Examining the Depth Dimension of Scale for the GEAR-Tech-21 Project

NSF ITEST Summit 2010

4-H SET Science, Engineering & Technology

CYFS the nebraska center for research on children youth families & schools

NSF

University of Nebraska Lincoln

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Presentation Overview

- Brief Background of Nebraska's 4-H Robotics GPS/GIS ITEST project
- Scale-up Dimensions
- Scaling for Depth
- Open Discussion

What We Are Doing

- National 4-H robotics program
  - Includes the integration of robotics with geospatial technologies (GIS, GPS, aerial photography).
  - Looking at applications in precision agriculture and natural resources.
  - On-line curriculum and resources @ 4hset.unl.edu/itest

Scale-up plans

- Scale-up project for national audience
  - Develop new educational robotics kit with integrated GPS and open source programming environment.
  - Continue to examine cognitive and attitudinal impacts.
  - Developed plan based on the scaling framework (Dede & Coburn, 2003).

Scale-up Framework Review

- Five dimensions of scale
  - Depth (deep and transformative change)
  - Sustainability (maintain changes over time)
  - Spread (increase users, decrease resources and expertise at the project level)
  - Shift (ownership shifts to users)
  - Evolution (learn from users, adaptations)
- Within each dimension examine considerations:

  Power of dimension, Traps to avoid,

  Role of technology, Next steps to explore

Dimension of Scale (Depth)

- Project will address the critical need to improve STEM education and to prepare youth for STEM and IT careers.
- Power of Dimension: (Evaluation and Research)
  - Examine impact on youth learning and attitudes
  - Longitudinal survey for STEM courses taken
  - Pre/Post 21st Century Skills evaluation instrument
  - Examine impact of informal educator training

Evaluation and Research

- What is the impact of an intensive week-long robotics/geospatial technologies summer camp (*full intervention)* and short 3-hr. introduction *(short-term)* on youth STEM learning and attitudes?
- Research Design: quasi-experimental research design with a between-group comparison between the treatment group (full intervention) and either the control or short-term intervention group.

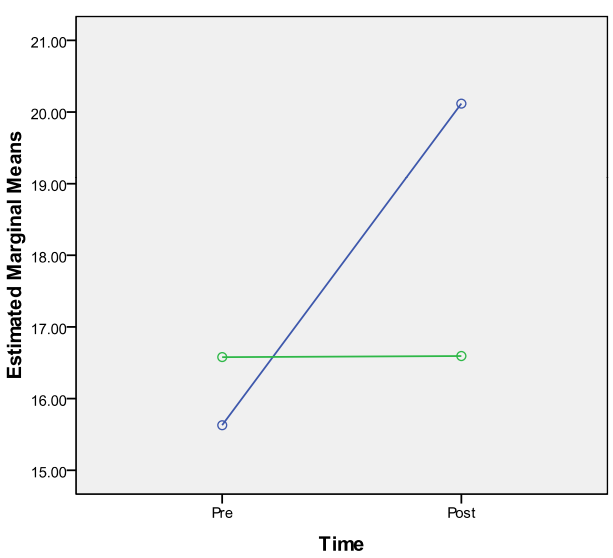
Short-term/control group intervention	O_1	O_2	X	O_3
Full intervention	O_1		X	O_2

Control Group Strategy Used

- Asked Educational Service Units to help
- Invited teachers to select several youth (with a diversity in ethnicity/gender/ability)
- Took pre-post assessments with no intervention
- After assessments the control group treated to 3-hr. robotics event with many activity stations
- Students then took the posttest again
- Resulted in good control participation (N=141)
- Schools now asking to be involved

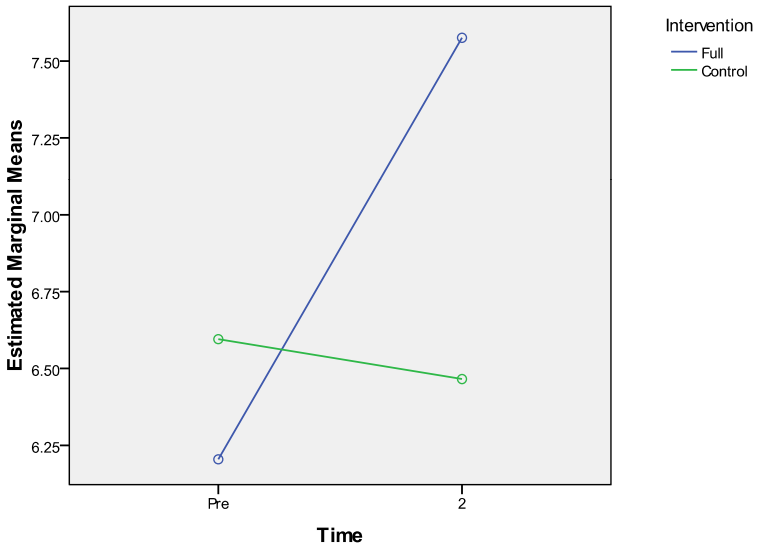
Evaluation and Research

- Learning Results



Overall Learning Score

(Wilk's $\Lambda = .72$, $F(1, 268) = 102.20$, $p < .0001$)

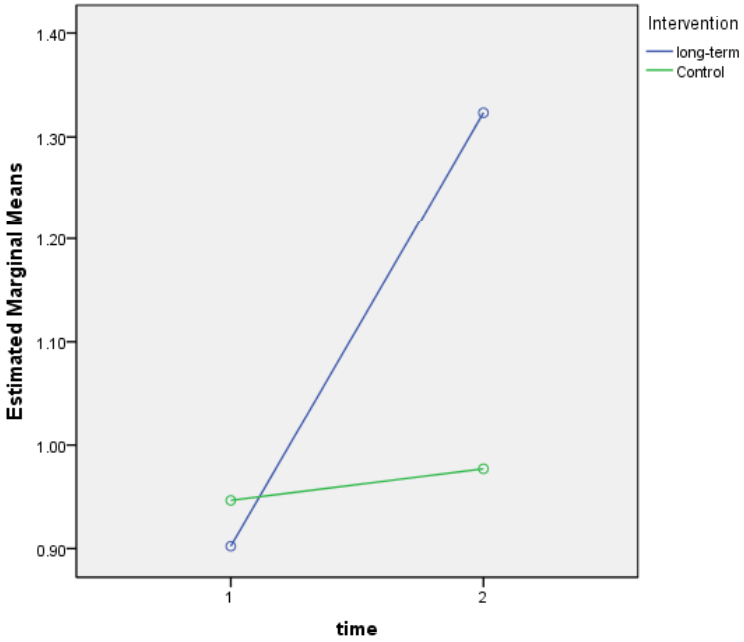


Mathematics Scale Score

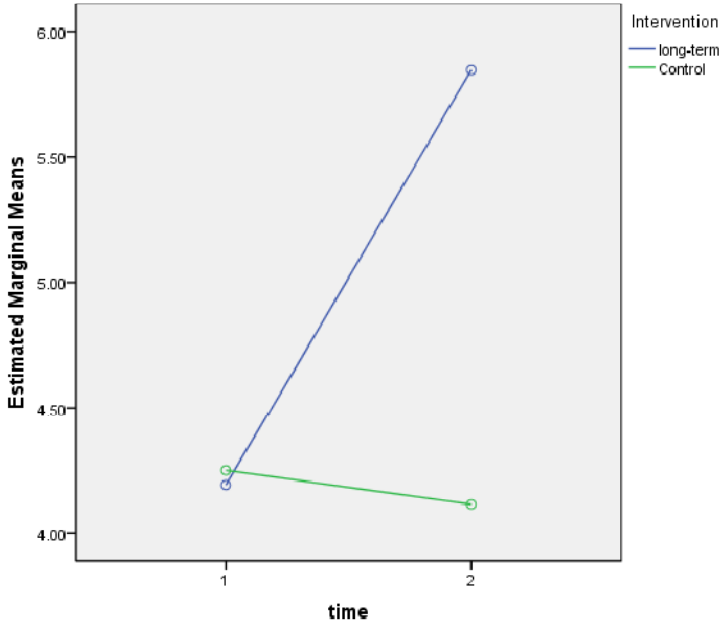
(Wilk's $\Lambda = .88$, $F(1, 261) = 35.29$, $p < .001$)

Evaluation and Research

- Learning Results



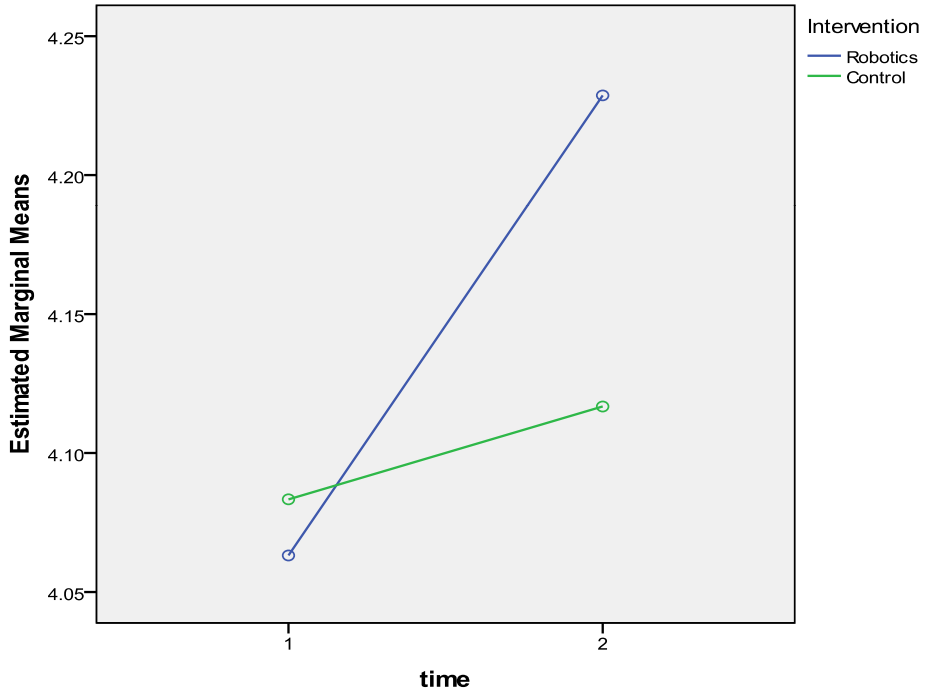
Geospatial Scale Score
(F = 10.24, p < .01)



Programming Scale Score
(F = 115.73, p < .0001)

Evaluation and Research

- Attitude Results

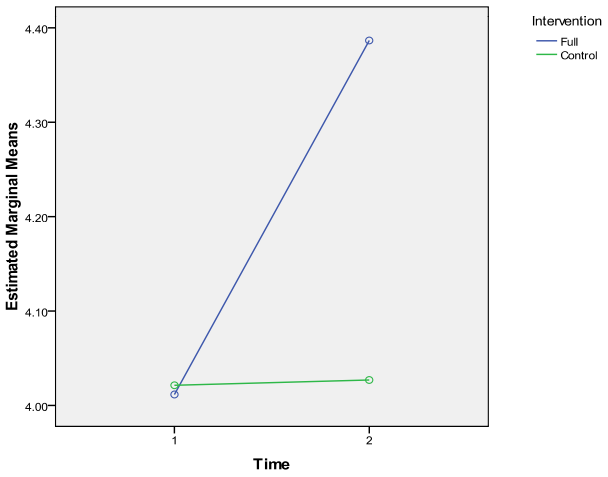


Overall Attitude Score
($F(1, 256) = 10.45$, $p < .001$).

Evaluation and Research

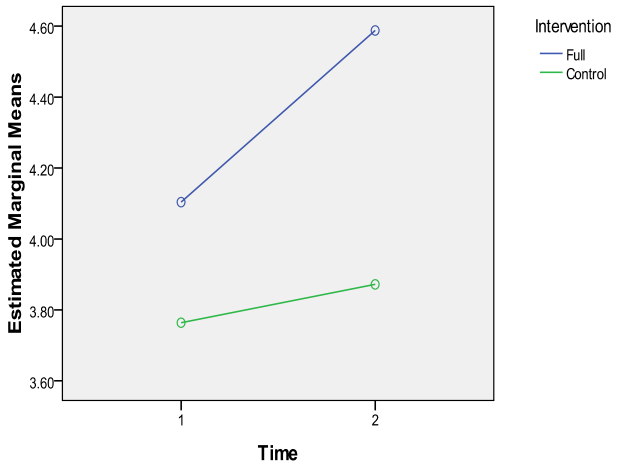
- Attitude Results

  Increases in robotics and GPS/GIS self-efficacy scores had greatest effect on overall attitude score.



GPS/GIS Self Efficacy

(Wilk's $\Lambda = .92$, $F\ (1, 249) = 20.84$, $p < .0001$)



Robotics Self Efficacy

(Wilk's $\Lambda = .92$, $F(1, 249) = 20.21$, $p < .0001$)

Evaluation and Research

- Comparison of Full and Short-term Intervention

Outcome	Full (Post) Mean	N	Short-term (Post) Mean	N	F	Effect Size Partial η^2	Significance
Total Attitude (5-point scale)	4.23	134	4.34	124	7.49	.03	P < .01
Task Value							
Science	4.20	134	4.33	124	5.89	.02	P < .05
Math	4.15	134	4.43	124	4.72	.02	P < .05
Robotics	4.41	134	4.55	124	12.86	.05	P < .0001
GPS/GIS	4.11	134	4.27	124	7.32	.03	P < .01
Self-efficacy							
Robotics	4.59	130	4.34	123	130.86	.34	P < .0001
GPS/GIS	4.39	130	4.40	123	.01	.00	P = .93
Teamwork	4.08	130	4.40	123	8.37	.03	P < .01
Problem Approach	3.96	134	4.26	123	8.30	.03	P < .01
Cognitive	20.12	137	16.81	132	126.43	.32	P< .0001

Evaluation and Research

Discussion

- Week-long robotics intervention resulted in significantly higher learning compared to a control group and short-term intervention
  - An intensive robotics instructional program can support the learning of challenging STEM concepts and processes.
- Week-long intervention resulted in higher STEM attitudes compared to a control group.
- Youth in short-term intervention had significantly higher STEM attitudes than those in the week-long intervention
  - Possibly due to highly engaging and motivating activities, with limited cognitive load.

Evaluation and Research

Professional Development: Informal educators (n = 80 from four states)

- Significant improvement in confidence in their robotics and GPS/GIS abilities and their ability to facilitate a youth-based STEM program.
- No significant improvement in their knowledge of robotics and GPS/GIS.

Dimension of Scale (Depth)

- Traps to Avoid: (Perfection)
  - Not all youth will pursue STEM courses and careers – this should not be seen as a failure.
- Role of Technology: (Computers and Telecom)
  - Technology will be used to assist learning
    - Developing interactive media for on-line delivery (4hset.unl.edu) using Drupal CMS.

Next Steps to Explore

- Developed longitudinal instrument to determine if GEAR-Tech-21 program influenced STEM courses taken.
  - Did program have influence on education choices.
  - List courses taken and courses they will take.
  - Asked potential college major and possible careers.
- Embedded assessments will be designed to focus upon specific concepts at key learning points throughout the experience.

Next Steps to Explore

- Evaluate Robotics Competitions
  - Examine learning and attitudes from robotics FLL and CEENBoT competitions (pre to post).
  - Survey parents to determine support of their child's involvement in STEM.
- Examine issues of fidelity of implementation
  - How is program implemented after training.
  - Survey and observational instruments to be developed.

Summary

- Examined depth dimension of scale as it applies to the 4-H robotics and GPS/GIS project.
- Major efforts in research and evaluation to determine effectiveness of program.
- Next steps include, researching adult training and fidelity of implementation issues, embedded assessments in the curriculum, and evaluation of competitions.

Questions?


Soar to Success
Sharing, Valuing and
Caring
About Each Other's Feelings


DELL

A final quote following questions…

"We have not succeeded in answering all of your problems. The answers we have found only serve to raise a whole set of new questions. In some ways, we feel we are as confused as ever, but we believe we are confused on a higher level and about more important things."

Omni Magazine, 1992

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