DOCUMENT RESUME

ED 382 237 JC 950 193

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TITLE A Natural Teaching Method Based on Learning Theory.
PUB DATE 91
NOTE 7p.; "Gamut" published by Seattle Community College District (Washington).
PUB TYPE Journal Articles (080) -- Viewpoints (Opinion/Position Papers, Essays, etc.) (120)
JOURNAL CIT Gamut; p12-15,36 1990-91

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Community Colleges; *Constructivism (Learning); Critical Thinking; Educational Strategies; Learning Experience; *Learning Processes; *Learning Theories; *Schemata (Cognition); *Teaching Methods; Two Year Colleges

ABSTRACT

The natural teaching method is active and student-centered, based on schema and constructivist theories, and informed by research in neuroplasticity. A schema is a mental picture or understanding of something we have learned. Humans can have knowledge only to the degree to which they have constructed schemas from learning experiences and practice. Constructivist theory suggests that it is only by direct, active, hands-on exploration and learning from errors can a person construct a schema. Brain and neuroplastic research indicates that as learning occurs, brain nerve cells grow additional fibers (dendrites) and synapses. The learner, through active trial-and-error exploration, increases physiological neuron networks. The six stages of the Natural Teaching Method Planning Model provide a way to guide students to construct new schemas: (1) stimulate students to activate any related knowledge; (2) guide students to start constructing the new structures or knowledge on the structures; (3) consolidate the first growth of new structures and knowledge; (4) give students the opportunity to gain more complex understanding; (5) give students the opportunity to start using their new knowledge in a creative way; and (6) give students the opportunity to fine tune the increasing complexity and richness of the neural network. Being taught the way the mind naturally learns helps students access and use their intelligence. (KP)

A Natural Teaching Method Based on Learning Theory.

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Article originally appeared in the 1990-1991 issue of *Gamut*, Seattle Community College District, Seattle, Washington.

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Gamut
Seattle Community College District
Seattle, WA
1990-91

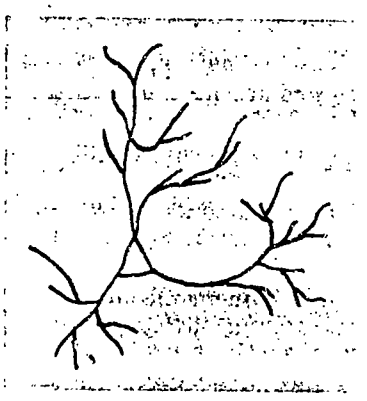
[Editors' note: This article continues a discussion of "Natural Learning" begun by the author in the Fall 1989 issue of *Gamut*.]

THE NATURAL TEACHING METHOD IS AN active, student-centered one based on a combination of two theories — schema and constructivist — and research in neuroplasticity (changes in brain structures).

Schema Theory

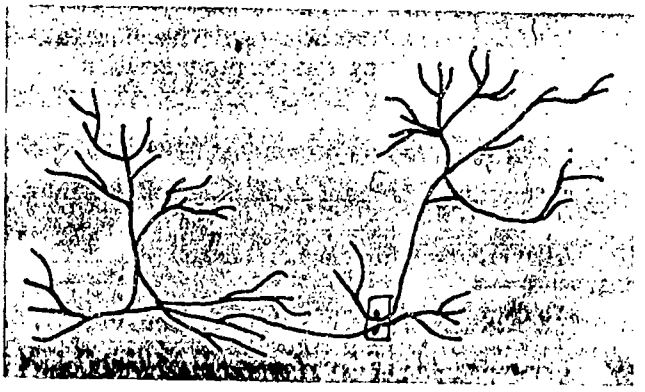
A schema is a representation or construct in our mind — a mental picture or understanding — of something we have learned. It is constituted of the elements or characteristics of the things we know. For example, how do you know when you are in a classroom? You have a mental construct, concept, representation of a classroom, a mental construct that is made up of qualities you know and have experienced a classroom to be. Similarly, you also have schemas for other kinds of rooms, such as kitchens, concert halls, restaurants, dental offices, libraries, etc. If someone blindfolds you and leads you to a seat in a room, takes off the blindfold and asks you where you are, you will begin to match the elements you see around you to the various room schemas in your mind: There's a low stage in front with rows of seats in a semi-circle facing the stage, but there is no chalkboard. Maybe it's a small concert hall. Then you see a movable chalkboard in the corner. Oh, it's probably a classroom.

When you do the work you do or read a book in your field, how do you know what to do, and why are



A brain cell (neuron), comprising a body and fibers (dendrites) emanating from the body. A normal human brain might have 200 billion neurons.

Figure 1



Two neurons touching at a contact point (synapse); one synapse is located within the box, enlarged in Fig. 3. As many neurons connect, they form neural networks. Each neuron might have tens of thousands of synapses.

Figure 2

We need always to ask ourselves, "What do I want them to know and be able to do at the end of this course?"

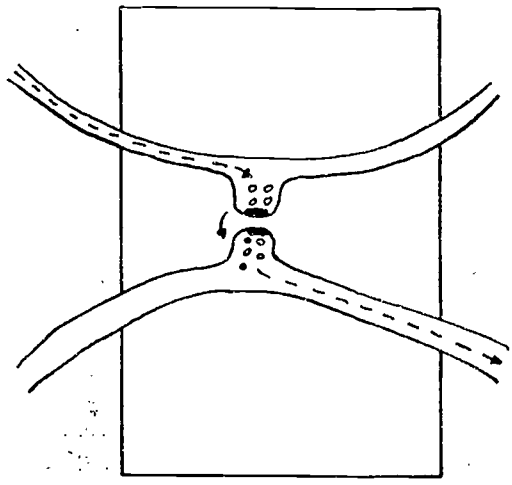
you able to understand the book? It is because your practice and experience in that field have caused you to acquire the schemas you need for knowing how to do that work and how to read and understand books about it.

We humans can be said to have knowledge only to the degree to which we have constructed schemas in our mind from our learning experiences and practice.

If we don't have these schemas in our mind, how can we know or recognize anything? Simply by this theory, we can't. According to schema theory, it's not possible to have knowledge unless and until we have constructed a schema for the specific subject or skill.

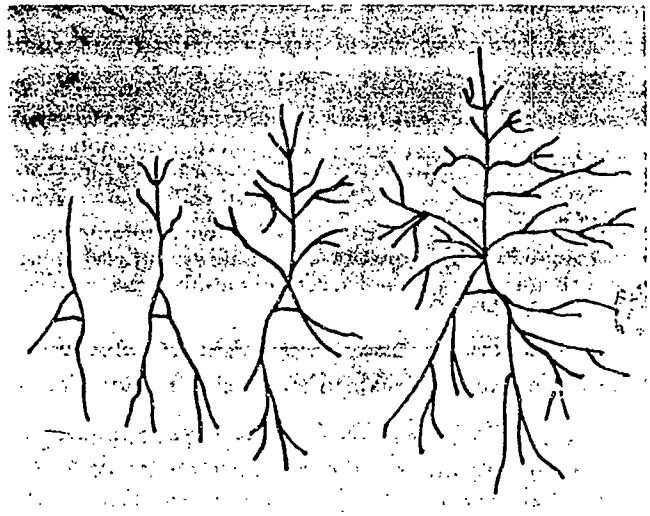
We have a specific schema or schemas for every skill or subject we have learned or experienced. Each is exquisitely experience- or learning-specific. Until and unless people have particular subject-specific or skill-specific schemas, they cannot think about or perform a particular skill or apply some particular knowledge or synthesize different areas of knowledge. Thus, the job of teachers is to help students construct schemas for each skill or subject we want them to learn.

How are schemas constructed? How do these mental constructs or representations get into a person's mind? Constructivist theory and neuroplastic research help us understand.



Enlarged area from Figure 2: A synapse. An electrical impulse travels into a spine of one dendrite. Chemicals in that spine are sent across the gap into the spine of another dendrite. An electrical impulse begins in the second dendrite and continues the process. Each brain might have trillions of synapses.

Figure 3



Dendrites grow on the neuron as learning occurs. The dendrites grow longer as well and connect with other dendrites at new synapses, forming new and/or richer, more complex neuronal networks.

Figure 4

Constructivist Theory

This theory, based on Piaget's work, tells us that it is only by direct, active, hands-on exploration and learning from our own errors that a person can learn — that is, construct a schema.

Cutting edge brain and neuroplastic research tells us that as learning occurs, brain nerve cells (neurons — see Figures 1,2, and 3) — which look like tree root systems — grow additional fibers (dendrites — see Figure 4) and new little spines on these fibers, and also develop new communication touch points (synapses) between the little spines as learning occurs. Picture a neuronal network as interlaced roots of several tree root systems. When two fibers touch at the synapse — and many are touching — an electrochemical action moves an electric charge from the spine of one nerve cell to the spine of another; this touching (synapse) serves as the neuronal communication mechanism. As learning occurs, more synapses develop, increasing the complexity and speed of communication between brain cell fibers (see Figure 5). "More efficient brains are characterized by a richness of neuronal interaction and a multiplicity of synaptic connections" (Restak, 48).

In other words, as the learner, through active trial-and-error exploration with his/her own direct participation, increases his/her physiological neuronal networks, a schema, which is the conscious

Two spines at a synapse.

Through repeated non-rote practice the spines enlarge, forming a larger area for the communication between the spines.

After much non-rote practice, the original spines split into two spines, increasing the complexity and fluency of the communication and the neural network.

Emotions affect this brain activity: Positive emotions like confidence and interest produce hormones that facilitate synaptic communication. But negative ones like fear and self-doubt inhibit transmission between neurons, producing a "blank" mind, i.e., the inability to think, learn, and remember.

Figure 5

Neuronal networks increase in complexity and fluency as a result of practice.

sense or understanding of new knowledge, is being constructed: *increasing neuronal networks, learning, and constructing a schema are the same thing* — and this occurs only when the learner is an active learner. In others words, constructing new schemas, i.e., new brain cell (neuronal) networks, is learning whereby the learner is actively acquiring new knowledge, internalizing it, increasing fluency, and, from the start, critically and creatively applying it through trial-and-error activities using his/her own ideas rather than pre-created ideas.

A key is that learning activities must be authentic. They must give students opportunities to creatively and thoughtfully, through trial and error, find how a certain skill works or how to apply a concept. Students must use their own ideas and feelings, because transfer from inauthentic learning activities to the real application, e.g., from workbooks to a student's own performance, does not occur. We all know that. Research confirms it. While students are learning to be experts at their workbook activities, they are constructing workbook-related schemas. For example, in order to construct their own schemas, they must learn by trial-and-error work of their own, through their own hands-on experience.

Schemas aren't transferable; they work only for the specific skill or concept for which their underlying neuronal networks are precisely and specifically constructed. This is why transfer from textbook to one's own performance doesn't — and can't — work.

In addition, the activity must be very active: The more active, the more nerve cell growth, the more schema construction.

The challenge to the constructivist teacher is how to increase student activity in the classroom.

Each student has a unique mind constituted of his/her neuronal networks and schemas that are unique to him/her since each person has a different and unique history, different learning and life experiences, different backgrounds. A natural teaching method based on constructivist and schema theories and neuroplastic research tells us students learn only what they practice, only what they construct brain structures for. We need always to ask ourselves, "What do I want my students to know and be able to do at the end of this course?" Then, have them practice that and only that, directly, actively, learning (with our supportive feedback) from their own mistakes. And they will not only learn it, they will be able to use it.

Figure 6 ▶

Example of 2 sets of lessons using the Planning Model

The Planning Model shows a way to facilitate and guide students to construct new schemas/grow new or more complex neural networks/learn — remember that these three are synonymous. Figure 6 gives two examples of how to use the Planning Model, one for an introduction to a poetry unit and one for an introduction to a Soviet Union unit.

To help students learn something new (construct new neural networks), we must always start a new unit by stimulating each student's knowledge/neural networks that are related in some way to the new skill or knowledge. This is essential because *brain structures (dendrites, spines, networks) cannot grow in a void. They can grow only off what is already there, i.e, off what the student already knows/off existing structures.*

Stage 1 in the Planning Model stimulates students to activate any related knowledge they already have. *Stimulated brain structures are brain structures that are ready to grow.* Since each student has his/her own unique, idiosyncratic mind-store of knowledge/brain structures, each student will come up with a different response. Good!

Stage 2 guides students to start constructing the new structures/knowledge *on* the structures/knowledge stimulated in Stage 1.

Stage 3 guides students to consolidate the first growth of new structures/knowledge. This consolidation of the first growth will result in only

CONTINUED ON PAGE 36

PLANNING MODEL

FOR SKILL/CONCEPT/UNIT: Introduction to Poetry / Introduction to the Soviet Union DATE

STAGE 1: STUDENTS NEED TO DO HANDS-ON LEARNING OF BASIC, CONCRETE KNOWLEDGE.

1 PREPARING TO LEARN (using current knowledge)	2 STARTING TO LEARN (experimental practice)	3 CONSOLIDATING NEW BASIS (skillful practice)
INDIVIDUALLY Ask students to write an answer to a question that lets them 1) use knowledge they already have, 2) start towards the new skill or concept: "What do you like about this poem?" / "You and your family are starving; the gov't has no concern or aid for millions of jobless; some people want to revolt. Will you join? Why/why not?"	INDIVIDUALLY Ask them to write on a question that has them focus on the new skill or concept: "What do you like about this other poem?" / "This is what it was in Russia in 1900 (lecture/film/reading). If you were a jobless/homeless person there, would you join a revolt? Why/why not?"	INDIVIDUALLY Ask them to write on a question having them consolidate what they've learned thus far: "What do you know about poetry?" / "What do you know about the Russian revolution?"
IN A SMALL GROUP Have them read and discuss their answers in small groups of no more that 3 or 4. This discussion is where much of the learning (dendrite growth) will take place. They are not asked to come up with a group view or a consensus. It is for ACTIVE work.	IN A SMALL GROUP Same	IN A SMALL GROUP Same
AS A WHOLE GROUP Ask them, "What did you come up with?" Write all answers verbatim on the blackboard. This will have several important effects: gives teacher a clear view of what they know; it creates a community of the class; it "strokes" each student, for nothing is criticized and everything goes on the board. You will probably feel like praising them! Do so!	AS A WHOLE GROUP Same	AS A WHOLE GROUP Same

A superficial but firm basis to build higher thought on. Dendrites/neural networks are being constructed.

As students increase their knowledge you will find that mistakes on the board from previous steps are corrected by the students themselves. If the teacher makes corrections, all the active work stops and students begin to take notes passively. Dendrites stop growing. People learn by making and correcting their own mistakes. The teacher will facilitate and guide and sometimes point out mistakes--but learning occurs (dendrites grow) when they correct their own mistakes. Point out there's a problem, and let them, alone and in small groups, find and correct it.

Repeat 2 and/or 3 with other activities as above, if needed.

END OF STAGE 1: STUDENTS NOW HAVE THE BASIC FOUNDATION OF THE CONCEPT/SKILL.

STAGE 2: LEARNING THIS FAR (NEW SCHEMA) IS NOW THE BASIS FOR FURTHER LEARNING.

4 BRANCHING OUT	5 CREATIVITY	6 IMPROVEMENT WIDER APPLICATION
INDIVIDUALLY Ask them to write on a question having them go deeper: "What is similar and different about these two poems?" / Interpret this article by Marx as though it were written about Russia in the early 1900s."	INDIVIDUALLY Ask students to do creative and critical thinking, now that they have a firm basis to think about : "Write an essay about a self-selected poem." / "Write an essay about a self-selected topic relating to the Russian revolution of 1917."	INDIVIDUALLY Give students the opportunity to improve their writing and enrich their new dendritic connections even further: "Revise your essay on the poem (or write another essay on another poem)." / "Revise your essay on the revolution (or write another essay about another aspect of it)."
IN A SMALL GROUP Same	IN A SMALL GROUP Have them read their essays to each other in groups of no more than 3 to 4. Have them say what they liked about and what they think would help improve each essay. Have them discuss what makes a good essay.	IN A SMALL GROUP Same as for 5.
AS A WHOLE GROUP Same	AS A WHOLE GROUP Put on the board their views of what makes a good essay. Read a few essays (anonymously) and discuss each one in terms of the criteria on the board.	AS A WHOLE GROUP If they have anything to add to the previous day's criteria of a good essay, put it on the board. Ask volunteers to read their papers to the class.

END OF STAGE 2: STUDENTS NOW THINK ABOUT AND USE THE NEW CONCEPT/ SKILL. THEY NOW HAVE NEW UNDERSTANDING AND COMPETENCE (A NEW SCHEMA).

STAGE 3: STUDENTS CONTINUE TO USE/IMPROVE THIS KNOWLEDGE/SKILL OVER TIME. IT IS NOW KNOWLEDGE (A SCHEMA) UPON WHICH FURTHER NEW LEARNING CAN BE BUILT.

Natural Teaching Method

CONTINUED FROM PAGE 15

superficial understanding. But it is *essential* to do this because it forms the necessary basis or foundation for the construction of more complex structures/knowledge. An even higher level can now be constructed on this basic or fundamental level/network.

Stage 4 gives students the opportunity to get deeper, to gain more complex understanding/construct a more complex neural network.

Stage 5 gives students the opportunity to start using their new knowledge/brain structures in a creative or critical-thinking way. This leads them to greater understanding and more fluency because their neural network is increasing in complexity (See Figures 4 and 5).

Stage 6 gives students the opportunity to go even further, to fine tune, to improve — that is, to keep increasing the complexity and richness of their neural network.

At the higher levels (Stages 4,5,6) students become able to do creative and critical thinking across networks, e.g., they can compare/contrast/synthesize the new skill or knowledge with other skills or knowledge they have already learned.

Another essential feature of this Planning Model is its student-centered, student-active method: at every stage students write individually to activate their own neural networks, then they share and talk in small groups in order to be as active as possible; finally, the whole group gets debriefed in order to show the instructor exactly where the students are, to create a sense of community, to enrich the sharing done in the small groups, and to encourage and praise the students for what they know.

Expect students to make many mistakes, but with encouragement and many opportunities to make and correct their mistakes, they will learn.

Whenever this teaching method is used, teachers are struck by two things: 1) the great energy and enthusiasm of students for learning, and 2) the great intelligence of the students.

Being taught in the way the mind naturally learns helps students access and use their great intelligence in their courses and beyond.

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