

De-constructing Constructs: Evaluating Stability of Higher-Order Thinking Across Technology-Rich Scenarios

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Big changes are afoot

(Multiple choice items aren't going anywhere)

- But, tests these days do look a bit different
 - tasks and response format options
 - delivery mechanism
 - media inclusion / resources
 - constructs / skills of interest (21C)
 - interactivity

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Technology-rich assessments

- Such tasks draw on technological capabilities to advance both
 - construct-related priorities
 - operational issues
- What data is captured can change the game
 - Not only outcomes but also process
 - Challenge to separate signal from noise

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Considering complex data (Zenisky & Sireci, 2013)

- When items administered via technology, anything could be observable
 - Semi-amorphous data (Scalise, 2013)
- What should be in the scoring model?
 - Universe of important actions (Luecht & Clauser, 2002)
- Item analysis as "information foraging"
- Potential for emerging measurement approaches to change how we (testmakers) think about tests, test quality, and item analysis

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So... Processing Process

Can our technological capabilities capture process data that helps educators better understand what students do when confronted with 21st century skills types of problems?

What kinds of approaches are and are not successful?

Almond, Deane, Quinlan, Wagner, & Sydorenko (2012), Bouchet, Harley, Trevors, & Azevedo (2013), Kerr & Chung (2012), Kinnebrew, Loretz, & Biswas (2013), among others

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The present (exploratory) study

- Our interest: Explore elements of comparability for two critical thinking tasks
 - What do these tasks and the collected data tell us about what examinees know and can do?
 - To what extent is this information consistent across tasks that are constructed to be parallel?
 - What data analysis methods are informative from a measurement perspective?

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Our Caveat: Think forest, not trees



- Data limitations are such that we will refrain from narrow focus on the tasks and specific implications
 - an illustrative example of DA issues
 - evaluative strategies and approaches

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Data

- Computerized 21st Century Skills Assessment
 - Critical thinking, creativity, and collaborative problem solving (Rosen & Tager, 2013)
- Two scenarios: Organic Milk (OM) and Dolphin Dilemma (DD)
 - Internet Search and Note-taking; Interviewing Experts; Concept Map; Recommendation (essay)
- Organic Milk: N = ~180 middle schoolers
- Dolphin Dilemma: N = ~90 middle schoolers
- Scoring: Each task is scored on 0-3 scale by teachers (total score is a weighted composite of subscores)

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BEFORE YOU BEGIN | YOUR TASK

The interface | The Task bar | The Tool panel | The Story panel | Email from the principal | ?

April
Timer: 0:00:21

You've received an email from the school principal...

Inbox

From: principal@schoolmail.edu
To: me@schoolmail.edu
Subject: Organic Milk

Mrs. K in the school cafeteria needs your help. She wants to know whether or not to buy organic milk for the cafeteria.

Please put on your investigative reporter's hat and research whether or not organic milk should be bought for our cafeteria.

Using Internet searches you will have to find several sources to support buying either normal milk or organic milk. You will also have the opportunity to interview experts. Take good notes and document your findings in your Journal. Be prepared to show how you conducted your research and summarized your findings in your article for the newspaper.

You should make a note of any claim made that supports either organic milk or traditional milk and look for evidence that supports these claims.

Journal | Video

You haven't created any notes yet!
Highlight & drag text or type below to create your first note.

Category?

Select 250 Save

Next

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BEFORE YOU BEGIN | YOUR TASK

The interface | The Task bar | The Tool panel | The Story panel | Email from the principal | Search the Internet | Search results

April
Timer: 0:00:55

Google

Search

World's Best Organic from Greenfield Organic Farms Milk
www.greenfieldorganicfarms.com
Produced by family farmers in harmony with nature without antibiotics, synthetic hormones or pesticides. All Greenfield Farms dairy farms are pasture-based, meaning a major portion of the cows' diet comes from certified organic pasture.

Organic Milk Association
www.organicmilkassociation.com
What's the difference between organic milk and regular milk? About \$3 per gallon in most stores -- but smart consumers are realizing that for health reasons alone, it's worth paying extra for organic milk.

Organic Milk FAQs
www.DairyFarmersofNorthAmerica.com
In terms of quality, safety and nutrition, there's no difference between organic and regular milk. Both contain the same combination of nutrients that make dairy foods an important part of a healthy diet.

Anti Organic: Why Organic Isn't Better
antiorganicblog.tumblr.com
Lost my job today, theoretically because the company is restructuring and no longer needed me. No one else was asked to leave, though. I think they may have seen my blog, and they must not have liked it.

Journal | Video

You haven't created any notes yet!
Highlight & drag text or type below to create your first note.

Category?

Select 250 Save

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BEFORE YOU BEGIN | YOUR TASK

The interface | The Task bar | The Tool panel | The Story panel | Email from the editor | ?

April
Timer: 0:00:24

You've received an email from a newspaper chief editor...

Inbox

From: mrwalson@thedailypaper.com
To: me@thedailypaper.com
Subject: The Dolphin Dilemma

Hi

Your last article for our newspaper was great. I have a new task for you.

A new dolphin stadium will be built in our city, but some people raise concerns about dolphins' captivity, such as dolphins' welfare, etc. I want you to investigate the issue of dolphins' captivity and write a new article for our newspaper.

Remember, every claim should be supported by evidence from your sources.

Ready?

Journal | Video

You haven't created any notes yet!
Highlight & drag text or type below to create your first note.

Category?

Select 250 Save

Next

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BEFORE YOU BEGIN | YOUR TASK

The interface | The Task bar | The Tool panel | The Story panel | Email from the editor | Dolphin show | Search the Internet | Search results

April
Timer: 0:01:21

Google

Search

Dolphin therapy is booming despite concerns about efficacy and animal cruelty
www.washingtonpost.com > Health
Do you or does your child suffer from cerebral palsy? Down syndrome? Autism? A knee injury? General ennu? If you do - and you have a week or two and a few thousand dollars to spare - a growing and controversial ...

Sea World Dolphinarium
www.seaworldparks.com > Dolphinarium
The most familiar of all dolphin species - bottlenose dolphins - live all over the world and travel in ever-changing social groups. These charismatic and intelligent marine mammals feature extraordinary adaptations and ...

In Opposition to Dolphin Captivity
animal.discovery.com/hiblood...opposition-dolphins-captivity.html
LDr. Lori Marino of Emory University speaks in opposition to dolphin captivity.

Journal | Video

You haven't created any notes yet!
Highlight & drag text or type below to create your first note.

Category?

Select 250 Save

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Data Limitations

- Component and overall scores for DD scenario not yet available, limits replication of OM analyses
- Some differences in data collection observed
 - 7 countries for OM, 3 for DD
- Scenario implementation varied in one important aspect
 - OM: students had to make notes before clicking through to the Concept Map creation task
 - DD: students could click to the Concept Map task without making any notes, then back to notes

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Method Overview

- Focus on process data for note-taking activity, note use in concept map creation
- Data extracted for **both** scenarios:
 - Task time
 - Percent of notes labeled as "claims"
 - Percent of notes labeled as "evidence"
 - Percent of notes labeled as "my notes"
 - Percent of notes labeled as either "claims or evidence"
 - Percent of notes used in the concept map
 - Total number of notes taken by students

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Method

- Similarity of information collection across tasks
 - What constitutes a claim or evidence may be indicator of critical thinking proficiency
- Note-taking patterns / strategies employed across tasks
- Relationship between process data and outcome data for Organic Milk only
 - Correlation between outcome score and process variables

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Results: Information Collected

- OM took longer for students to complete

Variable	Task	Mean	SD
Task Time (minutes)	OM	64.7	26.9
	DD	57.2	29.3
Total # of Notes	OM	16.2	11.9
	DD	13.5	9.7

- About 3 more notes taken for OM than DD

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Results: Information Collected

Variable	Task	Mean %	SD
% Notes: Claims	OM	36%	17%
	DD	50%	22%
% Notes: Evidence	OM	36%	17%
	DD	30%	18%
% Notes: "My Notes"	OM	29%	22%
	DD	20%	20%

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Results: Information Collected

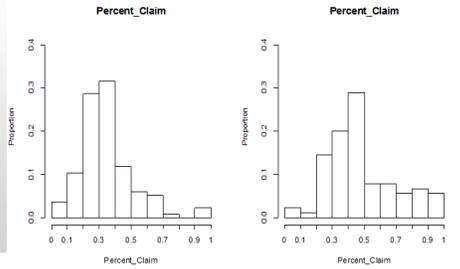
Variable	Task	Mean %	SD
% Notes Used in Concept Map	OM	59%	27%
	DD	72%	21%

- Higher proportion of notes was used for DD than OM
 - Recall that about 3 fewer notes taken for DD

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Proportion of Frequency, % Notes: Claims

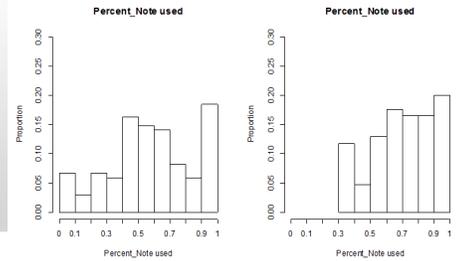
organic milk dolphin dilemma



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Proportion of Frequency, % Notes Used in Concept Map

organic milk dolphin dilemma



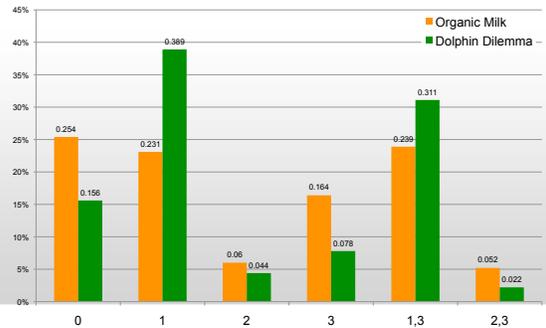
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Results: Note-taking Strategies

- 0: Did not go back to the web sites when constructing map
- 1: Go back to website for more notes before constructing map
- 2: Go back to website but do not take notes before constructing map
- 3: Type in own notes before creating map
- 1,3: Both go back to take notes and create own notes before creating map
- 2,3: Go back to website without taking notes, but create own notes before creating map

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Results: Note-taking Strategies



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Results: Process and Outcome

- Relationship between note-taking data and total score (Organic Milk only, N=129)

Variable	r	p-value
Claim	.46**	0.000
Evidence	.34**	0.000
My Notes	.21*	0.017
Total Notes	.43**	0.000
Percent Notes in Map	.21*	0.015
Task Time	.45**	0.000

* Correlation is significant at the 0.05 level (2-tailed)
 ** Correlation is significant at the 0.01 level (2-tailed)

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Results: Process and Outcome (OM)

- Descriptives for task scores by note-taking pattern

Pattern	N	Concept Map	CMap Link	Google	Essay	Total
0	30	1.23	0.33	1.11	1.24	1.17
1	31	1.45	0.35	1.26	1.58	1.38
2	8	1.38	0.25	1.13	1.50	1.29
3	21	1.62	0.38	1.38	1.62	1.47
1,3	32	1.84	0.38	1.16	1.63	1.54
2,3	7	1.00	0.29	1.14	2.00	1.37
Overall	129	1.50	0.39	1.20	1.53	1.38

Conclusions

- Original goal was to examine equivalence of two tasks evaluating critical thinking
 - Limitations proved to be limitations
 - Led us to focus on process, rather than outcomes
- Some clear differences between OM and DD were observed: but why?
 - Task differences, admin protocols, sample issues?

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Conclusions

- Difference in time taken: administration differences (OM v. DD)
- If note-taking strategies impact results, then it may be helpful to know which strategies are preferred from a pedagogical standpoint
- Some construct equivalence was found when examining intercorrelations of process variables
 - Patterns stable across tasks given small *N*s

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Conclusions

- The frequency of use for different note-taking strategies varied across scenarios
 - How task is administered matters
 - Let pedagogy guide that choice
- Connecting Process and Outcomes (OM only)
 - Moderate relationships between process and total scores
 - Actionable results - findings suggest that there are specific ways students can improve critical thinking skills as measured by these tasks

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Next Steps

- Operational: Ensure consistency in admin protocols
- Data: Investigate student sample characteristics
- Research: Replicate OM analyses with DD when scoring info available

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Closing Thoughts

- No strong conclusions about construct equivalence / stability possible here
- Promise of these tasks / task families is high, but plenty of work remains in this area
- Numerous strategies for investigation are possible and potentially informative

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Thanks!

Questions, comments?



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