Planning and analysing science teaching & learning:

Concept of learning demand (1)

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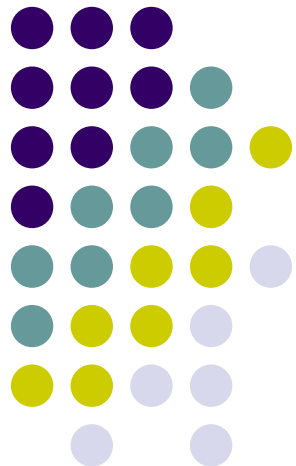
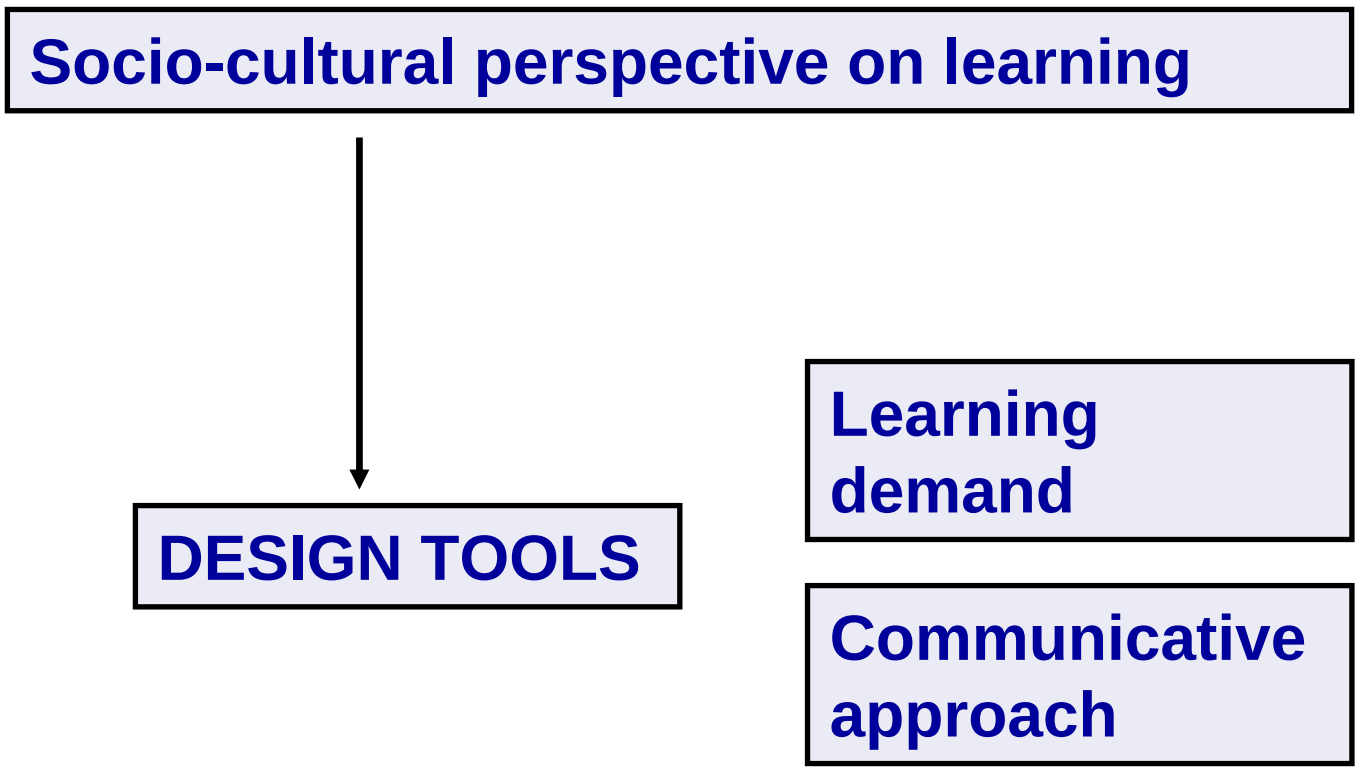


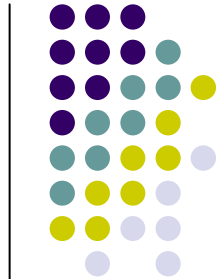
Finland December 2007

Overall approach to planning science teaching



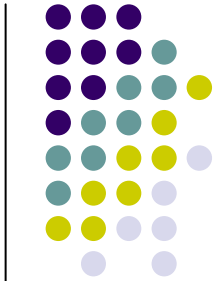
Frontispiece of Lev Vygotsky and facing title page from the original Russian edition (1934) of *Thought and Language*

Lev Semenovich Vygotsky



- Born 1896
- student days at the University of Moscow: linguistics, sociology, psychology, philosophy and the arts.
- systematic work in psychology did not begin until 1924. Ten years later he died of tuberculosis at the age of only 38.

Lev Semenovich Vygotsky



- with the collaboration of Luria and Leontiev, he launched a series of investigations in developmental psychology, pedagogy and psychopathology.
- Vygotsky actively participated in the development of the Revolution (1917) under atrocious conditions and almost total isolation from the West.
- His works were published after his death in 1934 and were not known in the West until 1958.

Lev Semenovich Vygotsky

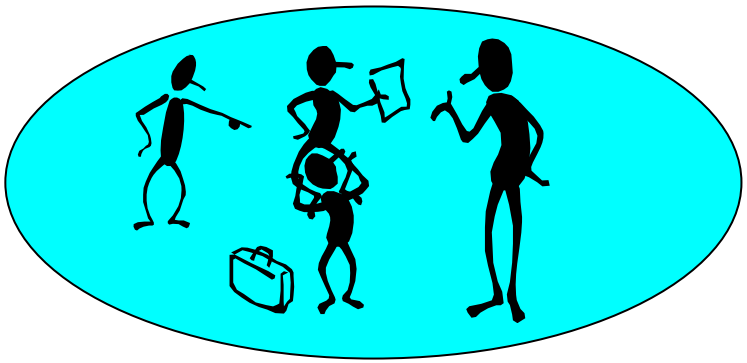
According to Luria, his student and key member of his academic group:

‘The entire group gave almost all of its waking hours to our grand plan for the reconstruction of psychology. When Vygotsky went on a trip, the students wrote poems in honour of his journey. When he gave a lecture in Moscow, everyone came to hear him’

(Wertsch, 1985, p.10).

Vygotsky: perspective on learning

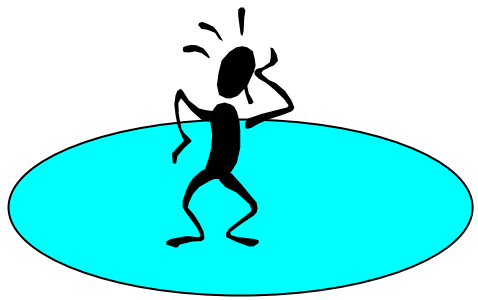
Social plane



Language (including other means of communication)

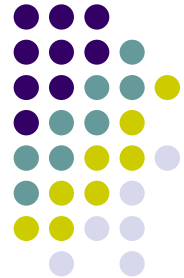
Internalisation with restructuring

Personal plane



Language as a tool for thinking

Vygotsky's general genetic law of cultural development

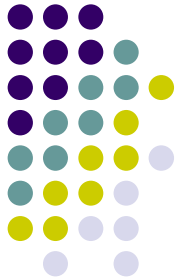


- Any function in the child's cultural development appears twice, or on two planes.
- First it appears on the social plane and then on the psychological plane.

- First it appears between people as an *inter-psychological* category, and then within the child as an *intra-psychological* category…social relations or relations among people…underlie all higher (cognitive) functions.

Vygotsky, 1978, Mind in Society, p.57

Internalisation: transfer of concepts?



‘The process of internalisation is *not* the transferral of an external activity to a pre-existing, internal plane of consciousness: it is the process in which this plane is formed’.

Leontiev, 1981, p.57

…there is a step of *restructuring* as the individual makes personal sense of the talk.

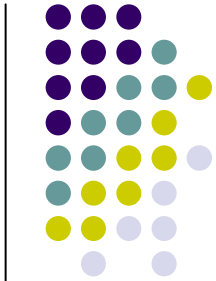
Internalisation: a dialogic process

For each word of the utterance that we are in the process of understanding, we…lay down a set of our own answering words.

The greater their number and weight, the deeper and more substantial our understanding will be…understanding strives to match the speaker's word with a counter word

Voloshinov/Bakhtin 1973

Meaning making: not just language



Semiotics:

The study of all systems of signs and symbols (including gestures, pictures, talking, writing, even hairstyles) and how we use them to communicate meanings.

Lemke, 1990, Talking Science, p.183

Kress, G., Jewitt, C., Ogborn, J. and Tsatsarelis, C. (2001)

Multimodal teaching and learning: the rhetorics of the science classroom. London: Continuum.

Development of speech…development of thought

- **Social speech**: communication with others

↓

- **Egocentric speech**: thinking aloud, seeking and planning the solutions of problems.

↓

- **Inner speech**: internal thinking

According to Piaget, 44-47% of the talk of children in their seventh year is egocentric.

Egocentric speech

A 4 year old child was posed the practical problem of getting candy from a cupboard with a stool and stick as possible tools.

Child stands on the stool, quietly looking, feeling along a high shelf with the sick:

1. **‘On the stool’.**

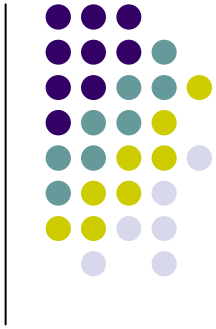
Glances at researcher. Puts stick in other hand.

2. **‘Is that really the candy?’**

Hesitates

3. **‘I can get it from that other stool, stand and get it’**

Egocentric speech



Gets second stool.

4. ‘No that doesn’t get it. I could use the stick’.

Takes stick, knocks at the candy.

5. ‘It will move now’.

Knocks candy.

6. ‘It moved. I couldn’t get it with the stool, but the, but the stick worked’.

Vygotsky 1978: Mind in Society, P.27

Children solve practical tasks with the help of their speech as well as their eyes and hands.

It’s a….

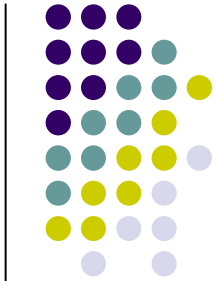
How do we develop a concept of ‘dog’?

Characteristic criteria of doginess?: NO!

The concept of ‘dog’

- develops informally through experience and language
- children develop ‘prototypical examples of dogs’ and make comparisons…
- we are socialised into ideas of doginess

Vygotsky: spontaneous and scientific concepts



Spontaneous (everyday) concepts:

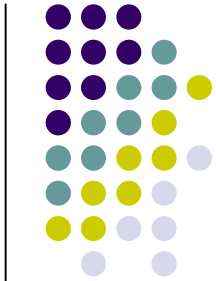
developed through everyday experience and communication and are formed aside from any process specially aimed at mastering them

Scientific concepts:

can only be developed through instruction. This is a conscious process.

scientific concepts provide the *alternative* way of talking and thinking

Students' everyday ideas



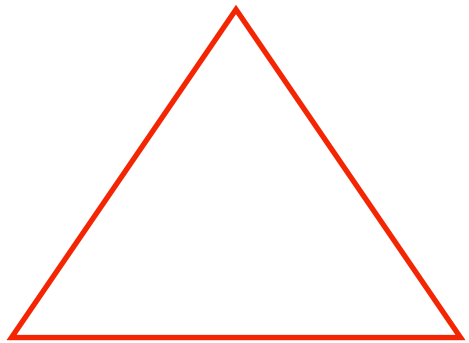
- Air is weightless…or has negative weight
- Heat is a kind of substance
- It's warmer in Summer because the Earth is nearer the Sun
- Energy gets used up

Everyday ways of thinking referred to as

'alternative conceptions' or 'misconceptions'!

Bakhtin: learning scientific knowledge

Phenomena in natural world



Everyday social language
(Spontaneous concepts)

Scientific social language
(Scientific concepts)

Learning science involves acquiring a new social language

Everyday and ‘scientific’ knowledge

Everyday social language

- Everyday ways of talking and knowing
- Moulded by experiences of the natural world and daily talk
- Learned and reinforced in daily communication
- Often non-conscious learning

‘Scientific’ social language

- A form of disciplinary knowledge
- Developed and validated by the ‘scientific’ community
- Learned through teaching
- Conscious learning

Why does the ball fall?

Everyday social language:

The ball falls because you let go of it, and it's heavy.

Scientific social language:

The ball falls because of the gravitational pull of the Earth.

Why does the ball fall?

What are the *differences* between explanations from everyday and scientific social languages?

Falling

- **Conceptual tools:** not ‘heaviness’ of the object…but the concept of ‘gravity’

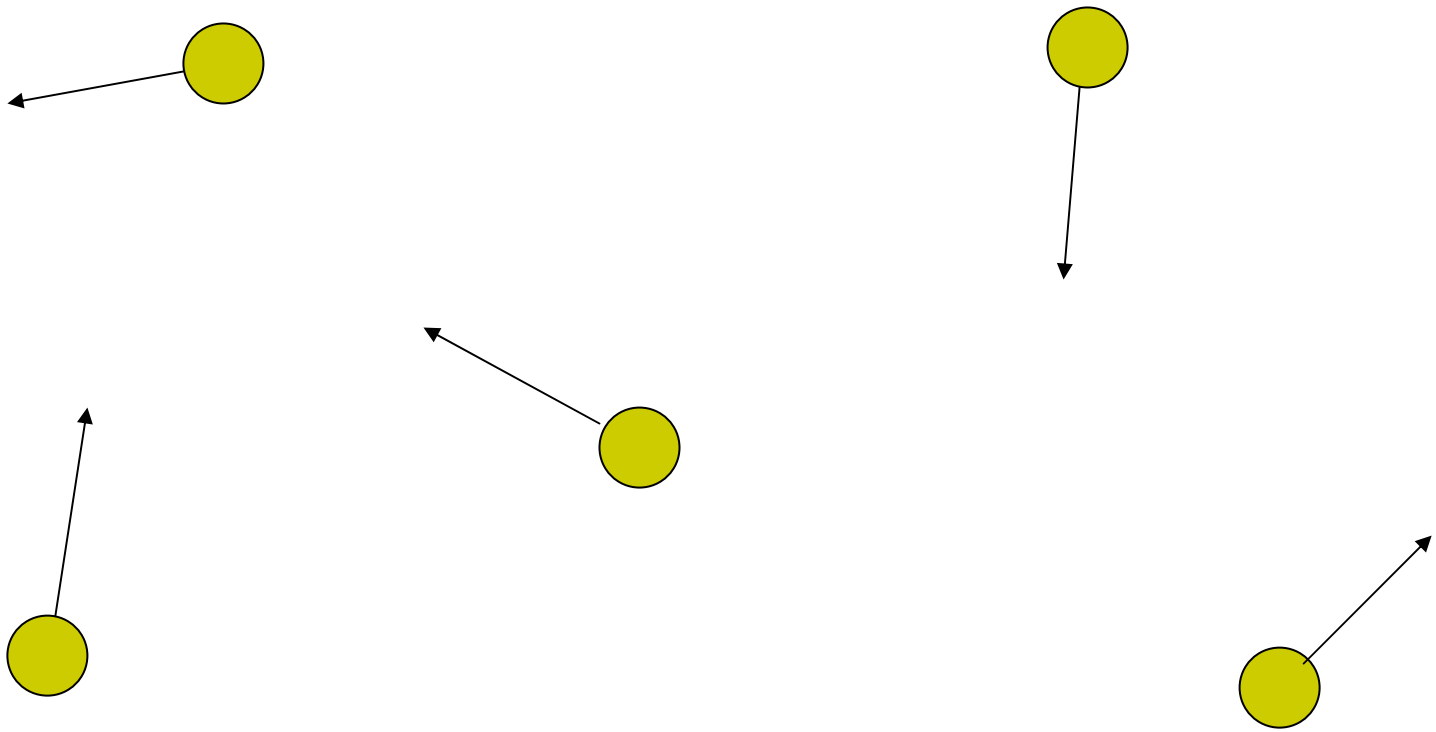
- **Ontological demand:** not a contact force…but action at a distance, ‘the pull of the Earth’

- **Epistemological demand:** not a ‘one-off’…but a *generalisable* explanation: falling, tides, planetary orbits…

Learning Demand: Leach and Scott, 2002.

Learning demand: between the particles

- What lies between the air particles?



1. And what is in between those particles?

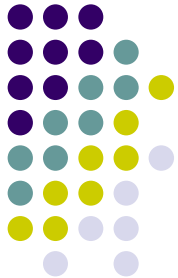
Researcher: And what is in between those particles?

Student: Hmm……..space?

Researcher: Tell me more about that.

Student: Well… there isn't really space because everything's made up of something. You can't just have something exists. Everything has pieces to it so it probably couldn't be space. It could be….smaller particles? Cos, there couldn't be nothing…so there's probably just ones that can move around. Smaller ones.

2. What is in that area between the particles?



Researcher: What is in that area between the particles?

Student: Erm….probably, as I said before…probably either smaller ones or…. erm….erm…energy?

Researcher: Smaller what?

Student: Smaller particles.

Researcher: And how are those particles different?

Student: They're probably from a different substance, since air's made up of different chemicals. Erm….the particles probably change…vary….. with the substance that it pertains to.

3. And what's in between the *smaller* particles?

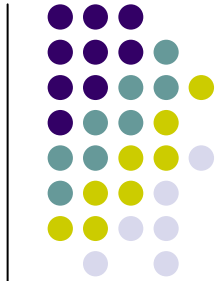
Researcher: And what's in between the *smaller* particles?

Student: Well….it couldn't be nothing. I could guess that there are probably smaller ones…. cos…erm….I'd love to say air but this is air. So…it would be….within air. You can't have nothing. So you'd have the smaller pieces.

Researcher: And why can't you have nothing?

Student: Cos I don't think that there is such a thing as nothing. Because even air which most people think is nothing….is made up of nothing…is just space…empty space. It has pieces to it as well.

Learning demand: Speed



Speed = distance/time

Learning demand

Everyday ways of talking and thinking

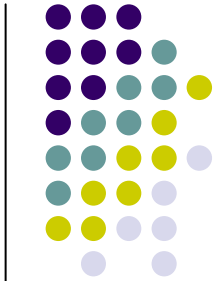
School science

(Spontaneous concepts)

(Scientific concepts)

Leach, J. and Scott, P. (2002)

BIG and SMALL learning demands



- Different areas of science make different demands
- Where the learning demand is **BIG** science can be difficult to learn and tough to teach
- Where the learning demand is **SMALL** the science seems like ‘common sense’.

Specifying learning demands

1. Identify the **school science** knowledge to be learned;
2. Consider how this area of science is conceptualised in the **everyday reasoning** of students;
3. Identify the **learning demand** by appraising the nature of any differences (conceptual, epistemological, ontological) between 1 & 2.

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