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ABSTRACT

Effective teaching strategies must be developed to help students bridge the gap between concrete operational thinking and full formal thinking in the content areas. Reading for meaning requires readers to categorize subjects, recognize relationships, develop and maintain a sequence of thought, recognize and understand inferences, and draw conclusions. Teachers must teach students to (1) recognize the impact of certain key words that provide cues for forming hypotheses; (2) make inferential deductions by showing them explicitly how an argument is developed by an author; (3) ask questions and consider possible answers to them; (4) compare and contrast, a productive linking exercise that develops decision-making abilities; (5) organize information by examining structure apart from content, such as in hierarchy development; (6) see more than one side of an issue and generate all of the possible interrelationships between the components of particular situations; and (7) be critical thinkers, alert to the subtleties in the material they read. In addition, teachers can use charts and graphs to encourage students to raise questions, spark group discussions, draw attention to the concept of variable as opposed to static situations, heighten the level of classroom motivation to examine material carefully, and demonstrate the interrelationships between several disciplines. (JD)

BRIDGING THE GAP FROM CONCRETE TO FULL FORMAL THINKING IN THE CONTENT AREAS

by

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Recognizing that many high school students have not attained Piaget's level of formal operational thinking, parallels are drawn between the way concrete and formal opeartional thinkers read. Using a Piagetian framework, the authors develop teaching strategies to provide the missing links needed for developing concrete thinkers into full formal thinkers.

BRIDGING THE GAP FROM CONCRETE TO FULL FORMAL THINKING IN THE CONTENT AREAS

Getting meaning from print, i. e associating symbols with meaning, may be an oversimplified definition of reading; however, the primary concern of this paper is not the decoding aspect of reading but the development of the thought processes necessary to conceptualize what the student is decoding. This process is dependent on the reader's general cognitive maturity since he must be capable of forming hypothesis, recognizing relationships, and drawing logical conclusions as he reads. In order to develop concepts through the act of reading, the reader must actively use the intellectual process to develop and integrate relationships into a new idea or notion. This requires the logical analysis characteristic of the formal operational thinker who considers the possible as well as the probable.

Although it was generally assumed from Piaget's work that children move developmently into formal operations at about 12 years of age, later researchers found that, in reality, many adults never reach the formal operations stage of cognition (Epstein, 1978, 1980; Day, 1981). While secondary school and college classes are taught in a manner requiring formal thinking processes, only one-third of the high school students and two-thirds of the college students are actually formal operational thinkers (Chiappetta, 1976; Juraschek, 1974; Silverman, 1978). Piaget acknowledged these findings by maintaining that while not all adults develop fully formal operational thinking processes, they all have the potential to do so (Day, 1981).

THINKING STRATEGIES OF CONCRETE AND FORMAL READERS

To bridge the gap between concrete operational thinking and full formal thinking in the content areas, we must develop effective teaching strategies which will provide

the missing links needed for students to develop into full formal thinkers. Let us look at how the formal thinker reads.

His approach to the printed word differs in several respects from that of the concrete operational child. First, the formal thinker is likely to use better judgment as to when skimming is an appropriate way to read, and furthermore, he can do so effectively. The concrete thinker is more apt to read everything at the same speed getting lost in unimportant details.

Second, the formal operational reader is able to construct tentative hypotheses based on what he already knows, to accept or discard events or details as he tests his hypothesis, and to conclude with a well developed concept or at least an adequate understanding of the main idea. The concrete thinker is less likely to integrate what he already knows with what he is reading. Instead, there is a separation between his world and what he reads making concept integration difficult, if not impossible.

Third, the formal operational reader can ignore the face value of words and consider their meaning in terms of the context in which they appear. He can pull together what he already knows and interpret inferred meaning. The concrete operational reader has difficulty reading between the lines; therefore, subtle meanings are lost to him.

Consider "The Jewbird," a short story by the late Bernard Malamud, as an example. This story is about a talking bird and a family living near New York's lower East River. It opens with descriptive language that the more fluent formal operational reader wonders about and hypothesizes about from the start. More likely, the concrete operational reader reacts with acceptance and less questioning than his formal operational counterpart.

The bird enters the Cohen family's apartment through an open window and flies past an escaped canary cage. The fowl is skinny, has frazzled wings, and lands right on Harry Cohen's lamb chop. Mr. Cohen swats at the bird and curses at it, and to the

reader's astonishment the bird does not chirp or caw. Instead, it says, "Gevalt, a pogram!" The formal, fluent, questioning reader is delving into the scene mentally with such wonderings as these: How will this all end? Of what importance are the escaped canary cage, Cohen's occupation in frozen foods, and the lamb chop? Who is this bird, anyway? What does the title really mean? This formal operational thinker forms hypotheses, makes inferences, and gathers evidence from the start to build a structure within which to comprehend the story fully. He looks not only at the story, per se, but also beyond it into the world of possibilities. The concrete operational thinker focuses on the details of the story to catch the events, just as the formal operational thinker does. It is much less likely that the concrete operational reader will spontaneously make the leaps ahead and even beyond the story surface that the formal operational thinker does.

From more recognizable Piagetian contexts come recollections that the formal thinker wants not only to understand the situation immediately at hand but also its implications for such cases, generally. In exploring equilibrium in the balance, for example, the formal thinker wants not only to make a given balance come to equilibrium, but to figure out how balances operate in general. The given balance is simply one example of such devices. For the concrete operational thinker, the consuming task is to find a way to hang weights to bring that apparatus before him into equilibrium. That task done, the project concludes for the concrete operational thinker.

These same intellective phenomena apply in reading patterns of concrete and formal operational thinkers. The striving beyond the story line in "The Jewbird" is the formal operational thinker's effort at achieving equilibrium in a frame of reference where the words and facts can symbolize more than a mere tale of a black bird and a family. For the concrete operational thinker, on the other hand, the events of bird and family constitute the whole story, period.

Due to the differences in the thought processes of the concrete operational and formal operational readers, the higher level comprehension skills needed to read and understand material presented in the content areas may not have been developed by many students.

CUES FOR FORMING HYPOTHESES

The concrete operational reader will benefit from instruction that teaches him to recognize the impact of certain key words in the textbook, for he is inclined to attach no specific importance to them. For example, some cues signal seriation such as "first," "second," "next," "then," "finally," and "in conclusion." These words should provide a mindset for the reader that an important sequence is being provided by the author.

Other cues alert the reader to contrasting ideas such as "however," "nevertheless," and "but" indicating that he should look for another point of view. Cause and effect is predicted when the author uses "consequently," and "then," and an explanation is imminent if the words "because," or "so" are present.

MODELING FOR INFERENCE DEDUCTION

Cue words are unpredictable in detecting an inference. In order to recognize an inference in a reading selection, the reader must first recognize the thought pattern developed by the author, and then associate it with his own experiential background. This behavior is more difficult because generally there is not any specific cue word for which to look. What the student must be alert to is the word or phrase that links information in the story with information in his experience. Raphael (1986) calls this "In My Head" information stating that students tend to overrely "... on the text, not considering the wealth of information gained from their many experiences."

In modeling how to detect and understand an inference, the teacher must share his/her own thinking process being explicit in how the inference is being developed by the author. Then instruction should focus on pointing out the specific phrase or

word that sparked the first idea of an inference and explain why it caused a change in the teacher's thought processes. Next, indicate which two sentences, for example, helped make the key connection. Finally, the teacher relates the "In My Head" information that made the passage more meaningful. This is the kind of modeling a teacher must do before asking the concrete operational reader to understand inferences. It is not enough to ask questions, the teacher must model for the student how to raise questions and consider possible answers to them.

COMPARING AND CONTRASTING

Learning to compare and contrast two things is a productive linking exercise in developing the ability to construct hypotheses. In order to compare and contrast phenomena, two divisions are involved, one for attributes of similarity and another for attributes of difference. In the social studies, for example, a reading assignment can include this approach by asking students to compare and contrast different countries' economic or social systems, historical figures, or geographical areas. The teacher may lead students in comparing and contrasting social and political conditions that occurred in France just before the French revolution with the conditions along those same dimensions prior to the American Revolution. The teacher can extend this activity to include more current and relevant events. For example, students can relate this previous work to the political and social upheaval in South Africa; they can make predictions based on their conclusions.

Not only does decision making require the ability to compare and contrast phenomena, it also requires synthesis. Formal and concrete operational thinkers use difference strategies in synthesizing. Formal operational thinkers construct a rich framework within which to respond, because they understand that situations may be examined along many dimensions. They can generate a range of possibilities and select the ones that apply. Thus, the formal operational thinker can set current experience

into a context of multiple possibilities. Concrete operational thinkers generally do not go beyond the current situation in their approach to questions like these. They hunger for structure because they do not have as flexible an internalized structure for problem solving as do formal operational thinkers. While we can teach them a strategy, we can not expect them to be successful teaching preorganizing structures didactically.

ORGANIZING FOR PROBLEM SOLVING

Teachers should set up problems with a common structure and facilitate the processes needed to organize for problem solving. For example, students can study their geneologies in history, language arts, or mathematics classes. Undoubtedly, numerous families will reflect the same structure though the people themselves are obviously different. If teachers are interested in promoting concrete operational students' abilities to recognize structure apart from content, a behavior consistent with formal operational thinking, then this task will be facilitative, and probably more motivational too, than traditional activities in these areas because it is personal and non-standard. This instructional tactic leads quite naturally to building a family tree which introduces the concept of hierarchy.

Hierarchy development is a useful concept to adopt as a bridge from concrete to formal operational thinking. Concrete operational students can understand the hierarchy structure if its levels are familiar to them. Family trees work effectively for this purpose, and three generations are enough to form the structure of ones own family tree. Students can draw their own generational hierarchies, and they can share data and draw generational graphs with friends. The objective is for the pupils to represent general structures starting from their own families. Some families share the same structure and others do not. This activity enables concrete operational students to examine structure apart from content, a behavior more typical of formal operations than of concrete operations.

There are other familiar hierarchies teachers can use for this kind of teaching activity. An organizational hierarchy such as the structure within a school can also be used. The military chain of command is another interesting hierarchy to draw and examine. Competitive sports, such as basketball, football, tennis, etc, that successively narrow the field from many competitors to two finalists represents another set of natural and relevant examples. These situations all enable concrete operational pupils to have experiences generating general structures from particular situations. Such behavior is typically formal operational.

Recognizing the structure of a hierarchy is an important abstract concept to learn, for it can be widely applied. What unites these diverse situations is their structure. If we can challenge concrete students to discern and describe the invariant qualities in such instances, we create the kind of conflict that leads to formal operational thinking (Cowan, 1978). Inducing cognitive conflict can lead to recognition of other possibilities if the teacher uses the appropriate strategies, including questioning, at a level requiring thinking beyond simple recall and comprehension.

NEW VIEWPOINTS

Learning to see more than one side of an issue is a mark of maturity and can be cultivated by an objective look at two other subdivisions; positive and negative aspects of a situation. A timely topic for this thinking process is the controversy over the minimum legal age for buying liqour. High school students may not be aware of the fact that in some countries there is no minimum age requirement. A comparison of automobile accidents and the incidence of alcoholism in those countries would be pertinent information to consider. The issue of additional sales taxes derived from the sale of alcohol to 18 year olds adds both a politcal and an economic viewpoint. The positive and negative sides to this issue then take on added dimensions. The natural

tendency toward egocentricism in teenagers makes this kind of exercise an important contribution toward mature thinking and reading.

COMBINATORIAL THOUGHT

Another characteristic of formal operational orientation is combinatorial thought in which the problem solver looks at all the possibilities or combinations to find the solution. Learning situations that cause students to consider generating all the possible interrelationships of crucial attributes of situations provide experiences in combinatorial thinking. These experiences can be developed by changing values of items in different relationships.

Music and art are excellent fields for this approach. For example, the combination of notes played by a single instrument changes value when another instrument, playing the same notes, is added. Each time another instrument joins the ensemble, tonal qualities of the production change.

Other dimensions in musical compositions subject to variations are rhythm, tempo, volume, and harmony. Changes in rhythm and tempo, for example, transform "Seventy-six Trombones" into "Good Night, My Someone." While any music teacher or band director can illustrate effects that such changes in melodies produce, Dant (1985) has demonstrated the application of computing to bring such "what if" experiences to college students in the humanities.

Dant (1985) has also experimented with varying attributes in works of art by computer application, and her efforts are contributing to students' active engagement in this area. She stimulates her pupils to write about the impact of changes that they make in creations of art, music, and literature. Her students study classic works and their own productions in an active, creative fashion.

CRITICAL THINKING

Mature readers, the formal operational thinkers, are reflective and questioning in the reading process. They display a skepticism, a wariness, of matter they encounter;

and they look for evidence to support or challenge authors' assertions. They seek crucial logical links in the arguments authors weave; they imagine alternative explanations and viewpoints; and they ask themselves about authors' biases and underlying assumptions. Thus, for mature readers, the reading process is an engaging and an interactive one (Friedman and Kilodiy, 1983).

Concrete operational thinkers are more likely to take in, uncritically, the surface meaning of a written passage. They can articulate the words with few errors. However, these less facile thinkers have trouble even at the basic comprehension level in expressing an author's position in their own terms. With their deficiencies of reasoning, concrete operational thinkers are inept at critiquing the logical structure of a writer's argument, grasping the force of counter examples, or even pulling from texts, sentences to support their own impressions of the material. Such students are truly at a disadvantage in typical high school and college content courses (Friedman and Kilodiy, 1983; Schwebel, 1972; and Silverman, 1978).

The mature, formal operational reader is far less susceptible to psychologically persuasive fallacies than is the concrete operational reader. The more flexibly minded of these two types are better equipped to recognize such misuse of language and reasoning as the so called "black and white" fallacy. This fallacy can appear in various constructions, one of which is the " either/or" form. (Example: "He is either a conservative or a liberal.") The" if/then" form provides another example of this flawed reasoning pattern, as illustrated in these two statements: "If you have never been arrested, then you are an honest person," and "If you are in the armed forces, then you love war."

Mature readers can decide that such statements as these are false, and they can offer convincing cases for their assertions. For example, the mature, formal operational thinker can imagine conscientious objectors serving on active duty in the armed forces. If conscientious objectors do not love war, then their presence on active

duty contradicts the idea that those in the armed forces love war. Such analytical consideration of a passage is much more likely to occur with formal operational thinkers than with their concrete operational cohorts.

Many high school and college students are not formal operational thinkers. Traditional instructional approaches and textbook assignments, consequently, are more accessible to pupils who are formal operational thinkers than to pupils are not. Alternative instructional strategies are available and are effective. Such approaches can aid less mature readers to be alert to subtleties in material they read and to achieve understanding of what they encounter in more meaningful fashion than they would otherwise (Friedman and Kilodiy, 1983; and Cowan, 1978).

INSTRUCTIONAL EXAMPLE AND COMMENTARY

Charts and graphs provide a format within which to apply approaches consistent with the themes of this paper. The chart below summarizes population data for the Shreveport, Louisiana, metropolitan statistical area. An effective first question for an individual or for a teacher leading a group

(Insert chart)

problem solving lesson employing charts and graphs is, "What does the chart say?" The teacher may want to ask directly what information the axes represent and what information the brief accompanying narrative conveys. Such instructional moves enable the students to take initial steps at getting meaning from the symbols in the chart, that is, at reading the chart fluently.

If concrete operational thinkers tend to stick to the data at hand, they may be content with only a cursory attention to the figure. They will, no doubt, note the following features that are striking: that five age groups appear in the figure; that more folks fall in the 25 - 44 age group than fall into any one of the other age groups; that children aged 0 - 14 are the second most populous group at present; that old people are the least populous group; and that young adults aged 15 - 24 are next to last in group

[illegible]

[illegible] These insights are representative of those that concrete operational thinkers [illegible] most likely to extract from the figure. They are in a sense at the surface level of this data summary.

If formal operational thinking takes reality as an example of possibility, then what [illegible] can teachers make to stimulate concrete operational pupils toward formal operational thought patterns? If concrete operational thinkers are less likely than their formal operational colleagues to apply inferential processes and garner information that lies beneath the surface numbers and trend lines, then what can teachers do to [illegible] concrete operational students to make inferences, to extrapolate, and the like?

In answer to these questions, we suggest that teachers can

- encourage students to raise questions based on the charts and to explore their questions
- spark small and large group discussions about causes and results that the charts do not address directly
- inject the concept of variation in what appears to be a static situation
- help students personalize the chart and often heighten the level of classroom motivation to examine material more deeply and broadly than otherwise

Both approaches provide a model to illustrate that graphs offer the possibility for increasing revelations when investigators penetrate beneath the surface. Representative questions based on the above chart such as the following ones, stimulate students to use the given data to investigate non-obvious relationships and to pose related problems:

1. Use the chart to estimate the overall population for the years 1980, 1985, 1990, 1995, and 2000.

2. This chart appeared in 1982. How good was its projection for 1985?
3. What proportion of the total population do the various age groups represent for each of the years 1980, 1990, and 2000?
4. Trace yourself through this chart. Put an "X" to mark your place at five year intervals.
5. Describe in writing some of the patterns that appear to you in this chart. Speculate on the causes of patterns you note.
6. Represent this data in pie-graph form for the years 1970, 1980, 1990, and 2000. You can apply your results from Job 5 above. Compare the pie-graph representation of this data with the original line presentation. What patterns are more apparent one way than the other?
7. If you examined other communities, how well do you think these data from the Shreveport metropolitan statistical area would represent them?

These seven examples characterize inquiry that can occur in classrooms. Each job enables students to manipulate the data causing them to actively think rather than to receive passively the results of a teacher's logical examination.

The focus of these jobs, really, is on problem solving, and in the course of problem solving students do practice many of the more mundane skills that so many school districts, the public, and colleges desire. However, in typical classrooms students practice skills merely to become proficient at those skills. These examples call upon students to use their skills to draw other conclusions that they may not realize are possible with the given data (e.g., to estimate the total population of the region at various points in time).

Finally, such a strategy pulls together numerous disciplines; as here with reading, mathematics, and sociology. Wirtz (1974), wrote of "mathematics as a search for

relationships that are not obvious;" Brown and Walter (1983) and Dant (1985) argued the importance of problem posing and raising "what-if" questions; and Cowan (1978) advocated that effective teaching and learning situations establish an "optimum mismatch" between the cognitive structures of the learner and the demands of the educational tasks.

Thus, the approach that these seven jobs demonstrate is compatible with principles of meaningful, and not rote, learning and instruction. They enable concrete operational students to meet data in one form, to draw inferences, to extrapolate, to speculate, and to synthesize in a safe environment with appropriate help from the teacher. Such strategies help concrete operational thinkers move toward formal operations, a cognitive level characterized by greater facility with abstraction and greater flexibility of mind than appears in concrete operations. But even if that developmental movement does not occur, students will find themselves much more active participants and constructors of knowledge in their learning experiences in school than is usually the case with instruction that is solely verbal and abstract..

CONCLUSION

Reading for meaning requires the reader to categorize subjects, recognize relationships, develop and maintain a sequence of thought, recognize and understand inferences, and draw conclusions. Although the student is usually in the concrete operational period of thinking when he is taught to read, formal operational thought clearly correlates postively with mature reading performance; consequently, critical and analytical reading is very unlikely for readers who can not think formally.

Reading with full comprehension also requires a certain breadth of experience with the subject matter being analyzed; therefore, it is up to the teacher to provide the background experience required. Only then can the teacher discern if a faulty thinking process is to blame or a deficit of background experience being brought to

the printed page is the problem. Standardized comprehension tests are timed and can not take into consideration lack of experiential background on the part of the child being tested.

Middle school, high school, and college teachers can not assume that all students are ready for instruction that presumes full formal operational thinking. Therefore, for optimum learning to occur, teachers should utilize strategies that help students bridge the gap between concrete and formal thinking, thus empowering them to become independent readers. Perhaps this approach will curb the rising number of aliterate people, (people who can read, but do not), in our society and will "keep Johnny reading" (Decker, 1986) and learning into adulthood .

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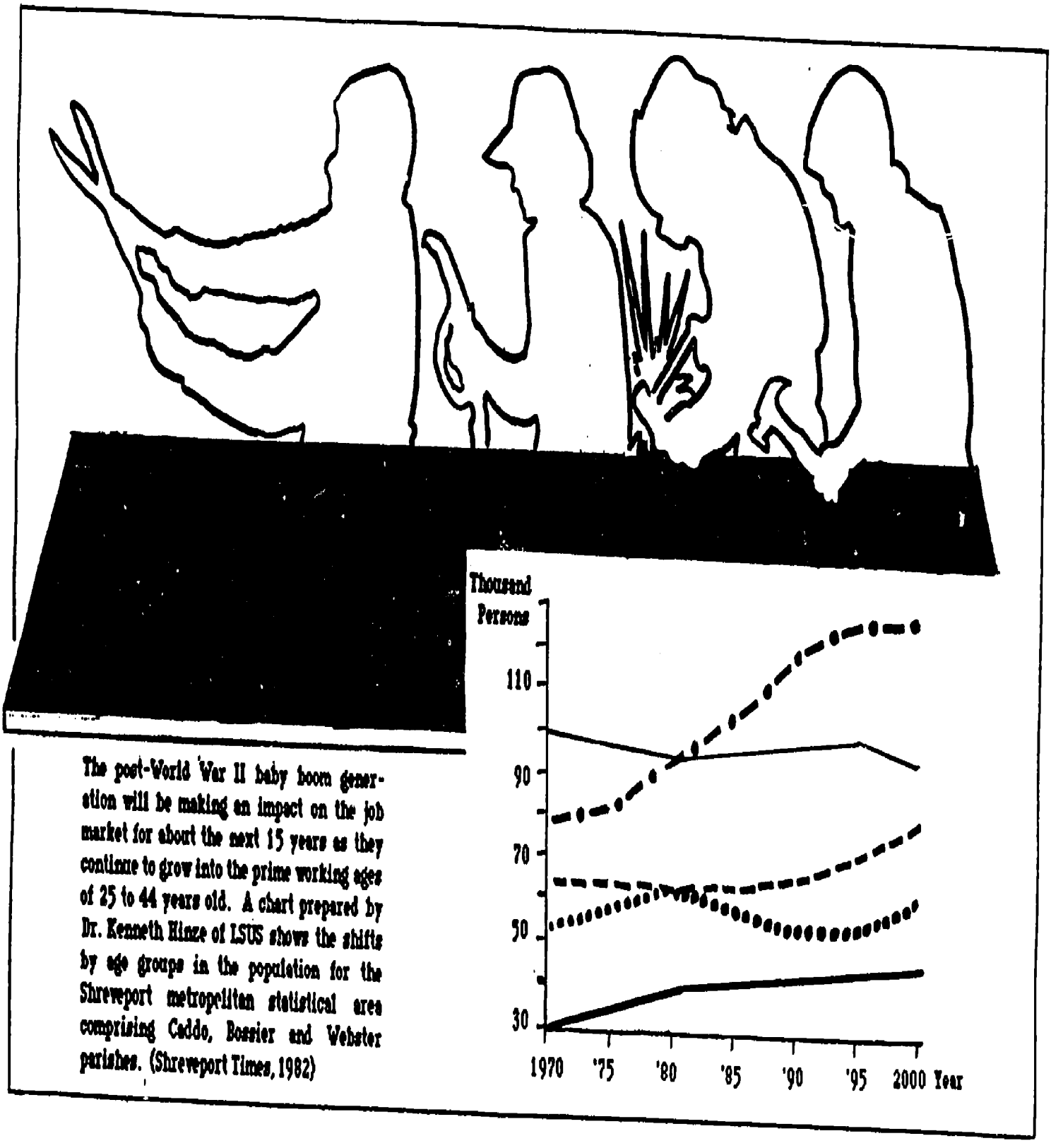

The post-World War II baby boom generation will be making an impact on the job market for about the next 15 years as they continue to grow into the prime working ages of 25 to 44 years old. A chart prepared by Dr. Kenneth Hinze of LSUS shows the shifts by age groups in the population for the Shreveport metropolitan statistical area comprising Caddo, Bossier and Webster parishes. (Shreveport Times, 1982)