Natural Language Processing in support of Learning: Metrics, Feedback and Connectivity

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Making Use of Language Technologies to Provide Formative Feedback

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Outline

• Background & LTfLL
  Language Technologies for Lifelong Learning

• Positioning of the learner in a domain

• Providing formative feedback on a learner’s Conceptual Development
  – Approach
  – Showcases
  – Future work

• Questions
Lifelong Learning
Survey: ‘critical’ support activities

- Assessment of student work
  - Formative feedback (including plagiarism)
- Answering questions
  - Routing questions
  - Formulating personalised answer
- Monitoring progress
  - Drop out prevention; personal advice
- Supporting groups and communities
  - Selecting and creating groups
  - Providing overviews & feedback to activities

Van Rosmalen et al. (2008)
Inspired to LTfLL (www.ltfll-project.org):
- FP7-TEL: a 3 year project 2008-2011
- 11 partners (8 countries, 6 languages)

LTfLL Objective

To create a set of next-generation support and advice services that will enhance individual and collaborative building of competences and knowledge creation in educational as well as organizational settings.

The project makes extensive use of language technologies and cognitive models in the services.
LTfLL - Themes

Theme 1
position of the learner in a domain

Theme 2
support feedback services

Theme 3
social and informal learning
Theme 1: Positioning

• Determine learner’s knowledge in a domain (given a specific context e.g. in support of Assessment of Prior Learning or with regard to a specific topic, competence or learning goal)
To determine in a (semi-) automatic way learner’s prior knowledge – by analyzing her Portfolio and the domain of study – to recommend learning materials or courses to follow

Locate best suitable learning materials or courses to follow

To provide formative feedback with regard to the learner’s profile in the domain of study and recommend remedial actions to overcome conceptual gaps

Provide formative feedback and recommend remedial actions
EXPERTISE DEVELOPMENT: KNOWLEDGE PROCESSES

FORMATIVE FEEDBACK
Formative feedback

• Services will offer semi-automatic measurement of *conceptual development* within a particular expertise area

• Diagnosing *conceptual development*
  – Person’s knowledge of a domain by looking on how s/he organizes the concepts of such domain
  – Novice vs. expert approach
The approach: Novice vs. Expert

Novices and experts differ in

• How they **express** the concepts underlying a domain
• How they **discriminate** relevant from non-relevant information
• And how they **use and relate** the concepts to one another
<table>
<thead>
<tr>
<th>Expertise Level</th>
<th>Knowledge Structure</th>
<th>Learning</th>
<th>Problem solving</th>
<th>Reasoning process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novice</td>
<td>Networks (incomplete and loosely linked)</td>
<td>Knowledge accretion, integration and validation</td>
<td>Long chains of detailed reasoning steps through networks</td>
<td>Step by step process</td>
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<tr>
<td>Intermediate</td>
<td>Networks (tightly linked and integrated)</td>
<td>Encapsulation</td>
<td>Reasoning through encapsulated network; abbreviated</td>
<td>Big steps (but still one at the time)</td>
</tr>
<tr>
<td>Expert</td>
<td>Illness scripts</td>
<td>Illness script for formation</td>
<td>Illness script activation and instantiation</td>
<td>Groups of steps activated as a whole</td>
</tr>
<tr>
<td>Experienced expert</td>
<td>Memory traces of previous cases</td>
<td>Instantiated scripts</td>
<td>Automatic reminding</td>
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Boshuizen *et al.*, 2004; Nievelstein, 2004
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**Evidence from:**
- Medicine
  - Networks, encapsulations, scripts
- Health sciences
  - Networks, scripts
- Business administration
  - Networks, scripts
- Law
  - Networks, encapsulation +/-, ...

Boshuizen *et al.*, 2004; Nievelstein, 2004
“Expert” Model

• Defines the expected set of concepts and relations that represent the domain of knowledge at a specific point in time of the development of a learner.

• *It is not absolute*

• → Derive it (semi-)automatically
“Expert” Model

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• *It is not absolute*

• → Derive it (semi-automatically)
“Expert” Model

1. ‘Archetypical expert’ model, state-of the art information (e.g., scientific literature)
2. ‘Theoretical expert’ model, documents of a particular course or context (e.g., course material, tutor notes, presentations)
3. ‘Emerging expert’ model, concepts and the relations a group of people (co-workers, peers...) use to describe a domain
Measuring conceptual development

Knowledge elicitation
- measure the learner’s understanding of the relationships among a set of concepts.
- Methods: concept maps, think aloud, card sorting, word association

Knowledge representation
- Define representations of the elicited knowledge that reflect underlying data organization.
- Methods: cluster analysis, tree constructions, dimensional representations, path finder nets

Evaluation of the representation
- Relative to some standard
- compare cognitive structures of experts and novices
Exploring the approach: Investigating the use of different ‘expert’ models

1. Theoretical expert model
   – Formal education
   – Medical students, course and tutor materials
   – Leximancer and Pathfinder

2. Emergent expert model
   – Informal learning
   – Employees
   – Leximancer
Exploring the approach: *Investigating the use of different ‘expert’ models*

1. Theoretical expert model
   - Formal education
   - Medical students
   - Leximancer and Pathfinder

2. Emergent expert model
   - Informal learning
   - Employees
   - Leximancer

Continuous or discontinuous?

- Gaps and transitions
  - Arts et al
  - Prince
  - Boshuizen, Schmidt
Knowledge elicitation

- A think aloud protocol to elicit students’ knowledge.
- The think aloud protocols were transcribed.

Knowledge representation

- Leximancer was used to generate concept maps for novices (think alouds) & theoretical expert model (tutor notes, learning materials).

Evaluation representation

- Pathfinder to compare cognitive structures novices & model, identify similarities and differences.
Generation of expert and student concept maps

Leximancer
Initial findings

Verification. Output discussed with an expert:

• The concept maps differ on the level of detail.
  – Student’s concept map: detailed concepts (biology)
  – Model: encapsulated concepts, panoramic view of the knowledge (the disease)
Initial findings

Learning material

Explain the reasons and conditions of a problem
“the why”

Students

Indicate procedural knowledge, mentioning how to solve a problem
“the how”

Not ideal to generate an “expert” model
Theoretical Emergent Model (Leximancer)

Knowledge elicitation

- A think aloud protocol to elicit employee’s knowledge.
- The think aloud protocols were transcribed

Knowledge representation

- Leximancer was used to generate a single concept map of all (think alouds)

Evaluation representation

- Leximancer to compare cognitive structures novices & model, identify similarities and differences
Feedback Report

✓ These are the concepts you mentioned the most …….

✓ From your peers these are the most mentioned concepts ……….

✓ The differences are: …. 

✓ This means that you might find useful to
  • Read this material
  • Do this activity
  • Contact this person
Future work

• emergent model (representation, number, quantitative metrics)
• Validation of the reliability and usability emerging expert map & report
• Design and develop service v.1
• Pilot with medical students (English)
Questions?
Contact:
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or
Peter.vanrosmalen@ou.nl

Project website:
www.ltfll-project.org

Publications: DSpace
dspace.ou.nl/simple-search?query=LTfLL