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ABSTRACT

In an embedded cognitive-strategy system, learners are forced to use a given cognitive strategy prepared by the instructor, designer, or researcher. In a generative cognitive-strategy system, learners are directed to generate a certain cognitive strategy activator by themselves. This is a review of experimental and theoretical studies conducted on cognitive-strategy activators and their systems, positions, and modes. It is related to learner characteristics, content characteristics, and levels of learning and proposes instructional-design models based on cognitive-strategy activators for embedded and for generative activators. Steps in instructional design are similar for the models, with differences apparent in developing the strategy activators (embedded model) or in developing directions or training for generating activators (generative model). When to use the models is explored, and the generative model is suggested for high-ability students, while the embedded model might be appropriate with organized or familiar learning contents. These models can lay a foundation of theory on design using cognitive-strategy activators. Four figures illustrate the discussion. (Contains 140 references.) (SLD)

Title:

Under What Conditions are Embedded versus Generative Cognitive Strategy Activators Effective? Two Prescriptive Models for Designing Instrution

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The propositions of those models have raised important questions among educators generally, and instructional designers specifically. For example, " What is the best instructional system that should be used for inducing learners' cognitive strategies? is it a system in which learners should be directed to generate their own cognitive strategy activators (GS), or a system in which teachers (researchers, or designers) should prepare those activators and give them to learners (ES)? What is the best position of cognitive strategy activators should be inserted in, Is it before instruction, during, or after instruction? What is the best mode of cognitive strategy activators that should be used, is it a visual (concrete) mode, or verbal, written (abstract) mode?

To address the above questions, researchers have conducted numerous experimental studies to investigate the effectiveness of cognitive strategy activators in terms of their instructional systems delivery, positions, and modes. In those studies, the cognitive strategy referes to intellectual functioning of the human mind and the abilities to use one's knowledge through such activities as remembering, comprehension, focussing attention, and processing information (Babbs, & Moe, 1983); whereas the cognitive strategy activators have been used to mean as instructional strategy components which either request or force students to use a cognitive strategy such as adjunct questions, organizers, underlining etc... (Reigeluth & Darwazeh, 1982).

With respect to the cognitive strategy activators' system, resrearchers have investigated two kinds of system:

1- The first system was known as an Embedded Cognitive Strategy System (ES) in which learners are forced to use a given cognitive strategy activator that was prepared by the teacher (instructor, designer, or researcher). For example, requesting learners to answer questions that are given to them by the instructor to help them to acquire, retain, and retrieve different kinds of knowledge is an embedded cognitive strategy procedure.

2- The second system was known as a Generative Cognitive Strategy System (GS) in which learners are directed to generate a certain cognitive strategy activator by themselves. For example, requesting learners to generate questions to help them to aquire, retain, and retrieve different kinds of knowledge is a generative cognitive strategy procedure.

With respect to the position of cognitive strategy activators, researchers have investigated mainely two positions of cognitive activators:

1- Before (or Pre) instruction in which the cognitive strategy activators are presented before beginning instruction.
2- During and After (or Post) instruction in which the cognitive strategy activators are presented during instruction or after instruction.

With respect to the mode of cognitive strategy activators, researchers have also investigated two kinds of modes:

1- Visual (or Concrete) cognitive strategy activators in which information of it is presented in figures, maps, flow chart, diagrams, trees, etc..
2- Written (or Abstract) cognitive strategy activators in which information of it is presented in a narrated language.

The results of previous studies concerning either system of cognitive strategy activators, positions, and modes have been inconsistent. This inconsistency was due to the effect of different instructional variables (or conditions) that existed during experimentation. These variables were centered around three major elements:

1- Learner characteristics (i.e., high vs. medium vs. low ability learners ; field-dependent vs. field-independent learners).
2- Content characteristics (i.e., organized, vs. random; familiar vs. unfamiliar; content sequenced from

specific to general vs. from general to specific information).
3- Levels of learning (i.e., high vs. medium vs. low level of learning).

Research Problem:

Despite the fact that there were a tremendous number of studies that have been conducted on cognitive strategy activators, there was no single research that synthesizes the results of those studies to see whether there is a common trend of those results that helps us, as instructional designers, to design insturction based on them.

On the other hand, the cognitive strategy activators are still not considered in the models of instructional design (e.g., Dick & Carey, 1990; Gagne, Briggs, & Wager, 1992), except for an attempt by West and his colleagues (West, Farmer, and Wolff, 1992) to put a template of instructional design based on cognitive science principles. Their attempt was a good trial, but still did not specify a clear and comprehensive prescriptive model for designing instruction with respect to cognitve activators. Thus, the general aim of the current research is to try to create two prescriptive instructional design models based on the general trend of the results of those previous studies which were conducted on cognitive strategy activators between 1960's-1990's.

Research objectives:

The objectives of the current research are the following:

1- Specifying conditions for the best use of cognitive strategy activators in terms of their systems (ECS vs. GCS) , positions (Pre vs. Post), and modes (Visual vs. or Written), with their relation to three instuctional variables: (a) Learner characteristics, (b) Content characteristics, and (c) Levels of learning.

2- Proposing two prescriptive instructional design models of cognitive strategy activators to be used as a guideline for either instructional designers, developers, or teachers. The model could also be used as a guideline for learners on how to develop effective learning strategies during studying.

3- Giving recommendations for future research.

Significance of the research:

The current research represents a small but hopefully important cummulative contribution to our understanding of how cognitive strategy activators can best be used to improve students learning. The suggested modelsof this research may be of immediate use to instructional designers and classroom teachers who, in addition to making the best use of existing prose materials and software programmes, are also concerned with fostering effective independent study skills in students. Instructional developers, including those at all levels and in all contexts of education and training, stand to benefit through an increased understanding of the role of cognitive activators in enhancing learning and instruction.

Research questions:

The current research is trying to answer the following three broad questions:
Question 1. Under what conditions are Embedded versus Generative cognitive strategy activators effective?

Question 2. Under what conditions are Pre versus Post cognitive strategy activators effective?

Question 3. Under what conditions are visual versus written cognitive strategy activators effective?

Question 4. How can we design instruction with a consideration of cognitive strategy activators?

Research hypothses:

Based on the reveiw of the literature on cognitive strategy activators, the author proposed the following hypotheses. These are:

Hypothesis 1.

Having learners generate or use cognitive strategy activators would lead them to a better achievement, hence, to a better understanding and learning (Peper & Mayer, 1986; Rothkopf, 1966, 1970; Rigney, 1978; 1980; Wittrock, 1974a, 1974b).

Hypothesis 2.

The preference for using a certain system of cognitive strategy activator (Embedded or Generative),using a certain position (Pre or Post), or using a certatin mode (visual or written) depends on its interaction with different the instructionsl variables that may exist in the instructuonal situation, such as: learner's characteristics, content's characteristics, and levels of learning.

Rationale for H1 :

1- Having learners generate or use cognitive strategy activators will lead them to pay more attention to the presented materials to be learned, so the learner can process the information more deeply and store it in long term memory (Barry, 1974; Frase, 1970; Norman & Lindsay, 1977; Osborne & Wittrock, 1983; Peper & Mayer, 1986).

2- Having learners generate or use cognitive strategy activators will lead them to get involved in additional cognitive processes, and to actively relate the materials to be learned to their existing knowledge (Ausubel,1960, 1968; Mayer, 1979; Peper & Mayer, 1980; Shreger & Mayer, 1989; Wittrock,1974a,1974b, 1990).

3- Having learners generate or use cognitive strategy activators will increase their levels of motivation (Attendance, Relevence, Confidence, & Satisfaction), hence, to acquire, retain, and retrieve different kinds of knowledge on different levels of learning (Keller, 1983; Reigeluth, 1983; Wittrock,1990).

Rationale for H2:

Since teachers (or instructionsl designers) are using different kinds of instructional systems, different positions, and different modes of cognitive strategy activators, and dealing at the same time with differnet learners characteristics, different content characterestics, and different levels of learning; it is logical to get different effects of cognitive strategy activators on learining. What we intended to find in this research is whether there is a general trend of those previous studies' results with respect to those instructional variables. The aim of doing such job is to create general prescriptive design models. Hopefully, these findings can also stimulate other researchers to conduct more studies, hence, to derive more principles and add them to the suggested models for the better use of cognitive strategy activators.

Research Methodology

While the author has been at different Universities in the USA as a doctoral student, then as a visiting professor, she sleuthed information and collected data about cognitive strategy activators which is within her research interest. The information was collected from different resources at different times. These resources were basically the following:

1- The Bird Library at Syracuse University.
2- The Randall Library at the University of North Carolina at Wilmington.
3- The Main Library at the University of Georgia at Athens.
4- ERIC Documentation at SU, UNCW, and UGA.
5- Papers presented at different Annual meetings for education held at USA at different times.
6- Conducting few studies on cognitive strategy activators by the author herself (See the reference section).

From those resources, the author was able to find approximately one hundred and fifty experimental studies and theoretical research on cognitive strategy activators. They were found in different books, periodicals, dissertation abstract iInternational, microfiche, working papers, papers presented at different annual educational meetings that were held in the United States of America. Thus, the author considers those studies as the ad-hoc sample of this research. The methodolgy she followed in this research was the descriptive methodology of research.

The procedure that the author used in conducting this research consisted of the following steps:

1- Reviewing a number of previous theoretical and experimental studies that were avialable to the author, which were conducted between 1960s - 1990s on cognitive strategy activators in terms of their instructional systems, positions, and modes.

2- Classifying those previous experimental studies into three major categories:

a- The studies that have manipulated the instructional system of cognitive strategy activators: Embedded versus Generative Cognitive Strategy Activators' Systems (ECS vs. GCS).

b- The studies that have manipulated the position of cognitive strategy activators: Pre- versus Post-position).

c- The studies that have manipulated the mode of cognitive strategy activators: visual (concrete) versus written (abstract) modes.

Therefore, any experimental study or theoretical research that did not fit in these categories was excluded, regardless its relation to cognitive strategy activators.

3- Summarizing the results of those studies according to: the author's name, published year, the aim of the study, the sample size, and the indepependent and dependent variables and then the results.

4- Synthesizing (or categorizing) the results of the experimental studies according to cognitive strategy activators systems (ECS vs. GCS), positions (Pre vs. Post Instruction), and modes (visual vs. written).

5- Drawing a conclusion from each cognitive strategy activator's studies. Then, a general conclusion of all studies' results was drawn at the end of each category. The general conclusions represented the general trend of the results of the previous studies. Consequently, two prescriptive instructional design models were proposed on cognitive strategy activators to be as a guide for instructional designers, developers, teachers, and learners, in their designing instruction, teaching, or studying.

The author found from the review of the literature that the most frequent cognitive strategy activators which have been examined by researchers were alphapetically the following : Adjunct questions, Advanced organizers, Analogies, Diagrams, Heading, Mental images, Information mapping, Meaning generation, Note-Taking, Outlines, Pictures, Stories, Summaries, Synthesis, Titles and Sentences. Thus, they were chosen to be the core of the current research.

For AECT presentation within a limited time, we will be satisfied to present just the name of the authors who conducted those studies and the year of publication, plus the general trend of their results. A full report of this research containing the detailed reviews of each of the previous studies will be submitted to the "Review of Educational Research" Journal.

Literature Review and Conclusions

1- Embedded versus Generative Cognitive Strategy Activator Studies:

Much of pervious studies have manipulated the usage of cognitive strategy activators as (ECS) only. Several studies have manipulated these activators as (GCS) only. But a limited number of studies have made a direct comparison between (ECS) versus (GCS).

In the current research, we are concerned mainly with the third category of studies which compar d

(ECS) with (GCS) by using various kinds of cognitive strategy activators. The review of previous studies coverd the following cognitive strategy activators alphapetically:

- Adjunct Questions (e.g., Andre & Anderson,1978-1979; Crouse & Idstein,1972; Darwazeh.1982; Davey & McBride,1986; Dreher & Gambrell, 1982; Duell,1977; Fraze & Schwartz,1975; Helfeldt & Lalik, 1976; King, 1991; Manzo, 1970; Owens, 1977; Seretny & Dean, 1986).

- Advance Organizers (e.g., Ausubel,1960; Ausubel,1964; Ausubel & Fitzgerald,1961,1962; Ausubel & Youssef, 1963; Darwazeh,1988; Dinnel & Glover,1985; DiVesta & Peverley, 1984; Doctorow, Wittrock, & Marks, 1978; Jonassen & Cole, 1993; Jonassen, Cole, & Bamford,1992;Kenny, 1992; Kozlow & White, 1980; Luiten, 1980; Mayer, 1978,1979; Schmid & Telaro, 1990; Snapp & Glover, 1990; Wittrock, 1974a, 1974b; Wittrock & Carter, 1975).

- Heading and Sentences (e.g., Dee Lucas & DiVesta, 1980; Jonassen, et al., 1985).

- Images vs. Pictures (e.g., Anderson & Kulgavey,1972; Bull & Wittrock,1973; Carrier, et al., 1983a, 1983b; Essen & Hamaker,1990; Pressley, 1976).

- Information Maps (e.g., Ally & SZabo, 1992; Dansereau, et al., 1979; Mayer, et al.,1984; McCagg & Dansereau, 1991; Lenz, 1992; Ragan, 1991).

- Note-Taking (e.g., Bretzing, et al., 1987; Darwazeh,1993; Kiowra & Frank,1988; Peper & Mayer, 1986; Simbo, 1988; Shrager & Mayer, 1989).

- Outlines (e.g., Tuckman, 1993).

- Summaries (e.g., Annis, 1985; Harris,1992; Hooper , dt al. 1992; Spurlin, et al., 1988; Wittrock & Alesandnni, 1990).

- Underlining (e.g., Blanchard & Mikkelson, 1987; Idestein & Jenkins,1972; Rickards & August, 1975).

General Conclusions:

After reviewing the above cited studies on cognitive strategy activators, we found that the generative system is generally more effective in increasing students' learning than the embedded system. At the same time, each system has privileges over the other under certain conditions. In other words, the effectiveness of embedded versus generative cognitive system or vice versa interacts with different instructional varialbles such as, learner characteristics, content characteristics, and levels of learning.

In short, we can state according to the above studies that the Embedded Congnitive Strategy Activators are effective under these condintions:

1- Low and medium ability students (Ausubel & Fitzgerald,1961, 1962; Lenze, 1992; Mayer, 1978, 1979; Schmid & Telaro, 1990; Seretny & Dean, 1986;).
2- Field-dependent students (Carrier, et al. 1983; Kiewra & Frank, 1988;).
3- Un-trained students (Kiewra & Frank, 1988; Simbo, 1988).
4- Organized learning content (DiVesta & Perverly, 1984; Wittrock & Carter, 1975).
5-Familiar learning content (Peper & Mayer, 1986; Sharger & Mayer, 1989).
6- Low and medium levels of learning (Ally & Szabo, 1992; Davey & McBride, 1986; Darwazeh, 1982; Darwazeh, 1988; Jonassen, et al. 1992; Jonassen & Cole, 1993; Jonassen, et al. 1985; Kiewra & Frank, 1988; Lenze, 1992; Manzo, 1970; Peper & Mayer, 1986; Ragan, 1991).

Whereas the Generative Cognitive Strategy Activators are effective under these conditions:

1- High ability students (Annis, 1985; Blanchard & Mikkelson, 1987; Bretzing, et al. 1987; Doctorow, et al. 1978; Lenze, 1992; Wittrock & Alesandrini, 1990).
2- Field-Independent students (Carrier, et al. 1983; Kiewra & Frank, 1988).

3- Trained students (Andre & Anderson, 1978-1979; Essen & Hamaker,1990; King,1991; Mayer, et al. 1984; McCagg & Dansereau,1991; Pressley, 1976; Simbo, 1988; Tuckman, 1993).
4- Random learning content (DiVesta & Peverley, 1984; Wittrock & Carter, 1975).
5- Unfamiliar learning content (Peper & Mayer, 1986; Shrager & Mayer, 1989).
6-Low, medium, & high levels of learning (Blanchard & Mikkelson, 1987; Bretzing, et al. 1987; Bull & Wittrock, 1973; Carrier, et al. 1983; Davey & McBride,1986; Dee-Lucas & DiVesta,1980; DiVesta & Perverley, 1984; Dinnel & Glover, 1985; Doctorow, et al. 1978; Duell, 1977; Essen & Hamaker, 1990; Fraze & Schwartz, 1975; Helfeldt & Lalik,1976; Hooper & Rysavy, 1992; Idestein & August, 1975; Jonassen, et al. 1985; King, 1991; Kulhavey, 1972; Manzo, 1970; Mayer, et al. 1984; Peper & Mayer, 1986; Pressley, 1976; Richards & August, 1975; Snapp & Glover, 1990; Simbo,1988; Shrager & Mayer, 1989; Spurlin, et al. 1988;Tuckman,1993; Wittrock & Carter, 1975; Wittrock & Alesandrini, 1990) (See Figure 1).

------Insert Figure 1 about here------

2- Position of cognitive strategy activator Studies:

A good number of studies have investigated the effect of the position of cognitive strategy activators on learning especially by using adjunct questions or advance organizers. The aim of those studies was to see whether pre position is more effective than post position or vice versa, and when. The review of previous studies coverd the following cognitive strategy activators alphapetically:

- Adjunct questions (e.g., Ander, et al.,1980; Anderson & Biddle,1975; Darwazeh, 1982; Felker & Dapra,1978; Frase, 1967,1968; Hedgins, et al.,1979; Memory, 1980; Rickards,1976; Rickards & Hatcher, 1978; Sanders, 1973; Shavelson, et al., 1974).

- Organizers (e.g., Alexander, et al.,1979; Anderson,1973; Bauman, Glass, & Harringtom,1969; Darwazeh,1988; Graber, Means, & Johnsten,1972; Mayer,1978; Simmons, et al. 1988; Woodward, 1966).

- Synthesizer (e.g., Careson & Reigeluth, 1983; Frey & Reigeluth, 1981).

- Pictures (e.g., Carrier, et al., 1983).

General Conclusions:

The major conclusion of the previous studies on pre and post cognitive strategy activators was that the post cognitive strategy activators are more effective in increasing learning than the pre ones. However, each position has privileges over the other under certain conditions. In other words the effectiveness of pre versus post cognitive strategy activators or vice versa interacts with different instructional variables. In short, we can state according to the above cited studies that the pre CSA 's are effective under these conditions:

1- Low ability students (Darwazeh, 1982; Memory, 1983; Sanders, 1973;) .
2- with learning content sequenced from specific to general information (Frey & Reigeluth, 1981).
3- Low levels of learning (Anderson & Biddle, 1975; Andre, et al. 1980; Darwazeh & Riegeluth,1982; Fraze,1967,1968; Rothkopf,1966; Rothkopf & Bisbicos, 1967; Sanders, 1973; Simmons, et al. 1988).

Whereas the post CSA's are effective under these conditions:

1- Medium and High ability students (Darwazeh, 1982; Hudgins, et al. 1979; Richards & Hatcher, 1978; Sanders, 1973).
2- With learning content sequenced from general to specific information (Careson & Riegeluth, 1983; Frey & Riegeluth, 1981).
3- Low, medium, and high levels of learning (Anderson & Biddle,1975; Andre, et al. 1980; Bauman, et al. 1969; Careson & Riegeluth, 1983; Darwazeh & Riegeluth, 1982; Darwazeh, 1988;Fraze, 1967, 1968; Rothkopf, 1966; Rothkopf & Bisbicos, 1967; Sanders, 1973; Sagaria & DiVesta, 1978) (See Figure 2).

------ Insert Figure 2 about here ------

3- Mode of cognitive strategy activator studies:

The studies on the mode of cognitive strategy activators have manipulated mainly the visual (concrete), versus written (abstract) cognitive strategy activators. The review of previous studies coverd the following cognitive strategy activators alphapetically:

- Advance Organizers (e.g., Barnes & Clawson,1975; Barron,1971; Corkill, et al.,1988; Kenny, 1992; Lucas,1972; Weisberg, 1970).

- Synthesizers (e.g., McLean, et al. 1983; Chao & Reigeluth, 1986; Rigney & Lutz, 1976; Holmes, 1987; Beentjes & Van der Voot, 1992).

- Analogies (e.g., Dean, et al.,1980; Newby & Stepich,1991).

- Maps & Diagrams (e.g., Cha & Dwyer,1991; Lambiotte & Dansereau, 1992; Lambiotte, 199; Winn & Sutherland,1989; Winn, et al., 1991).

General Conclusions:

According to the review of the above studies, we found that using visualized cognitive strategy activators are more effective than using verbal or written cognitive strategy activators. On the other hand, varying the mode of cognitive strategy activators depends on different instructional variables that might interact with the mode. Therefore, the verbal cognitive activators are effective under certain conditions which are different from the conditions that the written cognitive activators are effective under.

Generally, we concluded according to the above results that the visual cognitive strategy activators are effective under the following conditions:

1- Low ability students (Holms, 1987; Winn & Sutherland, 1989; Winn, et al. 1991).
2- With unfamiliar learning content (Lambiotte & Dansereau, 1992; Lambiotte, 1993).
3- Low and medium levels of learning (Barnes & Clawson, 1975; Beenties & Van Voot, 1992; Chao & Riegeluth,1986; Corkill, et al. 1988; Dean, et al. 1990; Holms, 1987; Kenny, 1992; McLean, et al. 1983; Newby & Stepich, 1991; Rigney & Lutz, 1976; Winn & Sutherland, 1989).

Whereas the written cognitive strategy activators are effective under the following conditions:

1- High ability students (Holms, 1987).
2- With familiar learning content (Lambiotte & Dansereau, 1992; Lambiotte, 1993) .
3- High levels of learning (Beenties & Van Voot, 1992 (See Figure 3).

----- Insert Figure 3 about here -----

Discussion

Before discussing the findings of this research, it is worthwhile to bear in mind three important points: 1) the current research was based primarly on a sample but not on all studies that have been conducted on cognitive strategy activators, 2) the findings represent the general trend of previous studies' results which were found in most of the reviewed studies but not in every study, and 3) the findings were organized with respect to three major instructional variables: a- learner characteristics, b- content characteristics, and, c- levels of learning. This organization does not mean that there were no other variables that might interact with cognitive strategy activators. These variables are used just because they were most frequently examined by previous researchers.

Thus, researchers are recommended to take into consideration some other instructional variables in future research such as, learner's level of anxiety (high, medium, or low), learner's level of motivation (high, medium, or low), type of personality (introvert, or extrovert), type of instructional content (facts, principles, concepts, or procedures), type of delivery system (text book, computer, interactive video disc, TV) etc...

1- Ebmedded vs. Generative Cognitive Strategy Activators' System:

The review of previous studies on embedded vs. generative cognitive strategy activators revealed six important results with relation to: 1) learner characteristics, 2) content characteristics, and 3) levels of learning:

1) With respect to the learner characteristics, the results of this research have indicated that the Embedded System (ECS) was effective with low and medium ability students; Field-dependent students, and untrained students; whereas the Generative System (GCS) was effective with high ability students, Field-Independent students, and trained students.

One explanation of these findings could be that, students under ECS are required to manipulate the cognitive activators that have been prepared by teachers. Hence, students in this system are dependent on teachers and expect to receive such activators from them, especially when they don't own the required ability to do this task by themselves (e.g., Darwazeh, 1982; Carrier, et al. 1983, 1984; Drane, et al. 1989). On the other hand, once they receive these activators from a teacher they don't need to be trained in how to generate these activators; because, the teacher is expected to give them ideal ones due to their competence and mature experience in teaching.

But the opposite was true with students under (GCS) in which students are required to generate the cognitive activators by themselves. Thus, students in this system are independent of the teachers and are expected to to do this job by themselves. And because it is not an easy job to do, students need to have a high learning ability or to be trained to do this job. In other words, it is not easy for everybody to generate cognitive activators unless they are capable enough to do it, and have an independent cognitive style. This explanation was supported by Wittrock (Wittrock, 1974) when he proposed and found in his research that highly skilled learners are more likely to possess and spontaneously use generative learning strategies; whereas less skilled learners are more likely to use generative straegies only when directly guided to do so during learning.

2) With respect to the content characteristics, the results revealed that ECS was effective with orgnaized and familiar content; whereas the GCS was effective with random and unfamiliar content. Perhaps, the explanation of these results has to do with learner characteristics. We mentioned above that the high ability students are more able to function under GCS; whereas the low and medium ability are more able to function under ECS. The high ability students are also more able to deal with unorganized and unfamiliar content because of the high learning ability they own. And the organizational skill is one of those special abilities that the distinguished students do have, so they can apply it in organizing random and umfamiliar content; whereas the low and medium ability students are most of the time lacking in such skills, thus, they can not deal with random and novice content as well as the high ability students can do (Carter & Wittrock, 1975; Doctorow, Wittrock, & Marks, 1978; DiVesta & Peverly, 1984; Lambiotte & Dansereau, 1992; Sharger & Mayer, 1989).

3) Considering the levels of learning, the results also revealed that ECS was more effective in promoting low and medium levels of learning; whereas GCS was more effective in promoting all levels of learning: low, medium, and high. The major explanation for these results could be that the students under ECS receive the prepared cognitve activators from the teacher and are required to manipulate them only, thus, their role during learning is supposed to be passive; whereas students under GCS are required to generate and manipulate cognitive acitvators, thus, their role is expected to be active. Therefore, it is obvious that students' involvement in generation activity makes them process the content information on a semantic and deep level of learning; whereas students who are not involved in such activities and just receive prepared cognitive activators instead, are not expected to process information deeply, and, to retrieve it on high levels of learning.

This rationale was supported by several researcher studies suchs as, Dinnel & Glover, 1985; Peper & Mayer, 1986; Shrager and Mayer, 1989; Weinstein & Mayer, 1985. They agreed that as long as students are getting actively involved in learning activities, they will proccess information on a deep level of learning.

2- Pre vs. Post Cognitive Strategy Activators's Position:

The review of previous studies on pre vs. post cognitive strategy activators have also revealed important results with its relation to: 1) learner characteristics, 2) content characteristics, and 3) levels of learning:

1) With respect to the learner characteristics, the results of this research indicated that pre cognitive activators were more effective with low ability students; whereas post cognitive activators were more effective with medium and high ability students.

One explanation for this finding is that the selective attention function of pre cognitive activators is more important for low ability students than for medium or high ability students; whereas the memory refreshing function of post cognitive activators is more important for high ability students than for low ability students (e.g.. Frase, 1967; 1968; Darwazeh, 1982; Hudgins, et al, 1979; Memory, 1983). It could be that, without selective attention, low ability students cannot remember important information presented in the passage. High and medium ability students, on the other hand, can remember most of the important information without the aid of selective attention aids, as they are good readers and have a better background in learning content. Therefore, the high and medium ability students profit more from a memory-refresher, which the post cognitive activators provide.

2) with respect to the content characteristics, the findings of this research revealed that pre cognitive activators were more effective with a content sequenced form specific to general information; whereas the post cognitive activators were more effective with a content sequenced from general to specific information.

One explanation of these results could be that when instruction begins at the most detailed level, learners need to start with a synthesizer that is represented in the cognitive activator to provide context for each detailed concept. On the other hand, when the instruction is arranged in a general-to-detailed sequence, it would appear that the most general concepts themselves provide the context for the subsequent concepts, such that students do not benefit from a pre CSA as an initial overview of the set of concepts (e.g., Frey and Reigeluth, 1981; Sanders, 1973). Conversely, in the general to detailed sequence, students appear to need a synthesizer that is representd in the cognitive activator at the end of the instruction to review the relationships among the concepts.

3) With respect to levels of learning, the findings also revealed that pre cognitive activators were more effective in promoting low levels of learning such as memory, intentional, or direct levels; whereas post cognitive activators were more effective in promoting high, incidental, or indirect levels of learning. One explanation of this finding, as was supported by Darwazeh & Reigeluth (1982); Andre, et al. (1981) in their experiment No.1); Anderson & Biddle (1975); Rothkopf & Bisbicos (1967); Sanders (1973) is that pre cognitive activators serve as a method of of arousing " selective attention". Hence, while reading the passage, the learner will focus attention on those thoughts and ideas which are related directly to the pre-cognitive activators and will neglect the ideas and thoughts which are not related to the pre CA. However because post CA comes after the passage, they cannot serve as a selective attention function; rather they can only serve to refresh the learner's memory within and beyond the frame of the passage, that is they reinforce intentional and incidental levels of learing (e.g., Andre & Womack, 1978; Darwazeh & Reigeluth, 1982) Well, further future studies are recommended on this issue.

3- Visual vs. Written Cognitive Strategy Activators:

The review of previous studies on visual vs. written cognitive strategy activators have revealedthe following findings:

1) With respect to learner characteristics, the previous studies revealed that visual (concrete) CSA'S were more effective with low ability students; whereas the written (abstract) CSA's were more effective with high ability students (e.g., Holmes, 1987; Newby & Stepich, 1991; Winn & Sutherland, 1989; Cha & Dwyer, 1991). The most reasonable explanation for these findings could be that, students using the visual CSA's, depend on more than one sense to manipulate them. They could use pictures, graphic organizers, maps or other concrete CSA beside reading the passage. Thus, using more than one sense while manipulating the CA will lead to a better understanding, hence to better learning. In addition, using visual or concrete CSA will

simplify the complicated ideas that are presented in the passage. Therefore, this will help low ability students in particular, who lack of the ability to deal with complex and abstract CSA'S like the written ones, more than high ability students who have the ability to deal with complex and abstract.

On the other hand, visual CSA's usually summarize the content and its relationships and present them in figures, diagrams, maps, trees, flow charts, etc.. This would help low ability students, who find it difficult to skim the content and see its relationships, to pay attention to the essentioal ideas, hence to understand the learning content. The opposite is true in the case of using written CA which use the narrated language for this purpose. Therefore, only the high ability students, who can deal with the abstract language, can befifit from this kind of activators.

2) With respect to the content characteristics, the general trend of previous studies' results revealed that the visual CSA's are more effective with unfamiliar content; whereas the written CSA's are more effective with the familiar ones (e.g., Winn & Sutherland, 1989; Lambiotte & Dansereau, 1992, Lambiotte, 1993). According to our above explanation, two characteristics of visual CSA are, the concreteness and clearness. Such characteristics are expected to make the unfamiliar content familiar, hence, more manageble and understandable. In contrast, two characteristics of a written CSA are abstraction and complex. Such characteristics are not expected to make the content familiar, manageble, or understandable, because, these CSA's need some clarification themselves. So, Students in this case would not get the optimal benefit from such activators unless they were intelligent enough to deal with the abstract and symbolic CSA's. Thus, further experiments are recommended on this matter.

3) Finally, with respect to the levels of learning, the research revealed that the visual CSA's are likely to be more effective in promoting low or sometimes medium levels of learning; whereas the written CSA's are likely to be more effective in promoting high levels of learning (e.g., Corkill, et al. 1988; New & Stepich, 1991). The results make sense in terms of the level of processing that the CSA's needed. The visual CSA's most of the time are simple, concrete, and clear, so, they are easier to be understood without the need of deep thinking. On the other hand, the written CSA's most of the time are complex, abstract, and not clear, so, they need from the students a great deal of attention and deep processing of information in order to manipulate and understand them . The deep processing mostly leads to a high level of learning such as application and problem solving, (or incidental levels); whereas the shallow processing of information mostly lead to a shallow level of learning such as remember (or intentional levels). So, this could be a reason that the visual CSA's promote low or medium level of learning; whereas the written CSA's lead to a high level of learning. Furtner experiments are recommended on this matter too.

Research Implemention

The research findings havean important implemention for designing instruction based on cognitive strategy activators.

The implemention of this research is represented in proposing two prescriptive models for designing instruction. These two models depend basically on Dick and Carey's model for designing instruction (Dick & Carey, 1990). The first model is for embedded cognitive strategy activators, and the second model is for generative cognitive strategy activators. These models are recommended to be used by teachers when they plan for every day teaching, and by instructional designers and developers when they design schools' curriculum, computers' programmes, or business projects. These models will be discussed from four angles: 1) Rationale of creating such models, 2) their outcomes, 3) method, and 4) conditions.

1- Rationale:

The Science of Instructional Design became prosperous in the last two decades in different countries of the world. Accordingly, instructional designers have done a great job in designing instruction based on the principles of instructional design science (e.g.; Briggs, 1977; Briggs & Wager, 1981; Darwazeh, 1986; Dick & Carey, 1990; Gagne, Briggs, & Wager, 1992; Mirrell, & Tenysson,1977; Reigeluth,(Ed.) 1983; Snelbeker,1974; Wager, et al. 1990). But still, the cognitive strategy activators are not considered in their models.

Recently, there was an attempt by West and his colleagues to specify a template for designing instruction based on cognitive science principles (West, Farmer, & Wolf, 1992, pp. 209-263) but still they did not specify a clear procedure on how to design instruction with a consideration of cognitive strategies.

Therefore, the major purpose of the current research is to propose two prescriptive models for designing instruction: one model is for Embedded CSA's, and the another model is for Generative CSA's. I believe that without considering the embedded and generative cognitive strategy activators while designing instruction, the learning and instructional process will be incomplete specially in this decade which is accompanied by cognitive revolution in the field of psychology. Stimulating students' cognitive strategies has become a very important issue for enhancing and accelerating their learning.

2- Outcomes:

Using embedded or generative cognitive strategy activators under certain conditions will help learners, teachers, devolopers, and instructional designers to do the following:

a) For Learners:

1- Stimulate their cognitive strategies and use them properly during learning.
2- Focus attention on the content of instructional materials, hence increase their level of motivation to learning.
3- Input, process, and output information effectively.
4- Create linkages between the existing knowledge and the new one, and between the ideas in the text itself, hence making the content more manageble and understandable.
5- Simplify complicated information to be learned, and make it more managable, and understandable.
6-Process information on deep (or high) level of learning, hence to store it in long term memory.
7- Retrieve information for later use specially for problem solving either for solving academic or persoal problems.

b) For Teachers, Developers, and Instructional Designers:

1- Design instruction comprehensively and integrated.
2- Compensate the defect in teaching method, if any, specially for novice teachers.
3- Compensate the defects in the organization of the learning content (i.e., incoherent, unfamiliar, or random content) and make it coherent, familiar, and organized as much as possible.
4- make the learning content more interesting.
5- Promote learning on high levels rather on low levels.
6- Enhance the quality of instructional process generally.

3- method (how to use):

1- Establish overall goals (ECS & GCS models).

2-Conduct content analysis and determine its characteristics. Is it organized or unorganized; familiar or unfamiliar; sequenced from specific- to-general or from general-to-specific information; containes mainly concepts, principles, procedures, or facts; long content or short one, or what ! determine (ECS & GCS models).

3- Conduct learner analysis and determine if they are above average, average, or below average; field-dependent or field-independent; high motivated or low motivated; trained or untrained learners, or what ! (ECS & GCS models).

4- Identify the level of performance that you want students to demonstrate after instruction. Is it a knowledge (low) level, or comprehension (medium) level or application, analysis, synthesis, problem solving, evaluation (high) level of learning, or what ! determine (ECS & GCS models).

5- Develop test items for measuring each level of performance that you have determined (ECS & GCS models).

6- Develop or select instructional materials and mass media that are suitable for teaching the determined learning content (ECS & GCS models).

7- Develop instructional strategies for teaching each component of the content that you have determined (ECS & GCS models).

8- Develop cognitive strategy activators to be used (ECS model).

9- Develop directions or a training program for generating cognitive strategy activators (GCS model).

10 - Determine the kind of cognitive strategy activators to be used. Is it adjunct questions, advance organizers, note-taking, pictures, outlines, stories, underlining, etc... or what ! (ECS & GCS models).

11- Determine the position of the cognitive strategy activators to be used. Is it pre, during, or after the passage ! (ECS & GCS models).

12- Determine the mode of cog. :tive strategy activators to be used. Is it concrete or abstract, audio-visual or written ! (ECS & GCS models).

13- Design and conduct formative evaluation (ECS & GCS models).

14- Revise instruction according to the results of formative evaluation (ECS & GCS models).

15- Design and conduct summative evaluation (ECS & GCS models).

------Insert Figure 4 about here------

4- Conditions (When to use):

1- Use (ECSM) if you deal with low or medium ability students; otherwise, use the (GCSM) when you deal with high ability students.

2- Use (ECSM) if you have students charactarized by field-dependent cognitive style; otherwise, use (GCSM) when you have students charactarized by field-Independent cognitive style.

3- Train Students if you use (GCSM) only, unless students under (ECSM) faild to manipulate the given cognitve activators.

4- Use (ECSM) if you deal with organized content of learning; otherwise, use (GSM) when your deal with unorganized or random content of learning.

5- Use (ECSM) if you deal with familiar content of learning; otherwise, use (GCSM) when you deal with the unfamiliar.

6- Use (ECSM) If you want learning to occur on low or medium levels; otherwise use (GCSM) when you want learning to occur on all levels of learning (Go back to Figure 1).

7- Under (ECSM), Use pre-cognitive strategy activators if you deal with low ability students; whereas use post-cognitive activators when you deal with either medium, or high ability students. But under (GCSM), use cognitive strategy activators during or after the passage, with any level of students ability specially with high abilities, and for any level of learning specially for high levels.

8- Under (ECSM), use pre-cognitive strategy activators if you have a content sequenced from specific to general information; whereas, use post-cognitive strategy activators if you have a content squenced from general to specific information. But under (GCSM)use the cognitive strategy activators during or after the content with any type of its sequence.

9- Under (ECSM), use pre-cognitive strategy activators if you want learning to occur on low levels such as remember, intentional, or direct learning; whereas use post-cognitive activators if you want learning to occur on all levels of learning such as comprehension, application, analysis, synthesis, evaluation, problem solving. But under (GCSM) use during or post-cognitive strategy activators for promoting any level of learning specially for high levels (Go back to Figure 2).

10- Use visual (concrete) cognitive strategy activators if you have low ability students, whereas use written (abstract) cognitive strategy activators if you have high ability students (ECS & GCS models).

11- Use visual (concrete) cognitive strategy activators if you have unfamiliar content; whereas use written (abstract) cognitive strategy activators if you have familiar content (ECS & GCS models).

12- Use visual (concrete) cognitive strategy activators if you want learning to occur on low or medium levels; whereas use written (abstract) cognitive strategy activators if you want learning to occur on high levels (ECS & GCS models), (Go back to Figure 3).

Recommendations

Considering the importance of cognitive strategy activators in promoting and enhancing students' learning in particular, and teachers' teaching in general; the potential for continuing and extending research on the effects of generative activities is very crucial. Given past research results, several suggested studies are recommended on cognitive strategy activators to compensate the shortage in the previous studies. Future studies are recommended to manipulate the folloing issues:

1- Comparing ECS's with GCS's by using other kinds of cognitive activators that were rarely used in the past, such as: abstracts, objectivs, stories, analogies, synthesizers, and mnemonic devices (Carney, et. al., 1988; Pressley, et. al., 1976).

2- Using posttest measuring high levels of learning such as analysis, synthesis, evaluation, and discovery levels beside the remember and comprehension levels (Bloom, 1956).

3- Using different lengths of learning content : short, medium, and long content (Reigeluth, 1981).

4- Using different modes of cognitive strategy activators such as abstract vs. concrete; audio vs. visual vs. written.

5- Using different learners characteristics such as high anxiety, low anxiety, high motivated, low motivated. Plus, using subjects in different stages of education such as kindergarten, elementary, middle, secondary, and graduate stages.

The aim of experimenting on such issues is to help researchers, hence, instructional designers to specify more conditions for using the cognitive strategy activators. Therefore, they can modify or add to the above suggested models whenever necessary.

Summary:

The research tried to accomplish three ends:

1) give definitions and clarifications on cognitive strategy activators in terms of their system, positions, and modes.

2) Summarize a sample of the previous experimental and theoretical studies which were conducted between 1960's - 1990's on cognitive strategy activators In terms of their systems, positions, and modes, and with their relation to three instructional variables: a- learner characteristics, b- content characteristics, and, c- levels of learning.

3) Propose two instructional design models based on cognitive strategy activators: one for embedded cognitive activators in which teachers, developers, or instructional designers are expected to take the major role in generating the cognitive activators, and the other model for generative cognitive activators in which learners are expected to take the major role in generating such activators.

These two proposed models are expected to lay a foundation of a theory on how to desgin instruction with a consideration of cognitive strategy activators. At the same time, they are considered as an invitation for researchers to conduct more studies on this subject, with the aim of increasing the validity of those models which was extracted from previous studies, hence, to modify and add to them whenever necessary.

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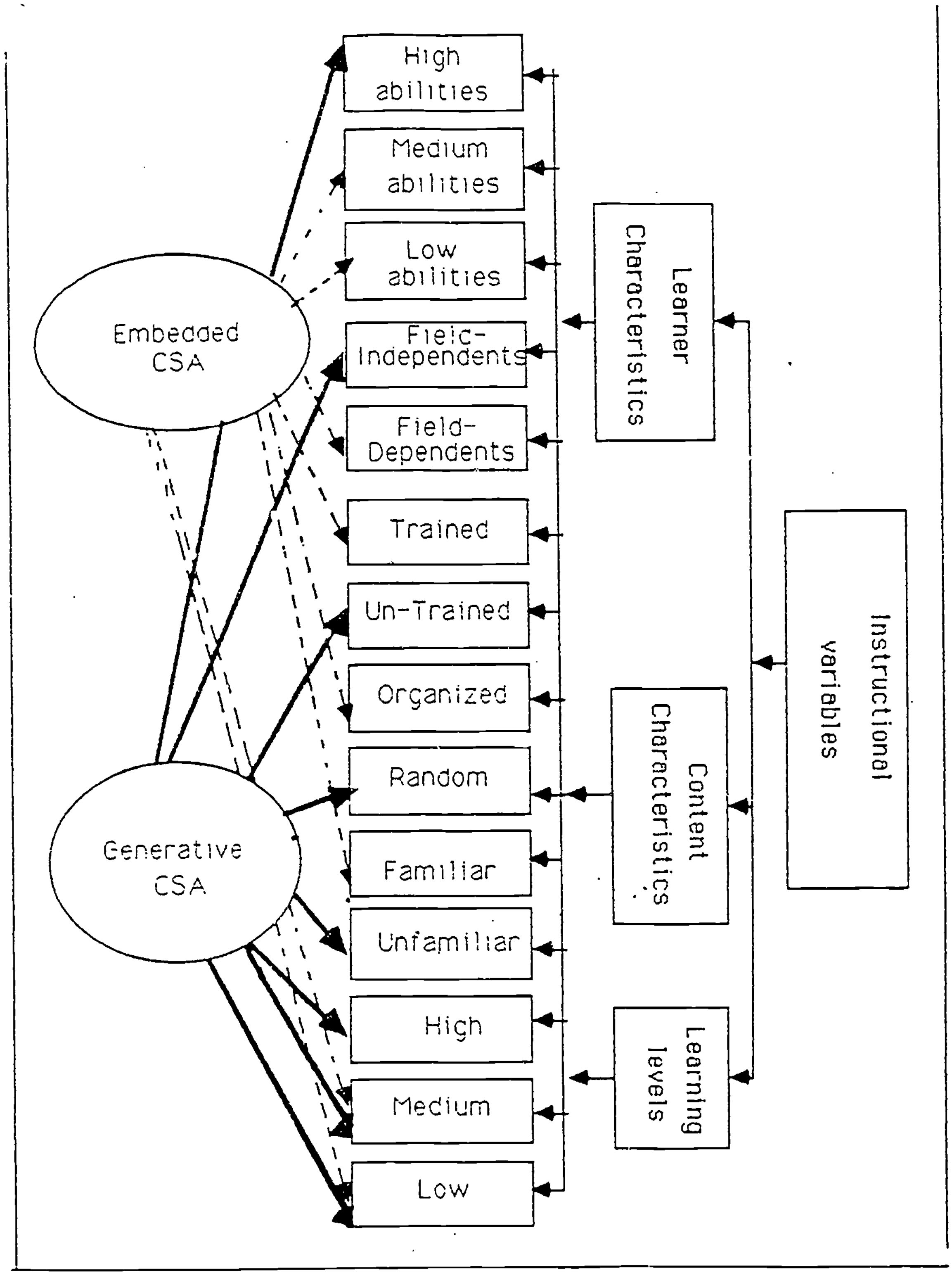

Figure 1. Conditions for using Embedded versus Generative Cognitive Strategy Activators (ECSA vs. GCSA).

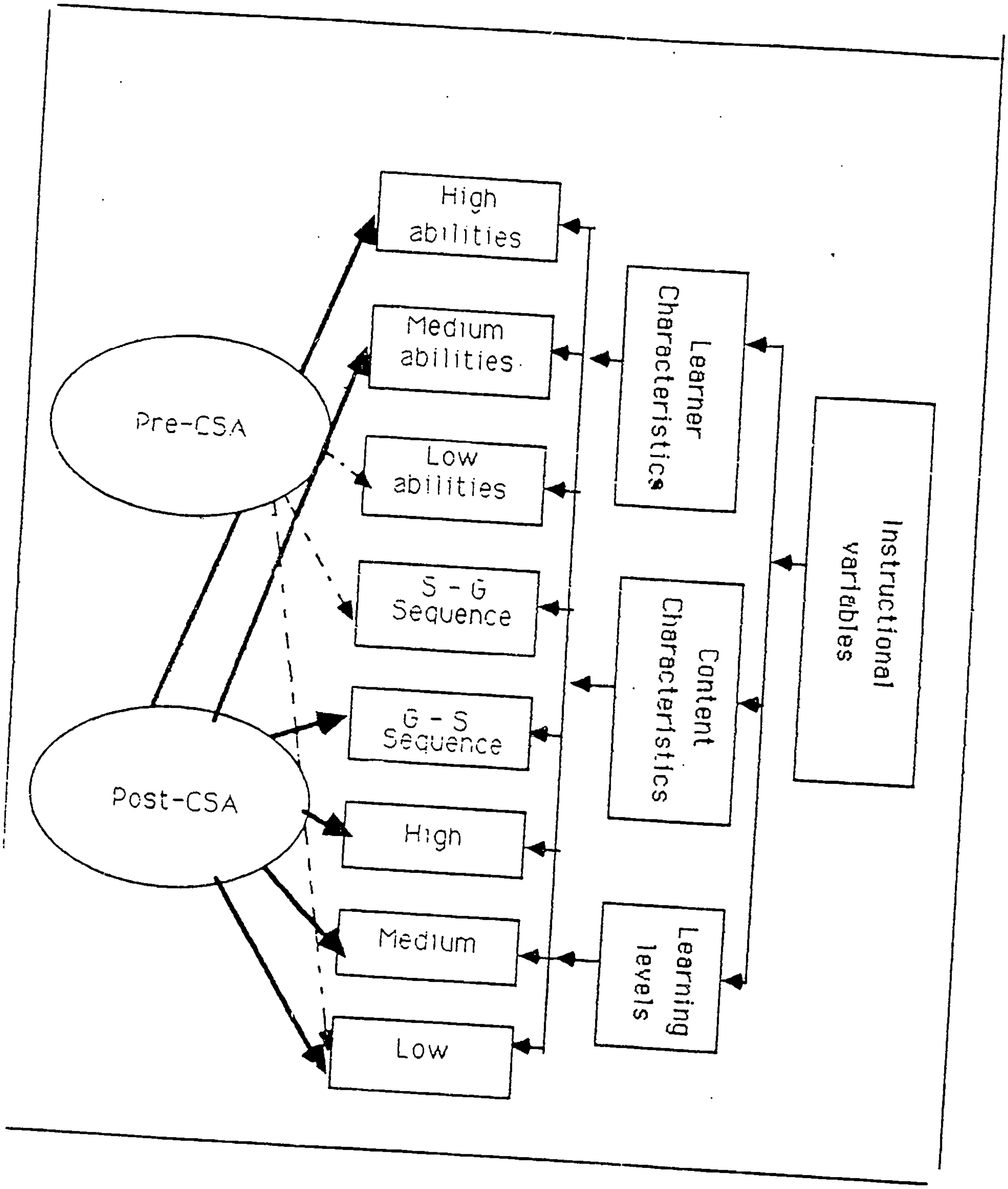

Figure 2. Conditions for using Pre- versus Post-Cognitive Strategy Activators (Pre-vs. Post-CSA).

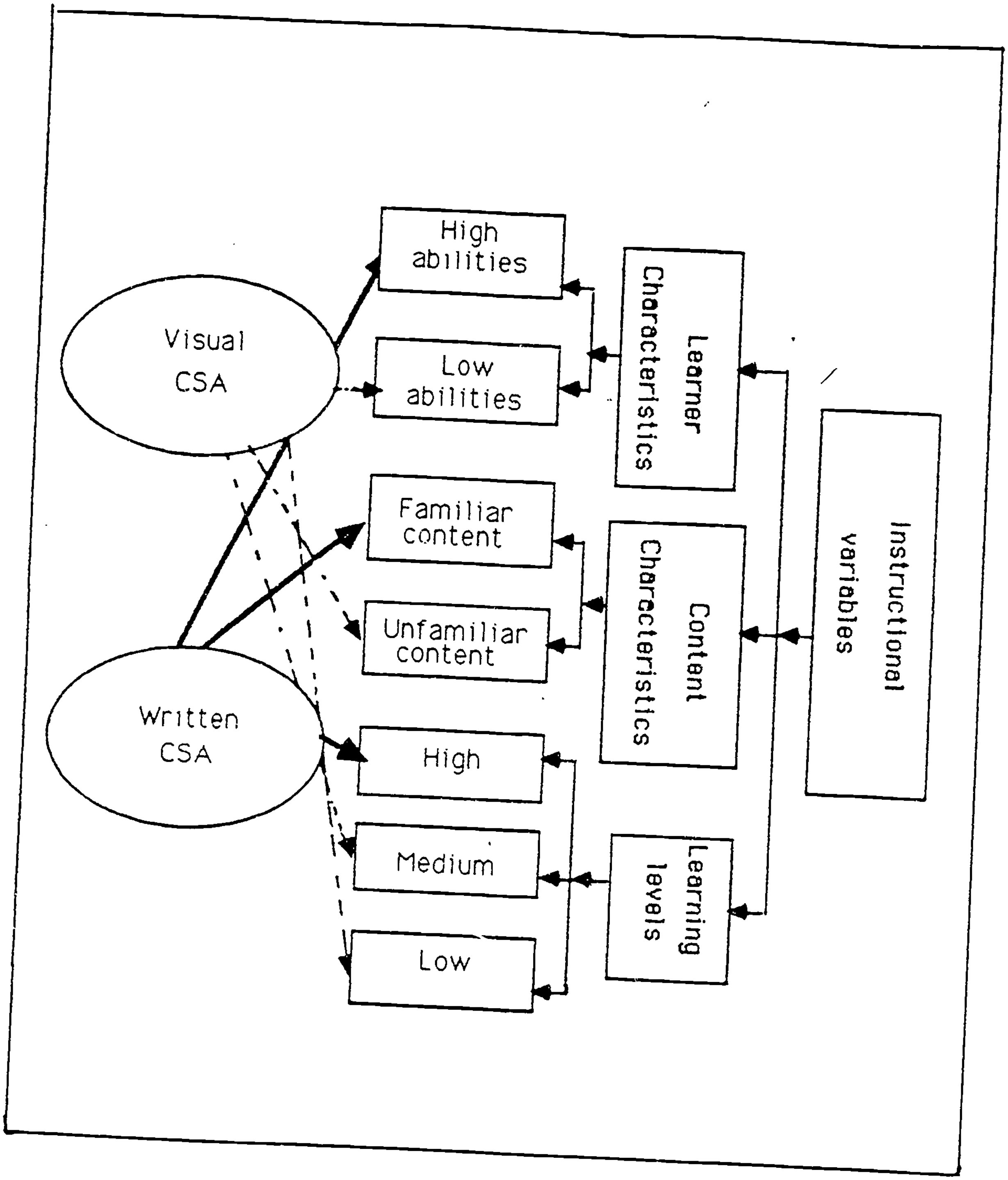

Figure 3. Conditions for using Visual versus Written Cognitive Strategy Activators

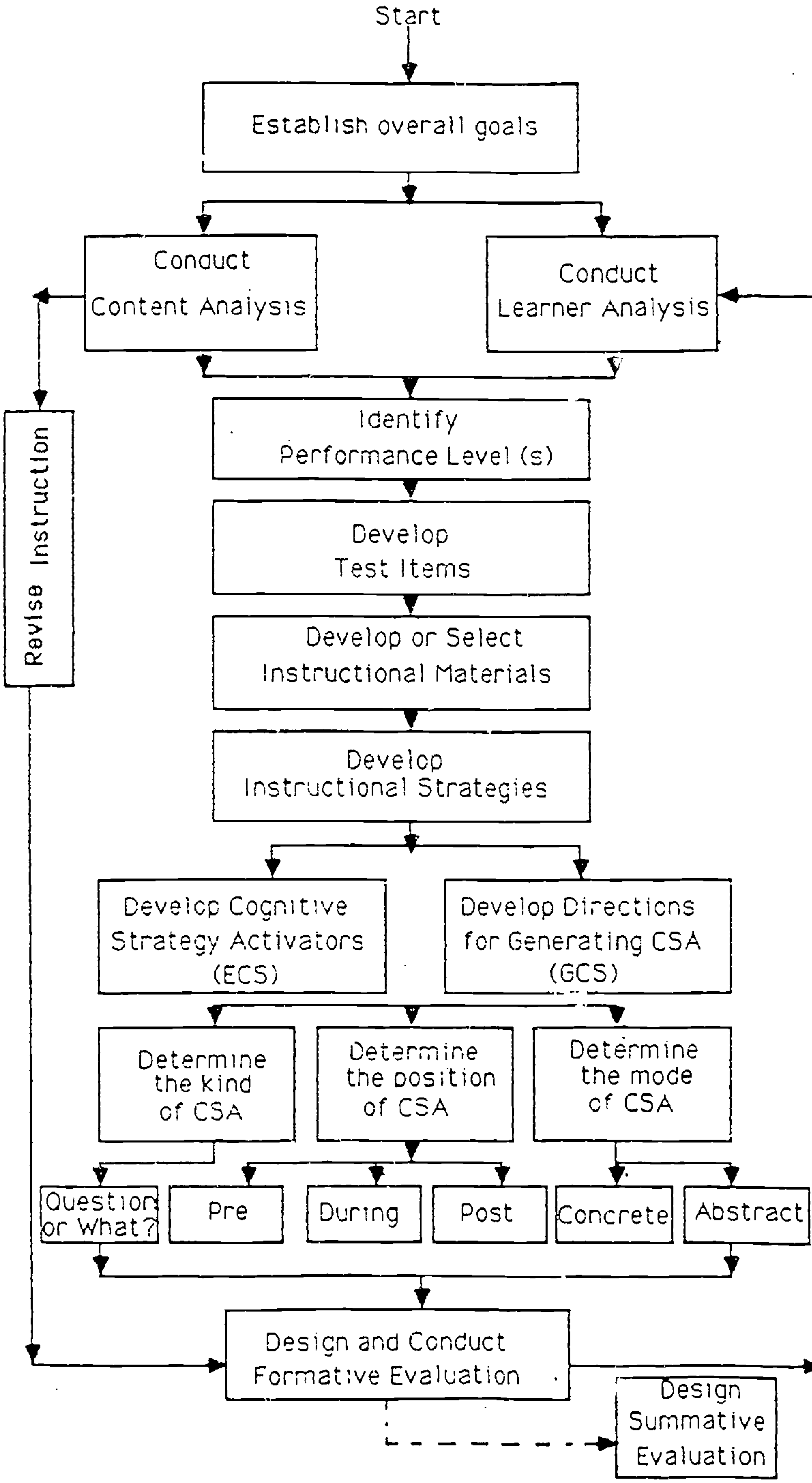

Figure 4. The instructional design model with a consideration of cognitive strategy activators

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