Group Learning Interviews to Facilitate Problem Solving Using Structure Maps

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This work supported in part by the U.S. National Science Foundation under grant DUE-0618549

Structure Mapping

Structure mapping is a visual representation which expresses relationships between concepts.

Research¹ suggests:
- Students of all ability levels could successfully create their own structure maps.
- Students, over time (~1 year) acquire high competency in using expert-designed structure maps to solve problems.

Goal

Use structure maps as a tool to facilitate students' development of expert-like approaches toward problem solving.

Research Questions

- How do students use expert-designed (by us) structure maps to solve problems in algebra-based physics and what difficulties do they experience?
- How do the structure maps evolve in response to students' feedback?

¹(Novak, 1983)
Research Design

Group Learning Interviews

2 Groups x 6 students
- 1 student dropped out, so N = 11.

Each group interview session : 50 mins.

In each session, students are:
- given 4 problems – progressively challenging.
- introduced to structure mapping strategy.
- asked to work individually and then in groups.
- asked similarities and differences between problems.
- asked to describe how they used the structure map.

Force

- 10 of 12 students: Map hard to follow, did not use
  - 2 of 10: would have used map if equations provided

- 2 of 12 students: used map
  - Helped keep track of info.

Work & Energy
Work & Energy

- 11 of 11 students preferred it over Force map.
  "...this (force map) it's all one big thing, but this (work energy map) you can follow along so you can go from this to get this ..."
- 10 of 11 students used the map.
  - Road map: followed connections from given values to those asked for in problem.
- Students still wanted to be provided equations.
  "Unless you know all the equations that they're suppose to be making, it's still a little confusing"

Simple Harmonic Motion

- At beginning: 11 of 11 saw map as too complicated.
  "...it's just a lot of arrows... a lot more stuff ... it's intimidating"
- By end of interview: 11 of 11 saw map as useful.
  - 4 of 11 used equations directly on map.
    "I don't have to like look up a bunch of different equations like, oh I don't have that... you can just see how everything relates."
  - 3 of 11 used arrows relating quantities between equations.
    "... but you know kinda what you're doing, you could be like this problem it (v) doesn't link to this (v_max) because your arrow isn't there."

Summary

How do students use structure maps designed by us to solve problems in algebra-based physics? What difficulties do they face?

- Difficulties using map with quantities in nodes, no equations.
- Map with equations in nodes and connections between quantities used as a roadmap in problem solving.

How do the structure maps evolve in response to students’ feedback?

- Initial maps had nodes containing physical quantities.
- Later maps had nodes containing equations, with arrows showing connections between quantities between equations.
Conclusions

➢ Structure Maps were used by students only when they were changed to facilitate students' existing, equation-based approaches to problem solving.

➢ So far, this study provides no evidence that structure maps significantly facilitate students' development of expert-like approaches toward problem solving.