**Psychology of gifted learning**

**Sessions 2 and 4: Intellectual development and gifted learning**

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**Objectives** At the end of Session 4 you should be able to

- describe Piaget's stage theory of intellectual development and Vygotsky's sociocultural theory and Bruner's theory of categorization
- suggest areas in which Piaget's theory may be modified
- identify implications of each theory for understanding gifted learning.

## Content

The theories of Piaget, Vygotsky and Bruner are qualitative change theories of cogntive development; they propose that as individuals develop, the ways in which they reason or think change in qualitative ways, that is, in how individuals think.

This approach raises the possibility that gifted children may think in qualitatively different ways from other children. The qualitative change theories provide us with options for looking at alternative ways in which these children think. To some extent these theories remove the focus from outcomes to define giftedness to the processes that lead to the outcomes.

### Piaget

**The person, the culture and the time.** Piaget

- as a biologist
- influenced by Binet

**The main concepts** Piaget proposed

- we make sense of the world, know about items and events in it, using what we know
- we symbolise the world and items in it in a number of ways; through
  actions -----> perceptions and images ----->real world concepts -----> abstract concepts
  Symbolic ability is learned first during the first two years of life.
- our knowledge at any time is represented in terms of sets of related ideas (schemes) .
- our ways of knowing change qualitatively through a sequence of stages that is invariant across people.
- our knowledge changes in situation of cognitive conflict. Language is not effective to changing what people know. Learners move from one stage to the next by various mechanisms:

  (1) maturation of the nervous system

  (2) physical experience (acting on one's environment)

  (3) social experience

  (4) a gradual re-organization of knowledge by adaptation; involves two processes;

(1) assimilation ; integrating new ideas into existing knowledge.
(2) accommodation ; changing existing knowledge to accommodate new idea.

- thinking consists of mental operations; physical actions become internalised.

- individual differences in knowing are explained through different rates of development.

**Stages in intellectual development.**

The changes in intellectual abilities are grouped into broad age ranges. These are intended as approximate estimates and should not be used prescriptively. Piaget emphasised the sequential nature of the development rather than specific age levels.

- Sensory-motor stage; 0 - 2 years; action understanding
.
- Pre-operational stage; 2 - 7 years; perceptual understanding; 2 sub-stages

(1) Preconceptual stage; 2 - 4 years; perceptual understanding and
(2) Intuitive stage; 4-7 years; intuitive understanding

- Concrete operation stage; 7- 11 years; real-world logical understanding.

- Formal operational stage; 12 + years; abstract understanding.

**Applications of Piaget's theory to gifted learning : learning is affected by development.**

Piagetian notions of stage, interaction, and transitions could become building blocks for a developmental framework for understanding giftedness (Feldman , 1982).

Evidence that gifted students

- symbolise differently / in more complex ways, move more rapidly through the sequence actions -----> perceptions and images ----->real world concepts -----> abstract concepts .

- are more prone to cognitive conflict.

- engage in adaptation more easily.

- develop operative thinking (mental operations through internalising physical actions) more easily and more broadly; gifted children show broader quality or breadth of ability within a stage:

    - gifted students use / apply their knowledge structures to subtle or difficult problems within a stage more rapidly (Webb, 1974); although they are advanced in a particular domain, such as music, chess or mathematics, they do not show advanced development universally.

    - gifted children may be somewhat more advanced in a particular area of reasoning (DeVries, 1974).

- move through the sequence of stages more rapidly. General support for faster or different movement within a stage among intellectually gifted children, but mixed findings on earlier transition between stages :

    - gifted children do not enter a higher stage of development (either on traditional Piagetian tasks or in specific areas) earlier than their typically-developing peers, ( Brekke, Johnson, Williams, and Morrison, 1976; Brown, 1978; Feldman, 1991; Kelly and Witters, 1981; Roberts, 1981; Roeper and Sigel, 1966; Tan-Willams and Guttridge, 1981.

- intellectually gifted children do show evidence of stage advancement (Carter and Ormrod, 1982; Devall, 1982; Goldschmid, 1967; Goodnow and Bethon, 1966; Hix, 1990; Horworth, 1981; Keating, 1976; Lempers, Block, Scott,- and Draper, 1987; Rader, 1976; Rosenfeld and Houtz, 1978; Verizzo, 1970) of up to 2 years ahead of typically-developing peers (Carter, 1985). Moderate and highly gifted students do not differ in speed (Bekey & Michael, 1987) with both groups performing at least one formal operations task by age 9 or 10. Training effects confound rapid movement within stagewith transition to the next stage. Domain specificity is a factor in formal operations (Berninger and Yates, 1993).

  Although gifted children did not conserve earlier than their typically-developing peers, once they made the leap, they conserved across domains on conservation tasks very rapidly (Roberts, 1981). Roberts suggested that neurological development must occur to support concrete operational thinking is unlikely before age five.

- show intellectual "readiness" to learn earlier.

- show advanced changes in ability to form concepts, to sequence, to impose order.

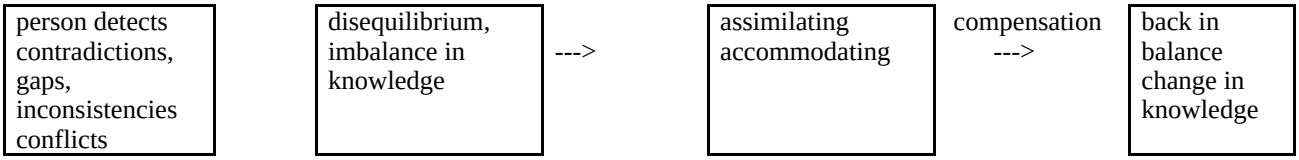
Schemes are defined as organized patterns of thought and action; the cognitive structures and behavior that allow the assimilation of new elements and help learners to adapt to the environment. Although Piaget considered schemes to be focused on action (such as grasping, eating, and drawing), concepts can also be thought of as schemes.

**Piaget's Theory of Equilibration**

When individuals encounter unfamiliar information they don't understand, an imbalance is set up in their knowledge structures. Equilibration is the self-regulating process that restores that balance but at a higher level of knowledge. To do this, two simultaneous component processes come into play

- assimilating the new item by fitting it within existing knowledge (taking in) and
- accommodating or modifying existing knowledge to deal with the new aspects.

Growth in knowledge requires structural change and occurs when children find aspects in the environment incompatible with their present schemes.




Two aspects of equilibration work in learning and cognitive growth :

- Adaptation- adjusting to the environment. When new objects, actions, ideas or events don't fit existing knowledge, the person assimilates them to what they know and modifies it to accommodate the new information. A child's concept of apples is red fruit. When given a golden delicious, the child assimilates (take in) the idea of different coloured apples and accommodates (changes) her knowing structure about apples to include their varied colours.

  Gifted students are more likely to apply the concept of different coloured fruits and vegetables to other foods or even other categories and unlike the typically-developing peers, use wide active inference ( Heller, 1979) applying the new idea to a wide range of schemes, enriching and enlarging them, making them more permeable to each other.

- Organization, the structural aspect, is the rules or laws for connecting thoughts that allow thinking. They describe how the person thinks at any time, that is, their schemes. The schemes are continually rearranged and combined to form an interconnected cognitive system.

Gifted students have enlarged and enriched schemes (Heller, 1979) that allow them to search for stimuli that help to complete their structure and show generalized assimilation, applying a scheme to all stimuli available. A gifted student interested in dinosaurs, consumes every picture book, artefact, and museum experience on the topic and relates it to monsters and present day reptiles. Their schemes are more networked, linked through extended and permeable schemes and sub structures.

As individuals' mental structures become increasingly organized and principled, they are more able to adapt, but may also lead to imbalances. This is how young gifted children think.

Types of Equilibration (Piaget (1977a) ---> three types of equilibration.

- Simple equilibration of an unfamiliar object to a scheme: for example, legos to a scheme of building things ----> small change within a stage.

- Reciprocal equilibration between two schemes which build sub-systems: for example, when a child cuts out a cat from paper and invents the idea of using it like a stencil to trace around it, she coordinates the schemes for cutting and tracing ----> more complex change within a stage..

- Equilibrations of totalities; hierarchical equilibrations in which the scheme is differentiated into parts and then the parts re-integrated into another whole. This is how person moves from one stage to the next (Piaget (1977b); for example, the child moves from pre-operational to concrete operational reasoning by constructing the operations or rules of

    - identity (the object is the same if nothing is added or taken away, i.e., when the ball of clay is transformed into a pancake, if nothing is removed, it is the same amount of clay),
    - reciprocity (a change in one aspect is compensated by change in another aspect, i.e., the pancake is wider and flatter), and
    - reversibility (can be returned to the original form, i.e., a clay pancake rolled back into a ball).

Progress through the three types of equilibrations is a slow building up of principles.

***Equilibration while learning to conserve: differences between gifted and average children***

Gifted and typically developing children differ in how they develop equilibration; (Roberts, 1981)

- typically developing children derive rules or principles from and applied to the specific and do not rapidly generalize them. They follow essentially a vertical, within scheme, movement, working forward a domain at a time, consolidating as they move through conservation. Their schemes appear to resist coordination and integration into total systems.

- intellectually gifted students, after the initial interactions which signal stage advancement :

    - move rapidly within that stage through sequential domains normally attained over span of years, or
    - move somewhat differently through these sequential levels.

Gifted learners

- operate as big picture thinkers, pattern seekers and try to construct general principles that apply to all domains, following feedback from few encounters.

- conserve simultaneously in several contexts, equilibrate across most domains of conservation; move horizontally.

- deal with specific instances of number and quantity at the same time, while developing the three operations or principles for conservation; the six year old girl who said, "I don't care what

stuff you show me. As long as you don't take anything away or add anything, it's going to be the same!" ( Roberts, 1981).

- don't generalize as much within a domain on the most difficult problems; they have the general principle but don't consistently apply it. Unlike his typically developing peers, a bright five-year-old quickly agrees that when one of the two equivalent balls of clay is flattened into a pancake or a snake, there is the same amount of clay in both "because they are the same." However, if one ball is made into seven little bears, he says, "There is more clay in the bears because there are so many!" The child's conservation is overcome by perception. He is at the beta level of compensation and is likely to sense being puzzled.

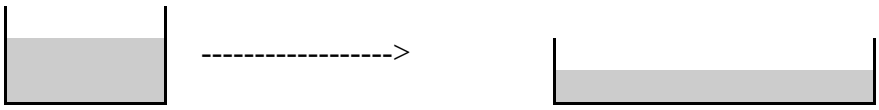
- conserve unstably across board, at beta level for broad set of domains :

    - rule applied to each new situation without extracting rule for that scheme and coordinate it with prior conservations.

    - from general to the specific

***Moderate Novelty*** Individuals assimilate new information that is moderately novel, where there are inconsistencies with what is known. Gifted children often not only ignore items that are too unfamiliar but also find then frustrating.

***Compensations*** The internal structures accommodate through actions that cancel or neutralize the disturbances ( compensations; Gallagher & Reid, 1981). Every equilibration involves both construction and compensation. Suppose child does conservation of continuous quantity liquid



previous state - now not visible or present (constructing negations) child needs to remember (construct) this

what is visible, present, evident in the object (the affirmations)

To change (accommodate) scheme, need to balance both states. To do this they need to undo mentally the action (reversibility of thought) . Young children do not represent negations well. Three levels of compensations:

- Alpha - The child doesn't deal with the inconsistency and distorts, denies or ignores it. Instruction cannot occur at this level until the child is aware of the inconsistency or contradiction.

- Beta - The child attempts to deal with the inconsistency but can only deal with partial modifications (partial accommodation). The novel element is distorted to fit existing schemes. This is the optimal level for learning.

- Gamma - the item is fits with the child's schemes.

These types of compensations are central to understanding qualitative differences in gifted children's thinking. The order of conservations is consistent but equilibrate and organize their structures differently .

| gifted students | typically developing peers |
|---|---|
| • anticipate the unknown and generalize the broad application of the principle | • conserve over a four to six year period |
| • anticipatory schemes formed before formal operational structure | • operational structure ---> anticipatory schemes |
| • begin hierarchical equilibrations when they develop schemes through simple equilibrations. | • simple equilibrations ----> ordering (differentiating)----> integrating (hierarchical equilibrations) |

The simultaneous equilibration ---> greater possibility of disequilibrium. The partial movement to a deeper level leads to an ability to anticipate - to see possibilities before having fully developed structures to deal with them. Such children are, therefore, more equilibrated.

**Summary of Piaget's Theory**

- Thought develops through qualitatively different stages. Learners go through the stages in the same order. They discover reality first through physical activity that is internalised.
- Contrast Piaget with the traditional psychometric approach. Stage vs the continuous theories.

**Neo-Piagetian theories of cognitive development**

Case modifies Piaget's theory by linking the stages in cognitive theory with information processing. Areas of modification:

- analyse the demands made in performing cognitive tasks, the strategies used.
- explain individual differences in development by looking at both qualitative and quantitative changes in the cognitive tasks, in both the complexity and focus of strategies and in the number of strategies and the extent to which they are automatized.
- memory demands in task completion.

***The processes of development*** : during thinking, knowledge is manipulated in a thinking space or 'short term storage space that has limited capacity. As learners develop, they use it more efficiently. The operational efficiency of the space is the maximum number of independent schemes a learner can attend to at once. Schemes can be combined through practice.

***Stages moved through*** in an invariant sequence and hierarchical, with higher ones reached by co-ordinating earlier ones. Movement through stages depends on the cognitive domain and is constrained by the efficiency of STM. The stages differ in

- the level of relationship child can represent / manipulate and
- the type of executive control structure they reflect.

Within each stage learners progress through 3 sub stages determined by number of elements that can be represented and how they are organized

- unifocal using one scheme of that type for obtaining a goal
- bifocal using two schemes
- elaborated co-ordination - using more than 2 schemes selectively and in co-ordinated way

unifocal bifocal elaborated co-ordination ----------
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increase in operational efficiency of STM -child can create more efficient control structures

***The structures of development :***

- sensory motor control structures — mental reps are linked to physical movements
- relational control structures — development of thought processes that control the co-ordination of 2 distinct activities /attributes child detects and co-ordinates relations along one dimension among objects or events.
- dimensional control structures — thinks in and compares in dimensional way
- relational control structures — thinks in abstract systems

Case's thoery versus Piaget's theory

- child can be at different stages in different areas of knowledge at once.
- mechanism for changing stages- determined by how well person solves problems; learners develop procedures through exploration, imitation and formal teaching.
- formal teaching allows students to learn, practice and consolidate schemes into smaller units and to increase the efficiency of the STM. Allows cultural knowledge to be taught.

**Vygotsky's theory of cognitive development** **S**ocial Development Theory (L. Vygotsky)

***Overview:*** The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition. Vygotsky (1978) states: "Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (inter psychological) and then inside the child (intra psychological). This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All the higher functions orig innate as actual relationships between individuals." (p57).

A second aspects of Vygotsky's theory is the idea that the potential for cognitive development is limited to a certain time span which he calls the "zone of proximal development" (ZPD). Furthermore, full development during the ZPD depends upon full social interaction. The range of skill that can be developed with adult guidance or peer collaboration exceeds what can be attained alone.

Vygotsky's theory was an attempt to explain consciousness as the end product of socialization. For example, in the learning of language, our first utterances with peers or adults are for the purpose of communication but once mastered they become internalise ed and allow "inner speech".

Vygotsky's theory is complementary to the work of Bandura on social learning and a key component of situated learning theory. Because Vygotsky's focus was on cognitive development, it is interesting to compare his views with those of Bruner and Piaget .

This is a general theory of cognitive development. Most of the original work was done in the context of language learning in children (Vygotsky, 1962), although later applications of the framework have been broader (see Wertsch, 1985).

Principles:
- Cognitive development is limited to a certain range at any given age.
- Full cognitive development requires social interaction.

- ***How we make sense of items and events that we perceive through our senses***

We make sense of the world through our social interaction with others, particularly in how we jointly solve social problems; the origin of learning and thinking is in social processes. Cognitive development is "the conversion of social relations into mental functions". "Intelligence is .... the internalization of 'tools' provided by a given culture". Members of different cultures interpret their experiences differently, based on how they use them.

- ***How we represent our knowledge at any time*** We symbolise the world using socially determined and valued tools and signs. Tools and signs are used and signs ----> bases for thinking and learning. Individual learning capacities at any time determined by what learners have internalized about aspects of their society.

- ***How our ways of knowing change*** . Our ways of knowing change qualitatively as we develop in a sequence that is determined by the major modes of thinking and problem-solving in a culture and vary across cultures. Our knowledge base changes when we are presented with social problems that we want to solve. Words and language are the basis for changing what people know.

- ***Thinking consists of mental operations; physical actions become internalized.***

- ***Individual differences in knowing*** are explained through different rates of development.

**Sequence in intellectual development.** Each stage is seen as being relatively stable and is preceded and concluded by a 'crisis' or transformation that leads to the next stage:

- infancy (the first year); the period of affiliation. The infant acquires 'elementary processes' that are based in conditioned and unconditioned reflexes that are determined by environmental stimulation.

- early childhood, the second to fourth years; the period of play Towards the end of the first year children are confronted by a crisis that centres around three developments; learning to walk, talk and to display emotional reactions. This stage is indicated by a curiosity about words, a rapid increase in vocabulary and the asking of questions about most aspects of life. Words are used as labels rather than as symbols. They learn grammatical forms and structures but don't understand the logic on which they are based. Vygotsky saw play as providing learners with the opportunity to try out culturally defined roles.

- pre-school period, the fourth to seventh years. Children use external signs and operations symbolically to assist in solving problems, for example, uses the fingers for counting and speaks aloud while thinking (egocentric speech). Vygotsky proposed that children speak aloud to themselves to help themselves to solve problems. He observed that children used it first at the end of an activity, then during the activity and eventually at the beginning of the activity to guide the problem-solving activity.

  During this period language and thought, that are initially developing separately, become fused or linked, thus allowing the child to use language to manage and control thinking. Speech starts to be used for thinking and thoughts are put into language.

- school period, the seventh to the fourteenth years; the period of learning. Children begin to do a range of mental activities such as count in their heads and to use logical memory. The egocentric speech is internalised and manages thinking.

**1. How tools and signs are used in a culture** Tools and signs are used in a culture ----> ways of thinking; thinking is internalized physical activity in the social context of work.

Gradual use of signs - acquisitions in intellectual development. Signs used in 3 main ways to interpret and explain experiences;

- iconic signs are images or pictures of what they stand for,
- indexical signs that have a cause-effect relationship with what they represent

- symbolic signs that have an abstract relationship with what they represent,

Children first learns to use actions signs as attempts to achieve goals and their culture 'conditions' these to operate as signs, for example, reaching for a toy-----> pointing gesture,

A sign mediates between stimulus and goal and the move to mediated activity by using signs alters cognitive operations. Higher mental processes when the mediation becomes internal and symbolic.

Signs need to be internalized. Adult's reaction to reaching changes it to pointing (a sign) via a social exchange process. When child internalises this meaning and uses the action as pointing, the interpersonal activity has become intrapersonal.

**Language (main sign system) ----> highest level thinking processes** Language is gradually internalized to become inner speech, the basis for thought, when the child's egocentric speech gradually disappears usually 5 - 7 age range.
With internalization signs are used in increasingly elaborative ways to extend understanding. Language frees them from the constraints of their immediate environment and provides the basis for decontextualization.

'**Zone of proximal development**' ; difference in how a person can solve problems without and with social support. It identifies those functions that are being acquired. This lead to proposition that learning precedes development ; learning initiates or activates developmental processes and 'pulls them along'. Teachers should not wait until students are developmentally ready to learn ideas, but rather teach to facilitate the developmental gain.

'**Intersubjectivity**' - quality of the social interaction between partners
- critical to success of learning; partners need joint understanding of the task; different from the traditional teacher-pupil interaction..
- work together to co-construct solution to problem and decide how to solve it.
- shared power and authority, inequality only in understanding of idea.

Adults are frequently more effective as partners for children than peers; because they
- promote more advanced planning strategies,
- provide more verbal instruction ,
- elicit more participation and
- are more sensitive to guiding instruction within the learner's ZPD.

Peers are often more effective in taking account of the perspectives of others.

Cultures lie along a continuum of social evolution; the more highly evolved the culture, the higher level the thinking processes of its members.
- compare the models of learning in 16th and 20th century European cultures.
- trends in categorising by adults reflect level of evolution of their culture. Level of context - bound thinking indicates cognitive development.

How do individuals categorised familiar items ?

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from non literate cultures categorise on how they go together in real life

literate individuals categorise in more generic decontextualised ways

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Individual development must be seen relative to the social contexts in which the person lives.

**Applications of Vygotsky's theory to teaching : development is affected by learning which is in turn socio-culturally determined.**

***Intellectual "readiness" to learn?*** Readiness is not a useful concept; the zone of proximal development, how far learners can develop with social support should be a focus in teaching. Learning initiates and 'pulls along' developmental processes. Teachers shouldn't wait until students are developmentally ready to learn ideas, but rather teach to facilitate the developmental gain.

***Self talk as a mediator for managing learning*** Help learners improve their ways of mediating their thoughts, for example, their understanding of visual imagery and inner language (self talk, self instruction) in learning. Ability to manage one's self as a learner, direct learning and become an independent learner can be achieved with a focus on using language to mediate learning.

***Provide opportunities for negotiating meaning in learning.*** Learners need to match their personal understanding of ideas with the conventional group understanding; the negotiation of meaning. For symbols and procedures that have culturally determined meanings, learners need to negotiate a shared understanding by transforming their empirical experiences into the culturally agreed meaning. They do this by guessing at what they might mean. They analyse, try out and share their guesses with other members to see how well they work, to take account of what others think, to question, challenge, debate and argue points of view, monitor and use evaluative feedback that indicates how close they are to what the group intends and modify their understanding. Learners also map cultural knowledge ( symbols, words and concepts) into their own experiences.

Various issues complicate the negotiation process. A learner can belong to different social-cultural groups and may need to negotiate different meanings for the same words, symbols, concepts, for example, formal versus informal non-school everyday mathematics.

***Students learn that ideas have a control or power value.*** Learners learn within a network of social-cultural interactions that direct the learning activity. The social knowledge is bound within the language in which they think. Groups impact on how learners show what they know;

- groups value some ideas more than other ideas. Tensions can arise when the ideas valued by different social groups, or how they allow the ideas to be displayed, clash.

- groups guide the course of learning towards socially valued outcomes or acceptable ends by responding evaluatively to the learning outcomes displayed.

Through feedback, learners' perceive power in the interaction and this can affect their preparedness to negotiate and show what they know. Teachers and peers use this power to direct the thinking and the outcomes of the group. They display this valuing through body language and verbal responses.

***Learners learn by co-operatively solving relevant social problems*****.** Provide opportunity to learn by collaboratively solving social problems that have relevance. Reciprocal teaching is an example combining intersubjectivity and scaffolding:

- readers working jointly to construct meaning from a text.
- the dialogue is structured to emphasise four main comprehension strategies;
    - questioning about the main points,
    - clarifying to resolve difficulties in understanding,
    - summarizing to capture the gist of the text and
    - predicting to forecast what might happen next

Teacher initially leads and models the strategies and transfers control to students.

***Encourage a student focus on ways of thinking and learning*** Encourage students to learn ways of thinking, cognitive and metacognitive thinking strategies, share with others how they go about solving problems, try out other people's ways of solving problems, etc**.**

***Develop ways of assessing learning that take account of the ZPD*** Don't only assess what learners can do independently but also what they can do with group support or teaching.

**Implications of Vygotsky for giftedness**

Evidence that gifted students

- have differed / do differ from others in their social interaction with others, engage in social problem-solving ?

- internalise different socially determined and valued tools and signs ?
- internalise socially determined and valued tools and signs more easily ?
- differ significantly in their cultural experiences ?
- have more highly developed iconic and linguistic coding systems ?
- operate more easily in the zone of proximal development (are easier to scaffold, are self-scaffolding) ? How might gifted students manipulate the ZPD ?
    - Are they more able to have their existing knowledge scaffolded by higher level thinkers ?
    - Do they need to be scaffolded in ways that allow them to develop their own directions, pursue their own interests in learning ?
    - Some gifted students show a smaller ZPD when their peers or teachers provide the scaffold ; they prefer to manage their own rather than learn in mixed ability groups.
- learn self talk more easily ?
- have parents who begin to mediate their child's learning at an earlier stage; do they manage the mother-child interactions differently ? Parents of pre-school gifted children model and foster metacognitive strategies to a greater extent than do parents of normal ability children, particularly during problem solving (Moss, 1990). The gifted preschoolers are more likely to predict consequences, reality test and monitor their thinking activity. The mothers of gifted children were more likely to initiate metacognitive interactions.
- find it hard to engage in negotiation of meaning ? they
    - attempt to make bigger adjustments at a time.
    - don't have access to models that display the intended meanings to the same extent; less access to models.
    - have difficulty getting appropriate feedback for their responses.

**Implications of Vygotsky for teaching gifted students**

- expose students to a richer, more diverse set of signs.
- encourage students to solve a more diverse range of problems, share in using tools, exploring tools to give a broader range of knowledge.
- foster, extend language learning, how to use it.
-

**Bruner's theory of intellectual development**

Categorization - humans understand the world by categorizing events or objects in terms of similarities. A major learning / thinking skill - to categorize or to conceptualize.

What is a category ?

- a representation of objects or events that have similar properties.
- a rule specifying those characteristics or attributes criterial for class membership.

Value of categorizations

- reduces complexity of environment.
- permits the recognition of objects.
- reduces need for constant learning by:
    - permitting recognition of new objects without any actual new learning.
    - permits going 'beyond the information given'.

An object is categorized on the basis of observed properties and its class membership allows one to make inferences about it.

How are categories arranged? Not all categories are at the same level of generality -- some subsume others e.g.,

ANIMALS

those that live on land those that live in water

those with backbones those without backbones

More general categories - generic codes. Forming codes assist in retention, discovery and transfer.

**How does cognitive development occur?** Two aspects

- representation - how the child codes and processes past experience
- integration - how separate acts of information processing are organized into "planful" problem solving activities

Two processes that influence how learners learn at any time;

- the representational codes to which they have access and
- the strategies by which they integrate ideas using the codes.

Representation - how learners code and process past experiences. As children develop, they gradually acquire 3 systems for making sense of their world;

- an enactive or action -based code, events and objects coded by actions ; learners can't separate objects from the characteristic actions done on / by them.
- an iconic or imagery -based code; learners build images of ideas; they can separate an image from its characteristic actions.
- a language or symbolic code; learners use symbols to represent items and events; translate their experiences into language forms. This code has greatest flexibility for learning and thinking.

The 3 modes are acquired developmentally by interaction between human capabilities and environment. Not by stage-like progress through the modes but by learning a wider range of ways of processing information. Environment facilitates movement between modes, eg, teacher questioning, students verbalising their iconic knowledge . The course of acquisition matches trends in human evolution.

The 3 modes reduce complexity in one's environment by allowing learners to order or relate groups of events in salient ways.

Learners use these modes to organize or integrate separate acts of information into "planful" sequences of operations to solve problems :

- enactive representations allow use of learned behaviours to solve problems.

- iconic representations allow information to be translated simultaneously in an image and sequence of actions.

- symbolic representations help learners to

    - deal with things remote in space, similarity and time from present and
    - plan action, organize behaviour at several levels of complexity at once

Forming codes assists learners to retain, discover and transfer knowledge.

Readiness - learner's dominant mode of thinking at the time. Whenever adults learn a new idea, they may represent it progressively in each of the modes.

Infer modes from how learners sort pictures of common objects into groups. There are 2 aspects of grouping

attributes used for grouping structure of the grouping used

Children show the following developmental trend;

| Child | Basis of grouping | Structure of grouping |
|---|---|---|
| youngest children | perceptual properties, colour, size | complexive grouping - items linked in chain, no consistency between links |
| older children | functional properties | super-ordinate groupings, linking items together on basis of shared uses or functions |
| eldest | nominal groupings | |

**Vygotsky and Piaget : similarities and differences**

***Similarities:***

- cognitive development involves qualitative changes in thinking
- change emerges from the need to resolve a conflict between ideas; one's level of reasoning changes when confronted with a challenge.
- the roles of learners and their environments are inseparable
- mental actions and operations are internalized physical actions. Vygotsky assumes that it is in the context of social problem-solving
- how they define intelligence ; both define intelligence in terms of problem-solving ability but in different ways;
    - Piaget - intelligence = problem-solving ability,
    - Vygotsky social problem-solving.
- Both agree that language is one of several semiotic (that is, symbolic) functions.

***Differences***

| Criterion | Vygotsky | Piaget |
|---|---|---|
| The elements by which thought is represented | internalized tools, signs, icons | mental operations or actions by which the elements (or contents) are represented |
| focus on development of logical thinking | how culturally developed tools, thought and language are internalized and used to understand the world | describes how a child's reasoning at any time differs from that of adults |
| Role of language in thinking | language shapes higher level thinking; can teach higher level thinking strategies | language is a vehicle for conveying thinking |
| The sources of mental images, symbols | social sources, interpersonal interactions | figurative knowledge, symbols are learnt through actions |
| Cultural / societal valuing and influences on thinking and learning | The role of what a culture / society values and encourages students to learn is a critical aspect | The physical actions that ---> basis for mental actions are learnt by acting on items provided by the culture and in ways valued by the culture. |
| How individual differences in thinking are interpreted | internalize symbols, tools, interact in different ways to solve different types of problems in different social contexts | slower development or movement through the stages |
| Role social interactions play in development | a greater emphasis on the social environment and social-cultural factors | the physical environment with a balance between the physical-logical environment and organismic factors |
| How transfer occurs | as child learns to relate knowledge and skills to new situations, initially under adult guidance | once a child has acquired a level of reasoning, can apply this across a range of situations while for |
| Source of motivation to change | child's curiosity and motivation of adults to teach cultural tools are motivators | child intrinsically motivated to interact with environment and resolve cognitive conflict |
| Readiness to learn | in terms of what child can learn next (ZPD) | in terms of level of development |
| Self-regulation, management of thinking | sees a role for this through self-talk | doesn't see a role for this |
| Variables in instruction | child's ZPD, nature and quality of teacher-child-peers interactions | child's level of development, the stimuli that initiate cognitive conflict |

- Piaget gives you a means for estimating a child's level of cognitive ability (learning) - indicates the types of relationships the child might be expected to perceive independently at any time -
- Vygotsky - not interested in isolated reasoning but in how far a child can reason with environmental support.

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