

Group Learning Interviews to Facilitate Problem Solving Using Structure Maps

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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.

¹(Novak, 1983)

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Goal

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

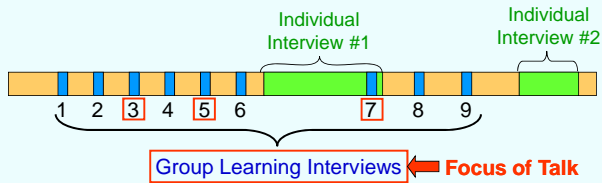
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Research Questions

- 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?

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Research Design



- | | |
|----------------------|------------------------------|
| 1. 1-D Kinematics | 5. & 6. Work & Energy |
| 2. 2-D Kinematics | 7. Simple Harmonic Motion |
| 3. Force | 8. Waves |
| 4. Rotational Motion | 9. Standing Waves, Resonance |

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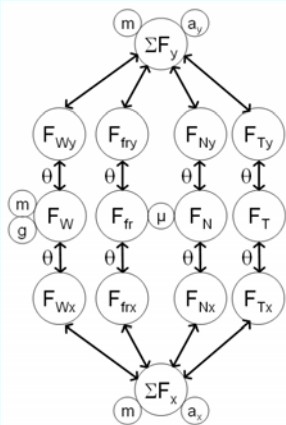
Group Learning Interviews

- 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.

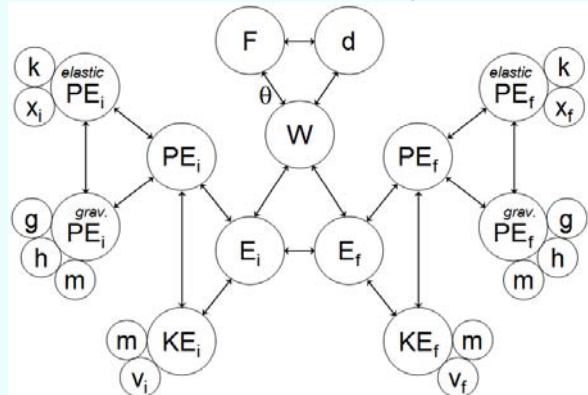
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Force

- 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

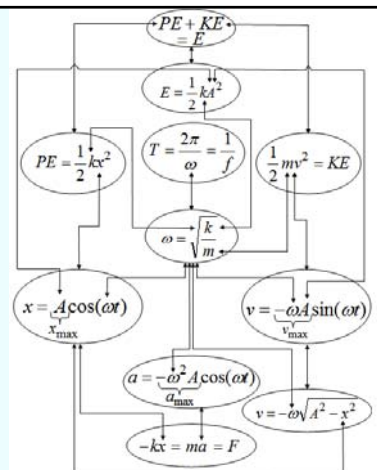


Work & Energy

- 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”

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Simple Harmonic Motion



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.”

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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.

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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.