Lifelong Learning Programme

Multiculturalism, Migration, Mathematics Education and Language

M³EaL Project International Workshop

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Mathematics and Language

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- Mathematics and Language
- Maths is a special Language
- Natural Language has some Maths-like cognitive and formal properties
- What's Language?
- Language is a Faculty of Human Mind
- Where is it?

- Language is in the Brain: traditionally in Broca area / left emisphere / Brodmann areas 44-45; actually a more complex neuron network.
- Aphasia pathology studies / Language specific desease (without any cognitive deficit) / NeuroImages (PET and fMRI) / Savants' mind (Smith,N. – Tsimpli I.M. (1995)

- A language is composed by Words and Rules: words are Symbols (conventional or conventionalized – from more iconic grounds); Rules are syntagmatic and paradigmatic structure systems (Syntax- Grammar).
- A finite number of rules generates a potentially infinite number of sentences
- A finite number of phonemes (smallest phonic functionally distinctive units) combinations permits all dictionary morphemes (words) cfr. infinite numbers from 0-1

- Recursive function is a classic language property (in Chomsky's opinion is the only special property of language: MERGER operation of connection A-B-C (ABC) and so on. Otherwise it's a more general evolutionary cognitive function (not language-specific) applied in different cognitive functions (associative psychology, maths, language): deseases of language recursion but perfect number recursion).
- More than 7.000 different languages (and dialects…) but many linguistic universals (typological universals cfr. J. Greenberg's papers(1970 last 40 years).

- Chomsky UG which is the human core grammar for every language (core grammar and periphery grammar)
- You can find out core grammar in:
  - initial child's language knowledge
  - L1 acquisition process
  - (input illformed, restricted)
  - new languages birth and growth (Nicaragua sign language, pidgin-creole languages etc)

- Linguistic universals research (recently second language acquisition process in adults immigrated in Europe (1980- European Science Foundation) may support hypothesis about common cognitive communicative pragmatic needs which are the first step (pragmatic lexical communication without formal rules); the syntactic mode is a successive step (ordo verborum is SVO or VSO or SOV while the other three orders are exceptional or absent).

Linguistic rules are not sequential but hierarchical, so a sequential utterance (necessary linearization for sensorial physical performance) has a deep structure with many types of parenthetical hierarchy.

- Language Evolution has grammaticalized words (lexical communicative meaning units strictly context-bound) into functional-grammatical-syntactical units which are the grammar stones :
  - o grammar is the result of a cognitive economy process in order to represent thoughts idea
  - o argumentations context free (new born languages grammars are simple grammars with few rules, morphology, few or absent inflection)

- New languages or special cultures languages have no numbers terms or only a difference one-more than one cfr Piranha Amazon language.
- Researchers confirm that in a language without numbers culture is possible recognize a quantity bigger than another one: so some kind of maths activity is possible without language.

In Math class language variation (from dialogical discourse to descriptive and argumentative ones: Peroni 2010, Peroni et Al. 2011) correspond to different teaching styles (informal-formal, affective-non affective), different subject topics, different school levels or types etc, and necessarily to different languages with different surface structures.

- Pragmatic, visual, paralinguistic components may be advantageous in pertinent contexts . Usage of foreign language too in classroom (CLIL approaches for example) can support participation interaction and psychological attitudes with better learning results.
- Descriptive discourse is context-bound, deictic and so connected to referential reality.
- Abstract maths formulations for complex logical argumentations may be apparently simple but are the result of scientific simplifications which probably need psychological elaboration process.