The Ergonomics of Learning - The Design of the Learning Environment is Key to Student Learning Performance

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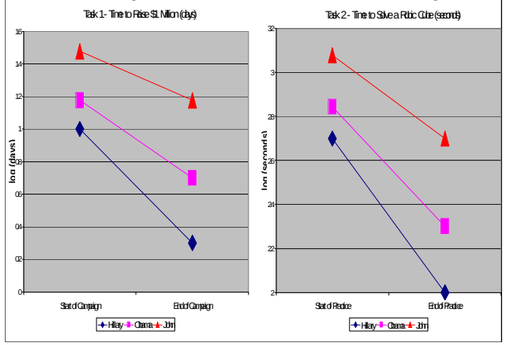
***"The main challenge in the science of human learning is to understand the requirements of educational design at all levels"* (K.U. Smith and Smith 1966, p. 478)**

PREMISE - The premise of this presentation is that the preponderance of observed variability in student learning is attributable to design factors in --- that is, the ergonomics of --- the learning environment

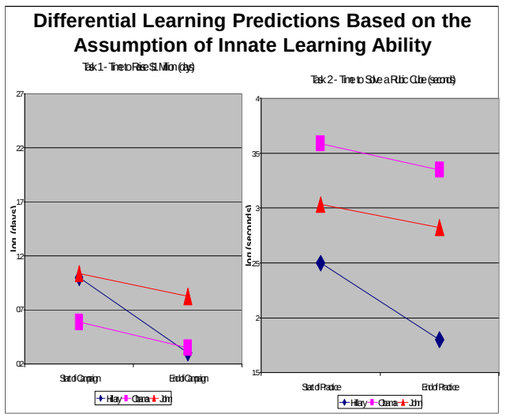
Evidence From Differential Learning Research

- Research on differential learning dates back over a century
- Variability in learning performance conceivably can be explained in one of 3 ways
  - innate biological differences in intellectual ability
  - innate biological differences in learning ability
  - differences attributable to the design of the learning environment
- Evidence from differential learning research strongly supports the conclusion that observed variability in cognitive performance and learning is largely context specific --- that is, attributable to the design of the task

Differential Learning Predictions Based on the Assumption of Innate Intellectual Ability



Differential Learning Predictions Based on the Assumption of Innate Learning Ability



Empirical findings from differential learning research support neither of these predictions

CONCLUSIONS FROM DIFFERENTIAL LEARNING RESEARCH

"IMPROVEMENT IN ANY SINGLE MENTAL FUNCTION NEED NOT IMPROVE THE ABILITY IN FUNCTIONS COMMONLY CALLED BY THE SAME NAME ... IMPROVEMENT IN ANY SINGLE MENTAL FUNCTION RARELY BRINGS ABOUT EQUAL IMPROVEMENT IN ANY OTHER FUNCTION, NO MATTER HOW SIMILAR, FOR THE WORKING OF EVERY MENTAL FUNCTION-GROUP IS CONDITIONED BY THE NATURE OF THE DATA IN EACH PARTICULAR CASE."

Thorndike and Woodworth, 1901

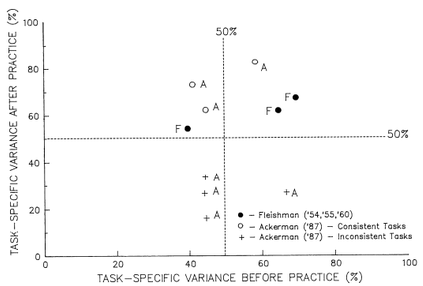
IN THE CASE OF ACTUAL WORK PERFORMANCE, THE VARIANCE ATTRIBUTABLE TO THE SPECIFIC DESIGN OF THE TASK SITUATION IS EVEN GREATER THAN THAT FOUND FOR EXPERIMENTAL TEST SITUATIONS, AMOUNTING USUALLY TO AT LEAST 75 PERCENT OF THE TOTAL VARIANCE, FREQUENTLY TO AS MUCH AS 90 PERCENT.

Jones, 1966

TABLE 1. Transfer of Learning in Cognitive Tasks*.

	Transfer Experiment			Type of Transfer
1.	Color Naming	--->	Form Naming	None
2.	Opposites Test	--->	Adjective Noun Test	Negative
3.	Two Digit Cancellation	--->	Group Cancellation	Positive
4.	Two Digit Cancellation	--->	Different Two Digits	None
5.	Addition	--->	Subtraction	None
6.	Addition	--->	Multiplication	Negative
7.	Addition	--->	Division	None

Results of Poffenburger (1915)



The Bottom Line

Understanding How to Design Learning Environments is Key to Understanding How and Why Children Learn

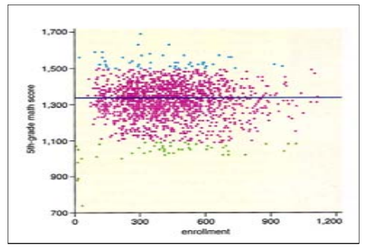
Unless or Until Educators Understand and Appreciate this Lesson, Efforts to Dramatically Improve Learning Performance of Children Will Continue to Have Limited Success

What ergonomic design factors have the greatest influence on variability in student learning?

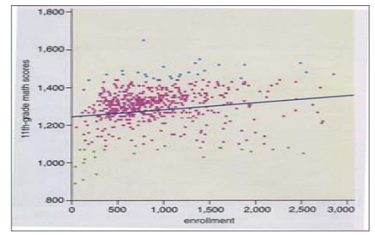
Class Size?

Nope!

Average Math Scores for 5th Graders in Relation to Overall School Enrollment for 1,662 Pennsylvania Schools (Wainer, 2007)



Average Math Scores for 11th Graders in Relation to Overall School Enrollment for 1,662 Pennsylvania Schools (Wainer, 2007)



Teacher Pay for Performance Systems?

Not Likely!

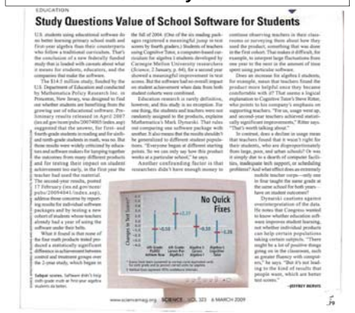
Minnesota › Education

Report: Q Comp not linked to results

Governor wants incentive pay extended

Use of Technology?

Probably Not!



EDUCATION

Study Questions Value of School Software for Students

Physical Activity Interventions?

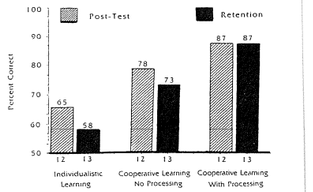
Very Likely!

Warming muscles & MINDS

Cooperative Learning Environments?

Absolutely!

Figure 4.4 Group Processing And Productivity

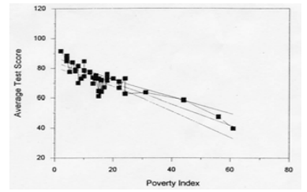


(Cartwright & Zander, 1968; Johnson & F. Johnson, 1982; Napier & Gerschenfeld, 1981; Schmuck & Schmuck, 1974). It is a truism in group dynamics that to be productive groups have to "process" how well they are working and take action to resolve any difficulties members have in collaborating together productively.

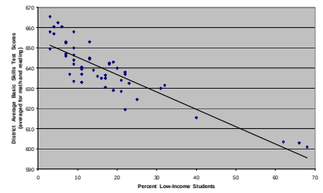
And the Winner is?

Socioeconomic Status of Students

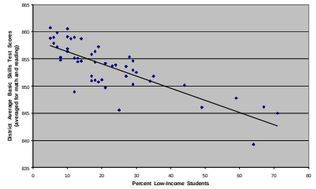
8th Grade Basic Skills Test Scores for 1996, 2002 and 2006, (averaged across math and reading) for Metro-Area School Districts, in relation to District poverty index levels
(1996: 38 Districts, $r^2 = 0.75$)
(2002: 50 Districts, $r^2 = 0.77$)
(2006: 50 Districts, $r^2 = 0.65$)



Twin Cities Metropolitan Area School Districts
Average 8th Grade Basic Skills Test Scores 2002



Twin Cities Metropolitan Area School Districts
Average 8th Grade Basic Skills Test Scores 2006



Conclusions

- Based on math and reading standardized basic skills test scores for 8th graders in metro-area school districts over a 10-year period, the poverty index consistently accounts for from two-thirds to three-fourths of the variance in test performance
- This suggests that school districts should invest in enhancing the socioeconomic status of their communities as a key strategy for improving student learning performance
- To do so however will require a paradigm shift on the part of the public school system
- The University of Wisconsin provides a model with the Wisconsin Idea: 'the boundaries of the campus are the boundaries of the state'
- For public school systems, the parallel idea is: ' the boundaries of the school are the boundaries of the community'

How do you extend the boundaries of the school to the boundaries of the community?

2007 Column by David Brooks, New York Times: 'A critique of pure reason in education'

- Relationships children have outside school shape their performance inside the school
- Family relationships matter more to learning than anything else
- Schools filled with students who can't control their impulses, who can't focus their attention and who can't regulate their emotions will not succeed
- If we want to have successful human capital policies, we have to get over the definition of education as something that takes place in school between the hours of 8 and 3, between the months of September and June, and between the ages of 5 and 18