Cognitive Trait Model and Divergent Associative Learning

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Motivation

- Cognitive Trait Model is a student model that aims at creating profiles of learners’ cognitive traits by analysing learners’ interactions with the learning system.
- Information about cognitive traits can be used to avoid cognitive load in educational systems in terms of providing adaptive courses.
- Cognitive traits are more or less stable over time → CTM can still be valid after a long period of time.
  → CTM is domain independent and can be used in different learning environments, thus supporting life long learning.
- CTM includes:
  - Working Memory Capacity
  - Inductive Reasoning Ability
  - Divergent Associative Learning
Implementation of Cognitive Trait Model

- Action History Component
- Interface Listener Component
- Learner Interface
- Performance Based Model
- Trait Model Gateway
  - Individualized Trait Networks Component
    - ITN 1
    - ITN 2
    - ITN n
- MOT Detector Component
  - MOT 1
  - MOT 2
  - MOT n
Divergent Associative Learning

- **Divergent Thinking**
  - Hudson, 1966 (thinking style)
    - Convergent:
      - Good in seeing information leading to a restricted answer or solution
    - Divergent:
      - Good in creating many responses to a single stimulus (or finding a greater variety of answers to a problem)
      - More creative

[http://www.learningandteaching.info]
Associative Learning

- Based on the assumption that association can be formed between simple events or stimuli
- One end of the association is called the stimulus and the other the response
- The stimulus and response constitute a pair to be learned → paired-associate learning
Divergent Associative Learning

- inherits characteristics from divergent thinking and associative learning
- Basic idea: learners develop links between new and existing concepts
- creates divergent-style associations from the new concept to existing concepts
Differences of DAL to divergent thinking and associative learning

**DAL & Divergent Thinking**
- Divergent thinking results in new concepts or ideas while the “end products” of DAL are new associations between the new concept and existing concepts
- Focus of divergent thinking is directed forwards into an unknown space (novel and original ideas), whereas the focus of DAL is directed backwards to what has been learned before

**DAL & Associative Learning**
- While associative learning is a one-to-one association, DAL supports one-to-many associations
Web-DAL

- A instrument was developed for measuring learners’ DAL
- Online accessible
- Two steps:
  - Participants learn a new concept
  - Participants are asked to use Web-DAL to write down as many related concepts as possible in one minute
- The new concept should be from a domain that the participants are familiar with
- Measure of DAL:
  - Total number of answer items
  - Originality of answer items (where the originality refers to the inverse of the items frequency of occurrence in the entire sample)
Web-DAL

- Web-DAL is based on commonly used approaches for measuring divergent thinking skills (Alternate Uses Test)
- In contrast to divergent thinking tests, Web-DAL involves learning and asks participants to create divergent associations to existing knowledge
- In contrast to association learning tasks, Web-DAL focuses on long-term associative learning → duration between learning and testing takes weeks or months
Cognitive trait model used six manifests of traits (MOT) to create approximations of students’ DAL:

- Associative hierarchy
- Classification ability
- Versatile navigation
- Relevance filtering
- Domain performance
- Working memory capacity
Aims at comparing the approximation from the CTM with the results of Web-DAL in order to evaluate the proposed approach.

Participants: 14 students from Massey University, New Zealand (studying in Information Systems course).

Participants used a learning system that tracked their behaviour:
- The new concept was about Information Technology Infrastructure and PHP programming
- Read the descriptions
- Take a quiz consisting of multiple-choice questions

Participants were asked to perform Web-DAL.
Result

- Variables
  - Total number of answer items (Web-DAL)
  - Originality of answers (Web-DAL)
  - Approximations of DAL from Cognitive Trait Model

- Correlations between results from CTM and Web-DAL

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<tbody>
<tr>
<td>Number of answers &amp; result from CTM</td>
<td>0.499</td>
<td>0.035</td>
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<tr>
<td>Originality of answers &amp; result from CTM</td>
<td>0.653</td>
<td>0.006</td>
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</tbody>
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- These correlations support the use of CTM to create DAL profiles of learners
Conclusions

- Cognitive trait model (CTM) aims at creating cognitive profiles of learners based on their behaviour in an online course.
- We demonstrated how divergent associative learning can be included in the CTM.
- Evaluation was done by comparing the results of CTM with the results from Web-DAL, a psychometric instrument for measuring the DAL of learners.
- Results supports the use of CTM to create DAL profiles of learners.