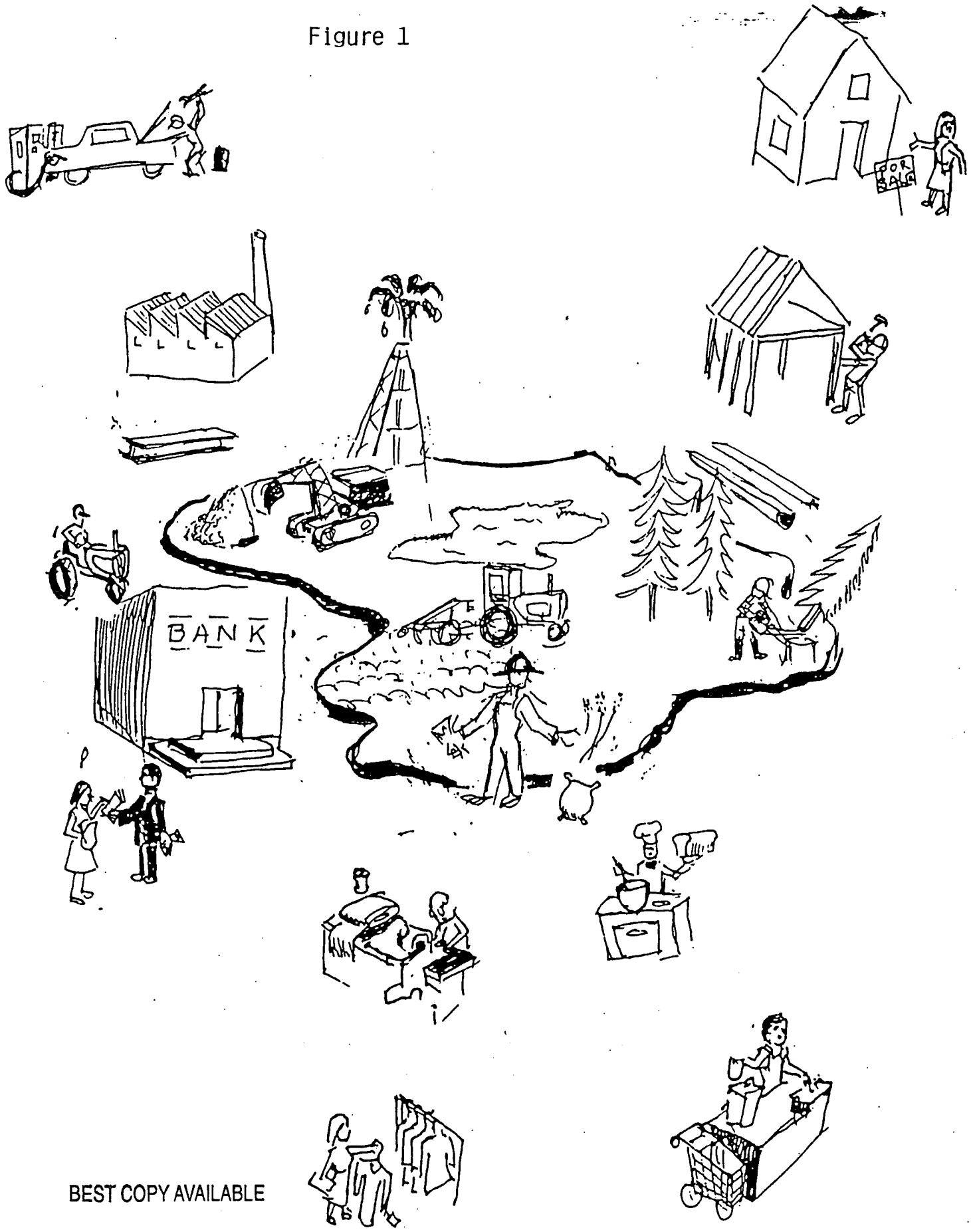

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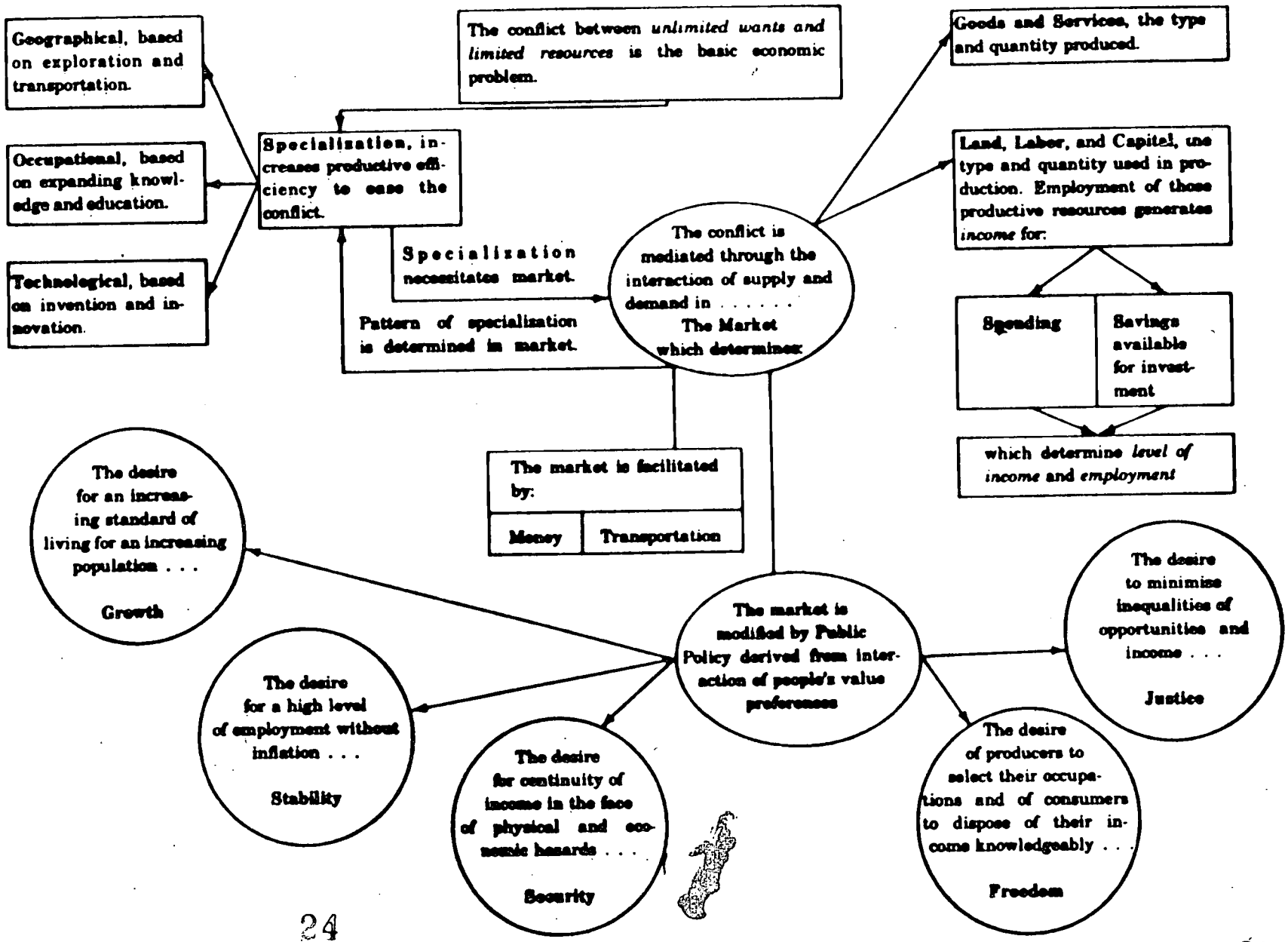
CHART I

THE FUNDAMENTAL IDEA RELATIONSHIPS OF ECONOMIC KNOWLEDGE



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