

Cognitive Learning Theory in the Math Classroom

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What is Cognitive Learning Theory???

- Cognitive Learning Theory is a broad theory that explains thinking and differing mental processes and how they are influenced by internal and external factors in order to produce learning in individuals.
<https://www.alleydog.com/glossary/definition.php?term=Cognitive+Learning+Theory>
- Cognitive Learning is how a person processes and reasons information. It revolves around many factors, including problem-solving skills, memory retention, thinking skills and the perception of learned material. Cognitive Learning Theory implies that the different processes concerning learning can be explained by analyzing the mental processes first.

<http://edtechreview.in/dictionary/2723-cognitive-learning>

Cognitive Learning Theorists

- Lev Vygotsky 1896-1934
Soviet Psychologist (relatively unknown until 1980's)
- Jean Piaget 1896-1980
Swiss Psychologist and Epistemologist (knowledge)
- Jerome Bruner 1915-2016
American Psychologist
- David Ausubel 1918-2008
American Psychologist

Vygotsky

- Human psychological development emerges through interpersonal connections and actions with the social environment
- Zone of Proximal Development (ZPD). Through the assistance of a more capable person, a child is able to learn skills or aspects of a skill that go beyond the child's actual developmental or maturational level. The lower limit of ZPD is the level of skill reached by the child working independently (also referred to as the child's actual developmental level). The upper limit is the level of potential skill that the child is able to reach with the assistance of a more capable instructor.
- Died at 37 from TB “I will like Moses die at the summit, having glimpsed the promised land but without setting foot on it. Farewell, dear creations. The rest is silence.”

Piaget (1 of 3)

- Concerned with children rather than all learners
- His theory explains how a child constructs a mental model of the world. He disagreed with the idea that intelligence was a fixed trait, and regarded cognitive development as a process which occurs due to biological maturation and interaction with the environment.
- Cognitive development is a progressive reorganization of mental processes as a result of biological maturation and environmental experience. Children construct an understanding of the world around them, then experience discrepancies between what they already know and what they discover in their environment resulting in learning.

Piaget (2 of 3)

Stages of Development

- Sensorimotor 0-2
Object permanence by forming mental representation. Peek-a-boo.
- Pre-Operational 2-7
Symbolic representation. A word stands for something.
- Concrete Operational 7-11
Logical or operational thought. Can figure things out internally versus physically.
- Formal Operational 11+ (many of our college students aren't here!)
 - Process abstract concepts and logically test hypotheses

Piaget (3 of 3)

Learning Model

- Schema (mental model, index card, script)
- Assimilation (use existing schema to handle something new)
- Accommodation (existing schemas does not work creating disequilibrium -- learning takes place forming new or modified schema)
- Equilibrium

Discovery Learning

- Children learn best through doing and actively exploring. Assimilation and accommodation require an active learner, not a passive one, because problem-solving skills cannot be taught, they must be discovered.

Bruner

- The purpose of education is not to impart knowledge, but instead to facilitate a child's thinking and problem solving skills which can then be transferred to a range of situations.
- Learners' construct their own knowledge and do this by organizing and categorizing information using a coding system. The most effective way to develop a coding system is to discover it rather than being told it by the teacher. The concept of Discovery Learning implies that students construct their own knowledge for themselves (also known as a constructivist approach).
- Using Spiral Curriculum a learner even of a very young age is capable of learning any material so long as the instruction is organized appropriately
- The role of the teacher should not be to teach information by rote learning, but instead to facilitate the learning process. This means that a good teacher will design lessons that help students discover the relationship between bits of information. To do this a teacher must give students the information they need, but without organizing for them.
- Teachers should help a child develop skills through the process of Scaffolding which involves structured interaction with the aim of helping the child achieve a specific goal.

Ausubel

- Humans acquire knowledge primarily by being exposed directly to it rather than through discovery. Understanding concepts, principles, and ideas are achieved through deductive reasoning
- Most important single factor influencing learning is what the learner already knows.
- Advance Organizer is information presented by an instructor that helps the student organize new incoming information. This is achieved by directing attention to what is important in the coming material, highlighting relationships, and providing a reminder about relevant Prior Knowledge (like schema).

Classroom Implications

Vygotsky

- Students can learn within their Zone of Proximal Development
- Teachers can help students learn more than they are capable of learning on their own

What we can do?

- Take an active role in students' learning
- Push students beyond their current capabilities but not so far as to lead to frustration
- Have students work in groups

Classroom Implications

Piaget

- You cannot teach problem solving. Students must learn through discovery and construct their own knowledge.
- Students ability to learn is pre-determined by their level (impacted by age, biology, and environment). Some of our students haven't reached the Formal Operational level and cannot process abstract concepts.

What can we do?

- Allow students to discover and construct their own knowledge that is within their ability.

Classroom Implications

Bruner

- Learners' construct their own knowledge by organizing and categorizing information using a coding system. The most effective way to develop a coding system is to discover it for yourself.
- Spiral Teaching
- Scaffolding

What we can do?

- Provide environments for students to be exposed to new material and help make connections, but let the students construct knowledge for themselves.
- Within the class and department wide, start with the basics of a concept and keep coming back to it with more and more depth and complexity
- Give students just enough help so that they can figure it out for themselves
- Stress critical thinking and problem solving skills that transfer to other situations

Classroom Implications

Ausubel

- Students acquire knowledge primarily by being exposed directly to it rather than through discovery
- Most important single factor influencing learning is what the learner already knows
- Advance Organizer

What can we do?

- Direct Instruction???
- Make sure students know prerequisite material
- Activate prior knowledge, present new information in a clear manner, and relate new material to prior knowledge

Suggested Reading

Frances Keating

References

https://en.wikipedia.org/wiki/Lev_Vygotsky

<https://www.simplypsychology.org/piaget.html>

<https://www.simplypsychology.org/bruner.html>

https://en.wikipedia.org/wiki/David_Ausubel