Concept Map Analysis in the Assessment of Speech-Language Pathology Students’ Learning in a Problem-Based Learning Curriculum: A Longitudinal Study

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• Concept map – What is it?
  “A concept map is a schematic device for representing a set of concept meanings embedded in a framework of propositions.”
  (Novak & Gowin, 1984)

• Why focus on concept mapping (CM) in PBL?
  - metacognitive tool → critical thinking
  - concept mapping is parallel to meaningful learning

• Development of the Concept Map Assessment Profile
  - scoring criteria (Novak & Gowin, 1984): proposition, hierarchy, cross-links, and examples → score
  - scoring rubric (Besterfield-Sacre et al., 2004): comprehensiveness, organization, and correctness → grade: 1 to 3, description in grid
Critical Thinking and Meaningful Learning

- 學而不思則罔，思而不學則殆。
  “Learning without thought is labour lost; thought without learning is perilous.” (Confucian Analects 2:15, trans. 1861)

- “For Confucius, learning cannot be separated from thinking.” (Kim, 2003, p. 72)

- *Critical* = *Kritidos* (Greek), to question and be able to analyze (Boyadijian-Samawi, 2006)
• **Definition of critical thinking**
  - “Critical thinking is reflective and reasonable thinking that is focused on deciding what to believe or do.” (Ennis, 1985, p. 45)

• **Enhancement of critical thinking**
  - Can be nurtured – teaching of strategies; modelling
  - Active engagement with a relevant problem – PBL
  - Practical activities – CM

• **Measurement of critical thinking**
  - paper-and-pencil tests
  - CM (West et al., 2000)
PBL, CM, Meaningful Learning & Critical Thinking

Concept Map A

PBL is parallel to Concept mapping

Concept Map B

Meaningful learning cannot be separated from Critical thinking

Concept Map C

PBL is parallel to Concept mapping

Meaningful learning facilitates Concept mapping

Meaningful learning cannot be separated from Critical thinking

Critical thinking is an alternative tool in the assessment of evidence can be reflected in
A PBL Research Study

focuses on

Student Learning

involves

How Students Feel

interacts with

How Students Think

interacts with

How Students Act

can be reflected in

Student Perceptions

can be shown in the skills of

Critical Thinking

can be reflected in

Approaches to Learning

that enhance

can be found out by

Questionnaire

can be investigated by the analysis of

Concept Maps

is believed to be related to

Performance in Tutorial and Clinical Practicum

are believed to be related to

Academic Performance

findings from data analysis help in the identification of

Factors
Concept Map Assessment Profile

1. Comprehensiveness (Nodes)
   Discriminatory |        |        |        |        |        | Too many/not enough
   Grade: A     B     C     D     E     F

2. Content (Linking words)
   Explanatory  |        |        |        |        |        | Classificatory
   Grade: A     B     C     D     E     F

3. Content (Propositions)
   Accurate     |        |        |        |        |        | With misconceptions
   Grade: A     B     C     D     E     F

4. Content (Cross-links)
   Integrated   |        |        |        |        |        | Linear
   Grade: A     B     C     D     E     F

5. Clarity (Overall appearance)
   Enhances understanding |        |        |        |        |        | Detracts from understanding
   Grade: A     B     C     D     E     F

A=Excellent, B=Above ave, C=Ave, D=Below ave, E=Needs improvement, F=Fail/unacceptable
Method

• Context
  - Four-year SLP education programme, Yrs 1 to 3: PBL (clinical from Yr 2), Yr 4: clinical practicum and research for dissertation

• Participants
  - whole class of 41 students (33 females and 8 males)
  - 3 students transferred to other courses in Yr 3 → $N = 38$

• Instrument
  - Concept Map Assessment Profile

• Procedure
  - 2005-06 to 2007-08 - collect individual concept maps
    - photocopy with identity concealed
    - semester 1: 2nd problem case
    - semester 2: 6th problem case
  - Intrarater reliability - $r = .92$ (Yr3-Begin) to $r = .99$ (Yr1-Begin)
  - Interrater reliability - $r = .85$ (a random sample of 20 concept maps)
Results

- Repeated-measures ANOVA (3 years x 2 time periods) of the mean total concept map scores
  - Year and time period – not significant
  - Interaction – significant, $F(2, 36) = 41.28, p < .001$
  - Bonferroni corrected paired $t$-tests (significance criterion level of $p = .017$) for time period
    - Yr 1: Begin < End
    - Yr 3: Begin > End
  - Bonferroni corrected paired $t$-tests (significance criterion level of $p = .008$) for year
    - Begin: Yr 1 < Yr 2 < Yr 3
    - End: Yr 1 > Yr 2, Yr 1 > Yr 3
• Correlation between performance in CM and measures of learning outcomes

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aData collected in Yrs 2 and 3 only.

• Linear regression
- predictors: total concept map scores in Yrs 1 to 3
- dependent variables: measures of learning outcomes in Yr 3, except clinical performance evaluation
- concept map scores in the three years accounted for:
  32.4% of the variance in the GPA for Yr 3
  33.6% of the variance in the PBL examinations for Yr 3
  21.0% of the variance in the tutorial process evaluations for Yr 3
Discussion

- Yr 1: marked increase in CM performance across the two time periods
  - had mastered CM by the end of Yr 1?
  - stable performance in senior years?
  - students were expected to have higher performance in senior years?
  - different problem cases?

- Students with higher performance in CM demonstrated higher performance in the measures of learning outcomes, except clinical performance evaluation → Why?
  - some educators believed that, “PBL is poorly understood by clinicians” (Williams & Beattie, 2008, p. 152) → Focus on different aspects of student learning in clinical performance evaluation?
  - emphasize the links between PBL and clinical practice?
• Students’ CM performances over the three years predicted 21.0% to 33.6% of variances in the three measures of learning outcomes. However, the extent to which CM can be distinguished from critical thinking engendered by other aspects of the PBL programme is difficult to determine.

• The use of the Concept Map Assessment Profile might be extended beyond its role as an assessment tool – students’ learning may be facilitated through the provision of feedback concerning the strengths and weaknesses in the development of critical thinking.

• Introduce CM to a wider context. An open-ended response from a Yr 4 student:

  *PBL tutorial’s CM mostly focus on organizing information, can also focus on using the concept map to solve problems, instead of scheduling CM to the end of the tutorial.* (Beginning of year)
Open-ended responses from a student:

- *I think CM is good for us to well organize the things we learned. However, as lots of new knowledge is learned in a single problem, the concept map, to me, may be too complex to serve its purpose.* (Beginning of Year 1)

- *After I promoted to Year 2, I find that the awareness of whether certain concepts are relevant to the case is a more important issue as the amount of materials that given is greater. Constructing a good concept map can be time consuming, but it worth the time as it helps us well organize our knowledge. A good concept map is really helpful for our revision as well.* (Beginning of Year 2)

- *The aspect that I value the most in PBL is the concept map. This is obviously helpful as a summary of the whole problem case. Furthermore, it is a good tool to refine our understanding of the relationship between concepts (i.e. the vague relationships can be specified through CM).* (End of Year 3)
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Key References


