

# Learning Progressions for Assessing 21<sup>st</sup> Century Skills

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A public lecture presented at the Faculty of Education  
University of Hong Kong

March 4, 2022

# Abstract

By 21<sup>st</sup> Century skills, we are interested in the assessment of skills such as digital literacy and collaborative problem solving. The use of these skills is often situated within technologically sophisticated environments: Hence, assessments of them must also be embedded in technologically enhanced testing contexts. This leads to a problem: the technologies involved are evolving rapidly, so that the means of assessment must also be de adapted rapidly, sometimes within just a few years. In terms of measurement, this creates a *problem* of linkage across time, where the old measurement tasks must be continuously replaced with new one, which will make for complications in maintaining a useful measurement reporting scale over time.

In this presentation, having set this *problem* in place, I will discuss the following topics:

- (a) the idea of a learning progression in the context of 21<sup>st</sup> century skills, giving an example in the domain of digital literacy;
- (b) how the presence of a learning progression can be used to address this *problem*; and
- (c) how the learning progression can also be used to relate different grain-sizes for assessment in the classroom.

# Outline

- Setting the problem
- Learning progressions in 21<sup>st</sup> Century skills
  - Example: ICT Literacy
    - Traditional formulations
  - A new formulation
  - Applying the BEAR Assessment System
    - Construct Maps, Item Design, Outcome Space, Wright Maps
- A perspective on the problem
- Using a learning progression to relate classroom assessment at different grain-sizes
- Conclusion

# Outline

- **Setting the problem**
- Learning progressions in 21<sup>st</sup> Century skills
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# The problem, in a nutshell

- **Definition** ... 21<sup>st</sup> Century skills: skills beyond the usual subject topics, such as digital literacy and collaborative problem solving.
- **Observation** ... The use of these skills is often situated within technologically sophisticated environments: Hence, assessments of them must also be embedded in technologically enhanced testing contexts.
- **A problem** ... the technologies involved are evolving rapidly, so that the means of assessment must also be de adapted rapidly, sometimes within just a few years.
- A measurement/assessment problem ... need for linkage across time
  - the old measurement tasks must be continuously replaced with new ones, which will make for complications in maintaining a useful measurement reporting scale over time.

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# A traditional ICT literacy framework

Basic Concepts

File Management

Information and Communication

Spreadsheets—Excel

Presentations—PowerPoint

Word Processing—Word

*From Framework for the Computer Skills Placement Test Questions*  
(Dallas County Community College District)

# A traditional ICT literacy framework (detail)

## Internet

- Open (and close) a Web browsing application
- Change the Web browser Home Page/Start Page
- Refresh a Web page
- Display, hide images on a Web page
- Bookmark a Web page
- Activate a hyperlink/image link
- Select a specific search engine
- Knows how to prevent unauthorized access to a PC

*From Framework for the Computer Skills Placement Test Questions  
(Dallas County Community College District)*



# Example items from the framework (1)

Information and Communication - How can the risk of unauthorized computer system access be reduced?"

- By installing anti-spam software
- By using a firewall
- By setting up a WAN
- By encrypting all data stored in the system

# Example items from the framework (2)

Information and Communication - How can the risk of unauthorized computer system access be reduced?"

- By installing anti-spam software
- By using a firewall
- By setting up a WAN
- By encrypting all data stored in the system

Information and Communication - What is 'Spam'?

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# Assessment and Teaching of of 21st-Century Skills ( ATC21S)

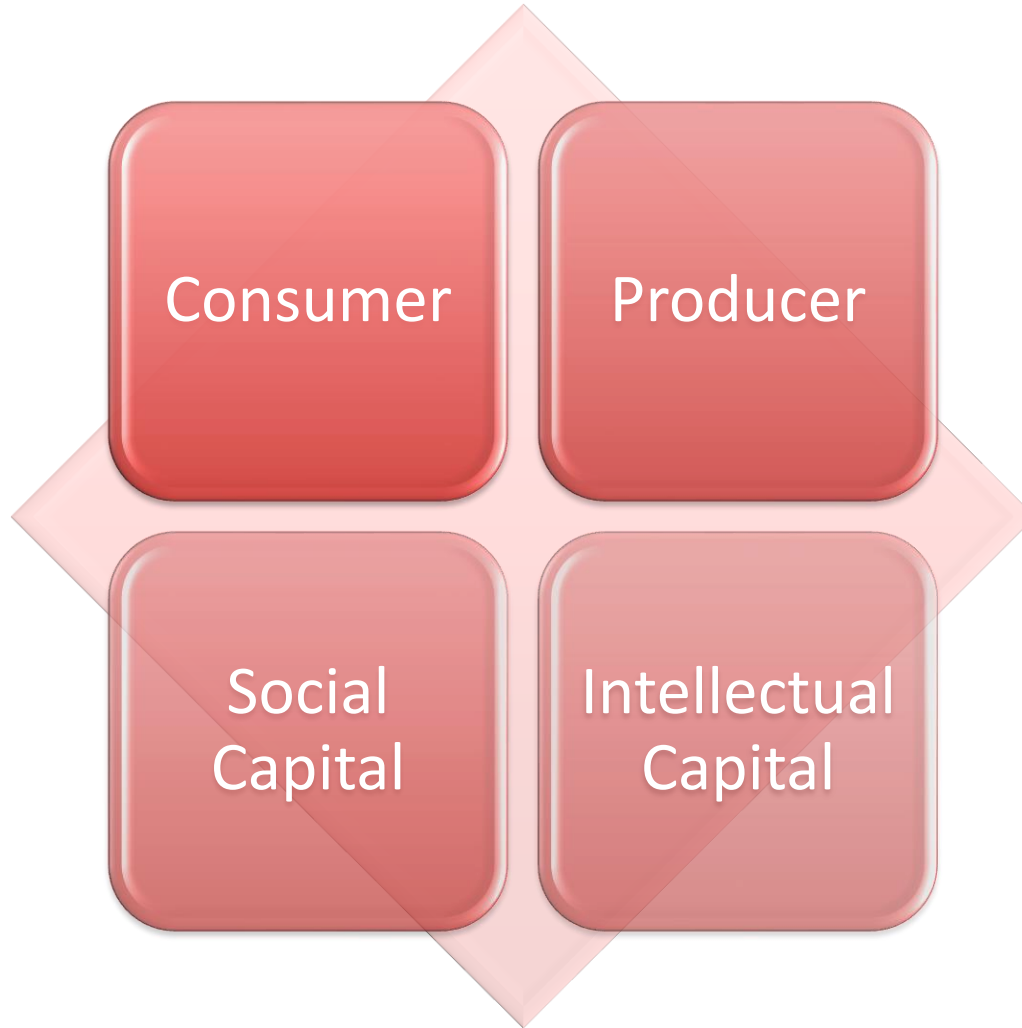
Kathleen Scalise &  
Mark Wilson

# The ATC21S partnership

- **Founding Partners**
  - Cisco, Intel, Microsoft
- **Founder Economic Jurisdictions**
  - Australia, Finland,, Singapore, USA
  - new partner—Costa Rica (World Bank sponsored)
- **Previous Work**
  - *White Papers* available at [www.atc21s.org](http://www.atc21s.org).
- **Developers of Assessments**
  - ICT Literacy: UC Berkeley and University of Oregon
  - Collaborative Problem Solving: University of Melbourne



# ICT Literacy: Learning in Digital Communities



# ICT Literacy: Learning in Digital Communities

Roles

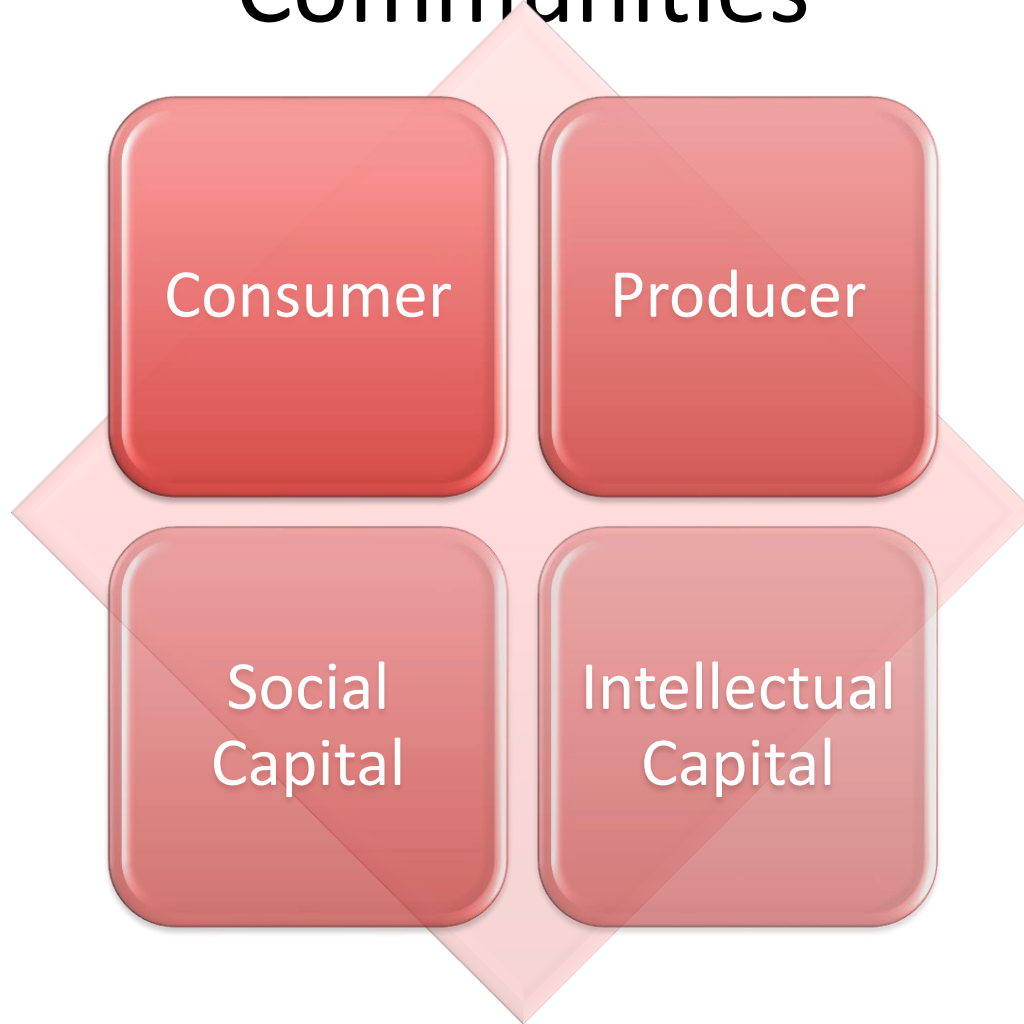
Consumer

Producer

Products

Social  
Capital

Intellectual  
Capital



# Example Learning Progression:

## Consumer in social networks

- **Definition** ... Obtaining, managing and utilizing information/knowledge from shared digital resources and experts in order to benefit their private and professional lives
  - **Examples**
    - Will a user be able to figure out how to perform tasks (e.g., by exploration of the interface) without explicit instruction?
    - How long will it take an experienced user to find an answer to a question using their digital device?
    - What arrangement of information on a display yields more effective visual search?
    - How difficult will it be for a user to find information using web resources?



# Outline

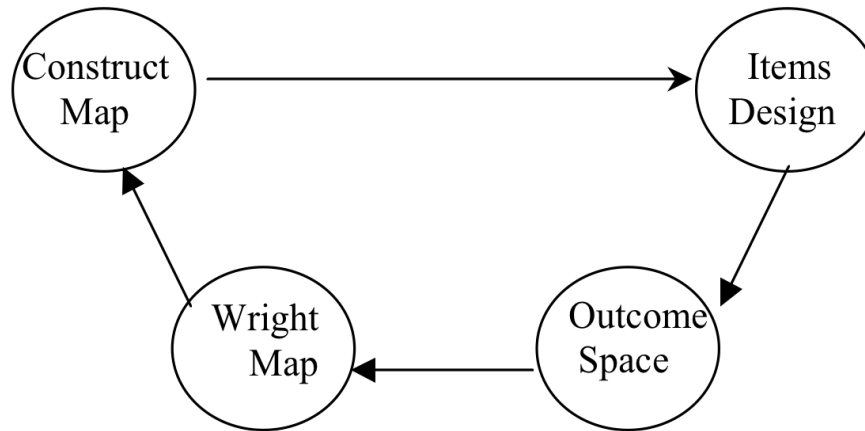
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# BEAR Assessment System



Principle 1:  
Developmental Perspective

Principle 2:  
Match Between Instruction and  
Assessment



Principle 4: Evidence of High  
Quality

Principle 3:  
Management by Teachers



# CONSUMER IN SOCIAL NETWORKS

## Discriminating consumer

Judging credibility of sources/people

Integrating information in coherent knowledge framework

Searches suited to personal circumstances

Filter, evaluate, manage, organize and reorganize information/people

Seeking expert knowledge (people through networks)

Select optimal tools for tasks/topics

## Conscious consumer

Select appropriate tools and strategies (strategic competence)

Construct targeted searches

Compiling information systematically

Knowing that credibility is an issue (web pages, people, networks)

## Emerging consumer

Performing basic tasks

No concept of credibility

Search for pieces of information using common search engines (e.g. movie guides)

Knowing that tools exist for networking (e.g. Facebook)

# Producer in social networks

- Creating, developing, organizing and re-organizing information/knowledge in order to contribute to shared digital resources
  - " ... learners and instructors are connected through [digital infrastructure] to craft identity, to institute mutual awareness, to develop social interactions, to form social relationships, and to build collaborative learning communities." (Tu et al, 2008)
  - producing a product that students "make their own"

# PRODUCER IN SOCIAL NETWORKS

## Creative producer

Team situational awareness in process

Optimize assembly of distributed contribution to products

Extending advanced models (e.g. business models)

Producing attractive digital products using multiple technologies / tools

Choosing among technological options for producing digital products

## Functional producer

Establishing and managing networks & communities

Awareness of planning for building attractive websites, blogs, games

Organizing communication within social networks

Developing models based on established knowledge

Developing creative, expressive or complex content artifacts

Awareness of security & safety issues (ethical and legal aspects)

Using networking tools and styles for communication among people

## Emerging producer

Produce simple representations from templates

Start an identity

Use a computer interface

Post an artifact

# Developing & sustaining social capital through networks

- Using, developing, moderating, leading and brokering the connectivities within and between social groups in order to marshal collaborative action, build communities, maintain an awareness of opportunities and integrate diverse perspectives at community, societal and global levels
  - better and worse forms of social participation and connectedness
  - resources or advantages that accrue to a group or person by virtue of being embedded in social organizations
  - Awareness of benefits associated with increased common ground
  - balance of diversity and common ground - typically in tension

# DEVELOPER OF SOCIAL CAPITAL

## Visionary connector

Take a cohesive leadership role in building a social enterprise  
Reflect on experience in for social capital development

## Proficient connector

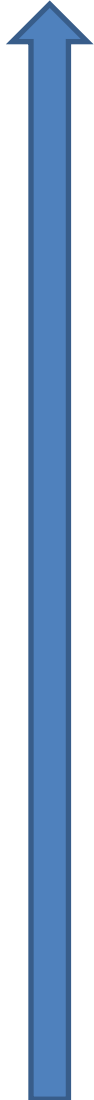
Initiate opportunities for developing social capital through networks (e.g. support for development)  
Encourage multiple perspectives and support diversity in networks (social brokerage skills)

## Functional connector

Encourage participation in and commitment to a social enterprise  
Awareness of multiple perspectives in social networks  
Contribute to building social capital through a network

## Emerging connector

Participating in a social enterprise  
Observer or passive member of a social enterprise  
Knowing about social networks

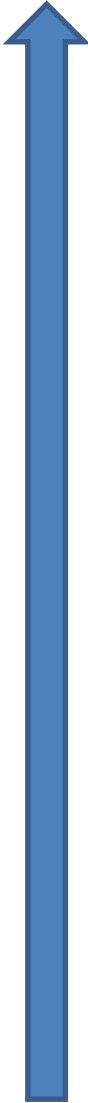


# Developing & sustaining intellectual capital thru networks

- Understanding how tools, media and social networks operate and using appropriate techniques for operating on those resources to build collective intelligence and integrate new insights into personal understandings
  - ongoing process of collective reflection and action
  - marshalling of available knowledge to act in an effective and efficient manner to achieve some purpose
  - online communities have multiple purposes with less coherence, more diverse motivations, and hence a greater need for complex mechanisms for marshalling and using information



# PARTICIPATOR IN INTELLECTUAL CAPITAL (COLLECTIVE INTELLIGENCE)



## *Visionary builder*

Questioning existing architecture of social media and developing new architectures  
Functioning at the interfaces of architectures to embrace dialogue

## *Proficient builder*

Understanding and using architecture of social media such as tagging, polling, role-playing and modeling spaces to link to knowledge of experts in an area  
Identifying signal versus noise in information  
Interrogating data for meaning  
Making optimal choice of tools to access collective intelligence  
Sharing and reframing mental models (plasticity)

## *Functional builder*

Acknowledges multiple perspectives  
Thoughtful organization of tags  
Understanding mechanics of collecting and assembling data  
Knowing when to draw on collective intelligence  
Sharing representations

## *Emerging Builder*

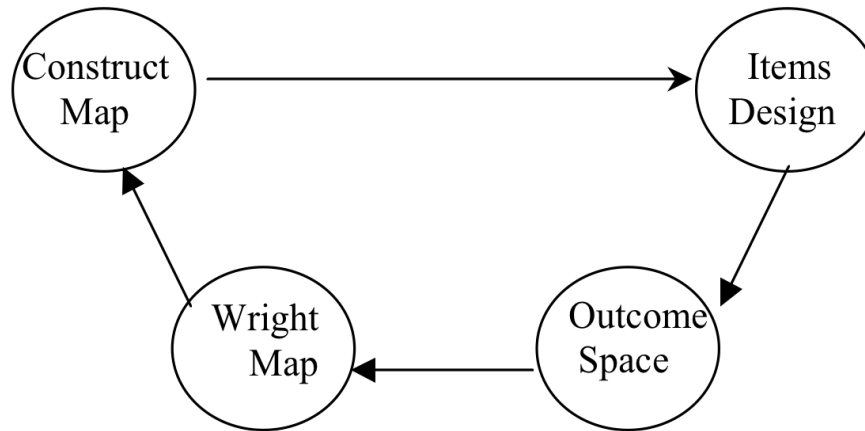
Knowledge of survey tools  
Able to make tags  
Posting a question

# BEAR Assessment System



Principle 1:  
Developmental Perspective

Principle 2:  
Match Between Instruction and  
Assessment



Principle 4: Evidence of High  
Quality

Principle 3:  
Management by Teachers

?	<b>Scenario 1: Webspiration</b>	<b>Scenario 2: Arctic Trek</b>	<b>Scenario 3: 2nd Language Chat</b>
<b>Digital Tools</b>	Concept Mapping, Embedded Audio/Video, Podcast Creation, Resource Sites, Screen Recorder	Teaming Collaborative Software, Decision Making-Planning Tools, Shared Documents, Game Lab for Programming	Chat Tool, Rating Guides, Crowd Sourcing, Cross-Country Collaborations, Spreadsheets
<b>Team Size</b>	3	4	2
<b>Location</b>	Asynchronous within Country	Synchronous within Country	Synchronous between Countries
<b>Constructs</b>	ICT Producer, Consumer, Intellectual Capital	ICT Producer, Consumer, Social Capital	ICT Producer, Consumer
<b>Context</b>	Verbal	Quantitative	Analytic
<b>Subject Matter</b>	Humanities	Math/Science	Second Language Acquisition

?



# ARCTIC TREK

Track down the answers  
**Over the ice**

ATC215

Companies

Countries

Developers

Back

Task id: task60

Next

# Your Goal: Discover **Six Clues**

ARCTIC TREK

Click **Next** when ready to  
**Meet your team**



Work with your team to decide who will do what:

Person 1	Person 2

Work on Clue 2: Getting dinner  
6

Take Role:  
D W  
(fir  
fi

Work on Clue 6: Ble  
cav

10

Work on Clue 3: Coloring task  
7

Work on Clue 4: Check  
4

Take Role:  
Captain  
(leads the team and keeps everyone at work)  
1

ole:  
der  
and  
res  
the  
ge)

Work on Clue 9: Results  
9

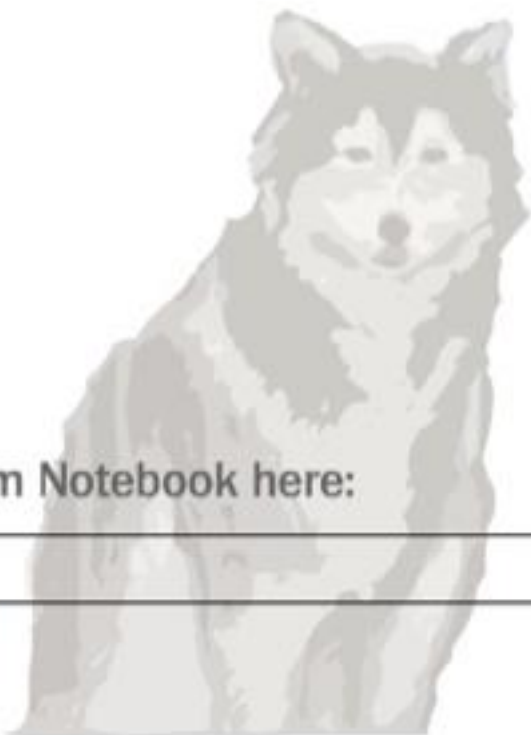
Person 3	Person 4

## ARCTIC TREK

Share ideas and coordinate using your team Notebook.

### Team 1 Notebook

Type in secret code from Notebook here:



# ARCTIC TREK

## Collaboration contest

For this collaboration contest, you work with your team and use clues to discover a series of 6 answers.

### **HINT:**

Here is how a clue works. The first part of the clue directs you to one of the web sites listed to the right. The rest of the clue guides you through the site to find the answer.

This is a timed contest to see what team can come up with the 6 answers first. Good Luck and Happy Hunting!

Track down  
the answers

## Over the ice

[Finnish Arctic Club](#)

[Polar Bear Population](#)

[Polar Bear Map](#)

[Land Animal Food](#)

[Basic Computer Use](#)

[Excel Spreadsheet](#)

[Global Fishing](#)

[Tagxedo](#)



T



## ARCTIC TREK

### Clue 1 - Practice

**Let's practice. Try solving this:**

Where the white bear lives. Where on the map do polar bears live who do NOT belong to any country?

Get Hint

Track down  
the answers

## Over **the** ice

[Finnish Arctic Club](#)

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## ARCTIC TREK

### Clue 1 - Practice

**Let's practice. Try solving this:**

Where the white bear lives. Where on the map do polar bears live who do NOT belong to any country?

Another Hint

The first sentence of the clue helps you select a webpage from the list at right. Which page is about where white bears (polar bears) live? Click on that link and find a map. Use the map to answer the question.

Track down  
the answers

## Over the ice

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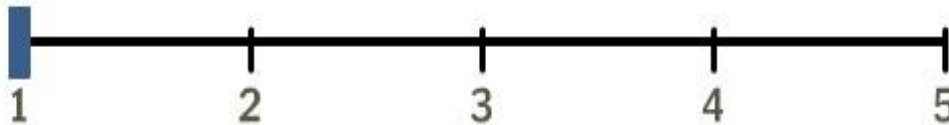
[Tagxedo](#)



# ARCTIC TREK

## Clue 3

This tells how many there are of me. In this table, how many colors are used to describe the bear population?



Explain your answer (by yourself, no sharing this time!).

Then post your answer on your team Notebook and paste a different answer from your team here:

Get Hint

Track down  
the answers

## Over the ice

[Finnish Arctic Club](#)

[Polar Bear Population](#)

[Polar Bear Map](#)

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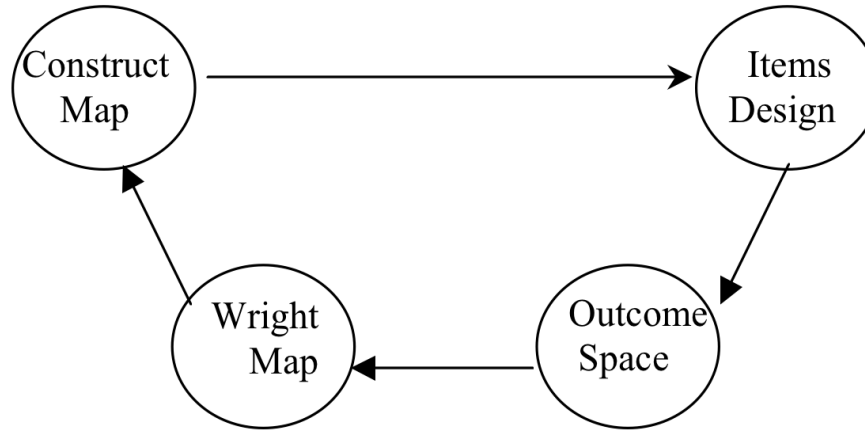
[Tagxedo](#)



# BEAR Assessment System

Principle 1:  
Developmental Perspective

Principle 2:  
Match Between Instruction and  
Assessment



Principle 4: Evidence of High  
Quality

Principle 3:  
Management by Teachers



15 yr olds

### **Roles**

- (1)David: Captain, Decoder
- (2)Stephenie:Work on clue 1,2,3
- (3)Xinyi: Work on clue 4,5,6
- (4)Amanda: Scout, Recorder

### **Clues**

Clue 1:

Where the white bear lives. Where on the map do polar bears live who do NOT belong to any country?

Polar bears live in North Pole

Clue 2:

Arctic Fox

Clue 3:

Answers of person:

- (1)There are 5 colours of red, orange, light green, dark green and yellow with one extra colour white to represent data deficiency
- (2) 5
- (3) 5
- (4) 5



a?

b?

Sc02 screen5v2 - Wave Intro		
DifferT		
ArcticB2	N/A	SJ3
ArcticB2_PageLinks	N/A	Team 11 Notebook
ArcticB2_taid_initials	0 / 0	
ArcticB2_taid_comment	0 / 0	
ArcticB2_taid_page	0 / 1	unchecked
ArcticB2_taid_team	0 / 1	unchecked
ArcticB2_taid_web	0 / 1	unchecked
Sc02 assignRole		
WebE1	1 / 1	Person 1
WebE2	1 / 1	Person 4
WebE3	0 / 1	Person 1
WebE4	0 / 1	Person 4
WebE5	0 / 1	Person 2
WebE6	0 / 1	Person 2
WebE7	0 / 1	Person 2
WebE8	0 / 1	Person 3
WebE9	0 / 1	Person 3
WebE10	0 / 1	Person 3
WebE_Links	N/A	
WebE_taid_initials	0 / 0	
WebE_taid_comment	0 / 0	
WebE_taid_page	0 / 1	unchecked
WebE_taid_team	0 / 1	unchecked
WebE_taid_web	0 / 1	unchecked

c?

?

d?

e?

f?

f?

g?

?

Screen ID	Count	Comments
<b>Sc02-Screen14</b>		
ArcticC5	0 / 1	5
ArcticC6	N/A	There are main 5 colours: red, orange, light green, dark green and yellow with one extra colour white to represent data deficient
ArcticC7	N/A	It should be 5, because the colours used are meant to describe the population of polar bears. White, is used to represent insufficient
ArcticC7_Hints	0 / 0	0
ArcticC_Links	0 / 1	
ArcticC_taid_initials	0 / 0	
ArcticC_taid_comment	0 / 0	
ArcticC_taid_page	0 / 1	unchecked
ArcticC_taid_team	0 / 1	unchecked
ArcticC_taid_web	0 / 1	unchecked
<b>Sc02-Screen15</b>		
ArcticC8	1 / 1	Good
ArcticC9	0 / 1	5
ArcticC10	N/A	Because the number line limits the number of colours to 5 and we have to ignore the extra colour white.
ArcticC_Links	N/A	
ArcticC_taid_initials	0 / 0	
ArcticC_taid_comment	0 / 0	
ArcticC_taid_page	0 / 1	unchecked
ArcticC_taid_team	0 / 1	unchecked
ArcticC_taid_web	0 / 1	unchecked

## 11 yr olds

first q is challenging

i can i be the decoder ? there are two colors used in the table . page 15 is very hard !!!!!!!!!!!!!!!!!!!!!!!!!!!!!

Your team's SECRET CODE: XF9

i don't know. i think may should be captin do you guys agree it's jas do you want to be a scout i will jas hmmm aggggggg! ok lets work this out lets vote!me me

capinok i think may should be ca

year i know

how do you want to work it out whos going to be captin

yes

WHAT CAN I DO

Jonathan should be scout

who should should be the decoder

i will ally

i havent got a job

w

who is going to be the captain what does everybody want to be who is the captain may 2 because thereare two colours on the table

i will be capten

than i will be capten



Sc02 screen5v2 - Wave Intro DifferT		
ArcticB2	N/A	
ArcticB2_PageLinks	N/A	Team 1 Notebook
ArcticB2_taid_initials	0 / 0	
ArcticB2_taid_comment	0 / 0	
ArcticB2_taid_page	0 / 1	unchecked
ArcticB2_taid_team	0 / 1	unchecked
ArcticB2_taid_web	0 / 1	unchecked
Sc02 assignRole		
WebE1	1 / 1	Person 1
WebE2	0 / 1	Person 2
WebE3	0 / 1	Not Sorted
WebE4	0 / 1	Person 4
WebE5	0 / 1	Person 3
WebE6	0 / 1	Not Sorted
WebE7	0 / 1	Not Sorted
WebE8	0 / 1	Not Sorted
WebE9	0 / 1	Not Sorted
WebE10	0 / 1	Not Sorted
WebE_Links	N/A	
WebE_taid_initials	0 / 0	
WebE_taid_comment	0 / 0	
WebE_taid_page	0 / 1	unchecked
WebE_taid_team	0 / 1	unchecked
WebE_taid_web	0 / 1	unchecked

Activity Name	Score	Comments
Sc02-Screen14		
ArcticC5	0 / 1	5
ArcticC6	N/A	there are 5 because are five different colors even though there shades are alike
ArcticC7	N/A	everyone said 5
ArcticC7_Hints	0 / 0	0
ArcticC_Links	1 / 1	Land Animal Food,Basic Computer Use,Polar Bear Population
ArcticC_taid_initials	0 / 0	
ArcticC_taid_comment	0 / 0	
ArcticC_taid_page	0 / 1	unchecked
ArcticC_taid_team	0 / 1	unchecked
ArcticC_taid_web	0 / 1	unchecked
Sc02-Screen15		
ArcticC8	1 / 1	Great
ArcticC9	0 / 1	5
ArcticC10	N/A	because everyone in my group agreed
ArcticC_Links	N/A	
ArcticC_taid_initials	0 / 0	
ArcticC_taid_comment	0 / 0	
ArcticC_taid_page	0 / 1	unchecked
ArcticC_taid_team	0 / 1	unchecked
ArcticC_taid_web	0 / 1	unchecked
Sc02-Screen17		

*Item Descriptors: Arctic Trek Task*

<b>Task</b>	<b>Item</b>	<b>Score</b>	<b>Description</b>
<b>ArcticA:</b> Preorg	1	Auto	Install Screen Reader software and upload trial image
<b>ArcticB :</b> Clue 1-2	1	Auto	Answer Clue 1 (Arctic Basin)
	2	Auto	Wave Team Organizer Chat Session Upload
	3-4	Auto	Wave Team Organizer Scenario Selection and Reflection1
	5	Hand	Wave Team Organizer Scenario Reflection2
	6	Auto	Answer Clue 2 (Snow)
	7	Hand	Clue 2 Tagged Resource Upload
	8-19	Auto	Food Web Object (One item / correct arrow + no-extras item)
	20	Hand	Lemming Explanation
<b>ArcticC:</b> Clue 3-7	1-2	Auto	Clue 3 Numbers from Spreadsheet Calculation on Bear Totals
	3-4	Auto	Clue 4 Upload Bear Population Map to Wave (indiv and team)
	5	Auto	Clue 5 Map Color Number
	6	Hand	Clue 5 Explanation of number
	7-9	Auto	Clue 5 Upload, Team Ratings, Final Number
	10	Hand	Clue 5 Explanation of final number.
	11-12	Auto	Clue 6 Bear Population Increase/Decrease with Explain
	13-14	Auto	Clue 7 Historical Removal and Spreadsheet Upload
	15	Hand	Explain Relationship in 13-14
<b>Arctic D:</b> Dynamic Assmts	1-3	Auto	Spinner Task
	4-6	Auto	Urn Task
	5-7	Auto	Data Modeler Task
<b>Arctic E:</b> Clue 8-9	1	Auto	Clue 8 Fish Anatomy Information Search
	2-3	Auto	Considering Evidence Reflection1 (Fishing Trendlines)
	4	Hand	Considering Evidence Reflection2 (Fishing Trendlines)
	5-14	Auto	Clue 9 Tagxedo List Generation (10 words)
	15	Hand	Tagxedo Posting
<b>Web F:</b> Clue 10 and Post	1	Auto	Clue 10 Finnish Trek Question
	2-3	Hand	Two Questions

## ICT Literacy—Learning in digital communities

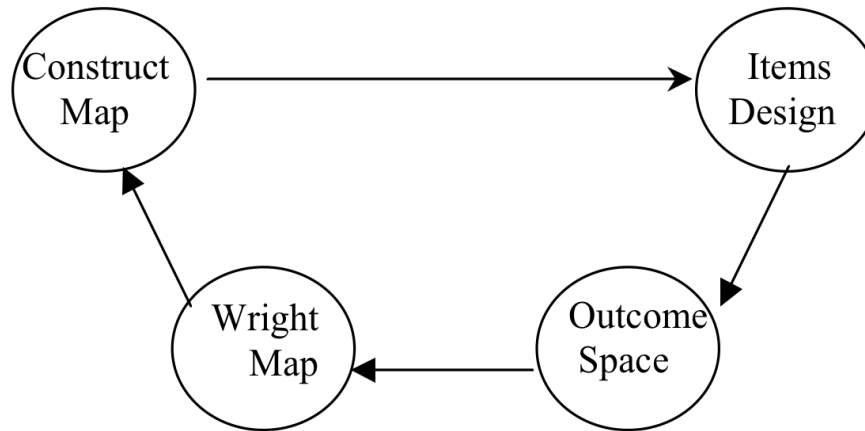
Levels (Progressive)	CONSTRUCT/Learning Outcomes				Total
	Consumer	Producer	Social Capital	Intellectual Capital	
Level 4	N/A	N/A	Web: 1 Arctic: 1 2LChat: 1	Web: 1 Arctic: 1 2LChat: 1	Web: 1 Arctic: 1 2LChat: 1
Level 3	Web: 1 Arctic: 2 2LChat: 1	Web: 1 Arctic: 2 2LChat: 1	Web: 1 Arctic: 6 2LChat: 1	Web: 10 Arctic: 2 2LChat: 1	Web: 10 Arctic: 12 2LChat: 2
Level 2	Web: 3 Arctic: 6 2LChat: 1	Web: 4 Arctic: 16 2LChat: 3	Web: 7 Arctic: 10 2LChat: 6	Web: 6 Arctic: 7 2LChat: 10	Web: 25 Arctic: 29 2LChat: 14
Level 1	Web: 2 Arctic: 2 2LChat: 2	Web: 4 Arctic: 10 2LChat: 6	Web: 1 Arctic: 10 2LChat: 6	Web: 2 Arctic: 2 2LChat: 10	Web: 9 Arctic: 4 2LChat: 14
Total	Web: 10 Arctic: 10 2LChat: 2	Web: 8 Arctic: 18 2LChat: 14	Web: 8 Arctic: 27 2LChat: 13	Web: 18 Arctic: 11 2LChat: 1	120 per age group plus PU/FP/HUE, Practice, & Covariates

\*Some CR items (Constructed Response) will measure up through the listed level (listed levels top score).

# BEAR Assessment System

Principle 1:  
Developmental Perspective

Principle 2:  
Match Between Instruction and  
Assessment

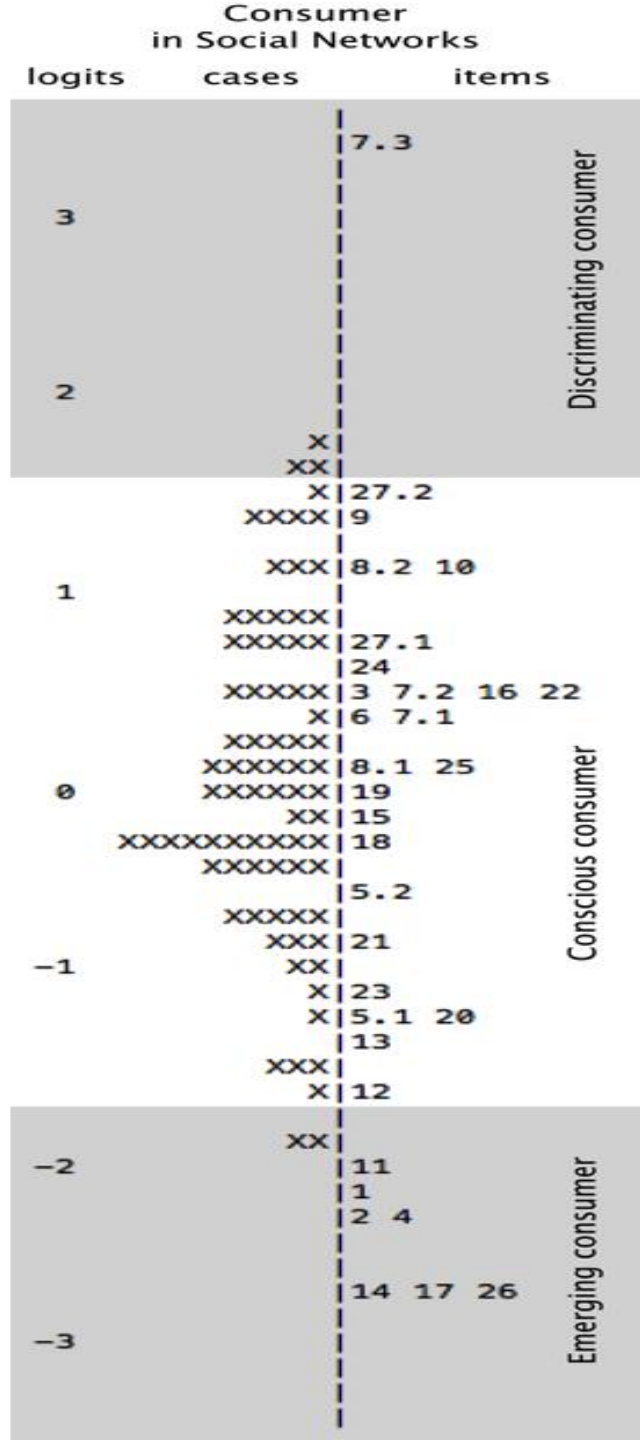


Principle 4: Evidence of High  
Quality

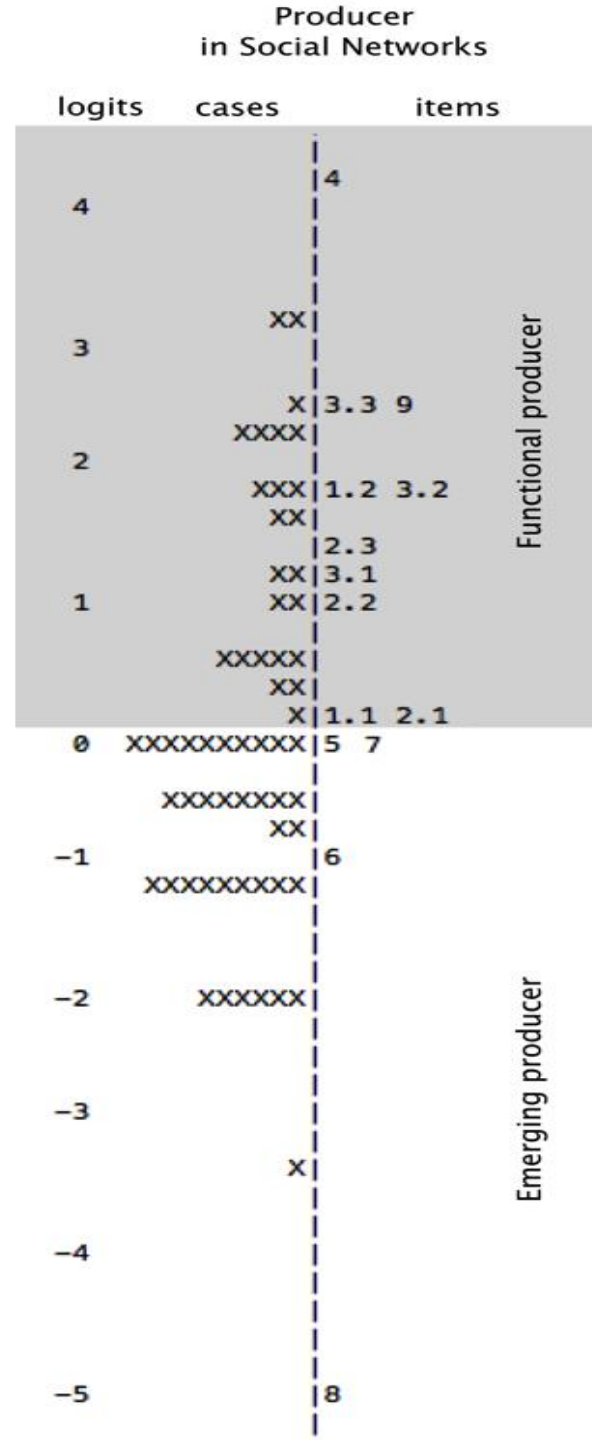
Principle 3:  
Management by Teachers



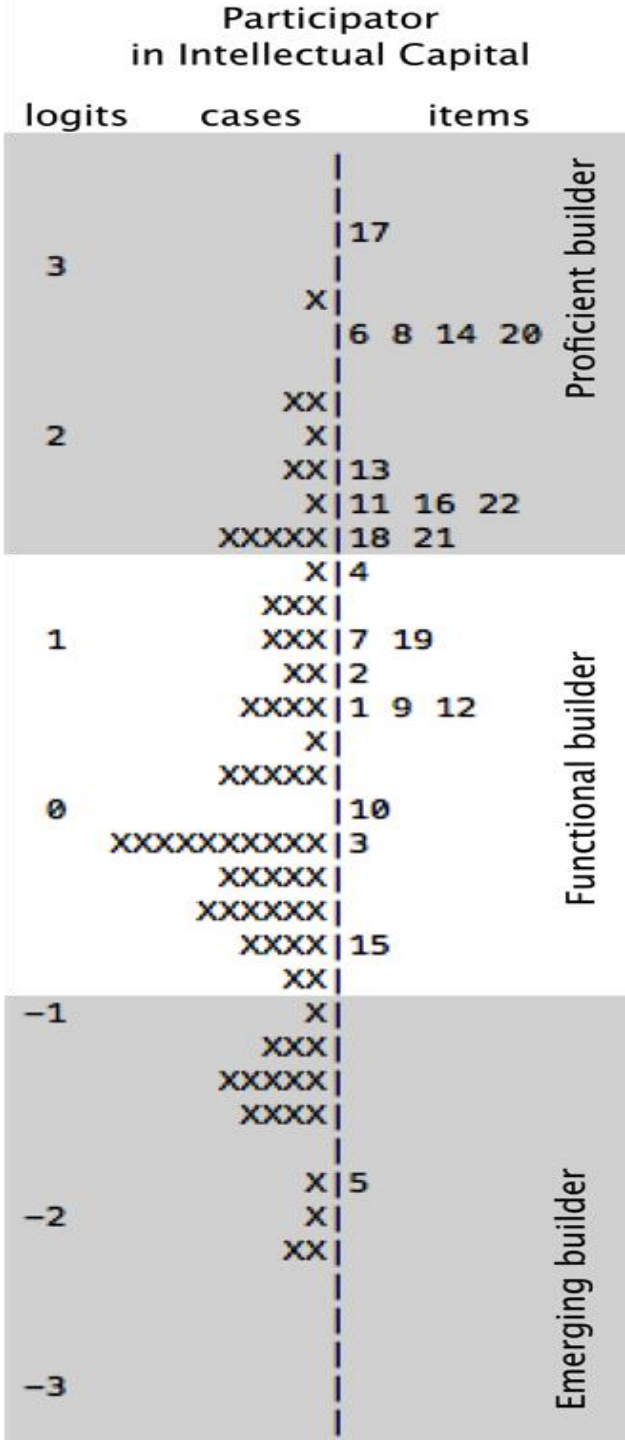
# Consumer in Social Networks



# Producer in Social Networks



# Participator in Intellectual Capital





# Correlations and variances of EAP scores from three consecutive unidimensional models

	CiN	PiN	ICN
PiN	0.65		
ICN	0.57	0.57	
variance	0.97 (0.14)	2.54 (0.35)	1.79 (0.25)

# Outline

- Setting the problem
- Learning progressions in 21<sup>st</sup> Century skills
  - Example: ICT Literacy
    - Traditional formulations
  - A new formulation: The ATC<sup>21</sup>S project
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- **A perspective on the problem**
- Using a learning progression to relate classroom assessment at different grain-sizes
- Conclusion

How does this help build a learning progression that can be persistent over time?

E.g., back to example item ....

Work with your team to decide who will do what:

Person 1

Person 2

Work on Clue 2: Getting dinner  
6

Work on Clue 3: Coloring task  
7

Work on Clue 4: Check  
4

Take Role: Captain (leads the team and keeps everyone at work)  
1

Work 6: Ble cav  
10

Work on ... results  
9

Take Role: ... (der and res the ge)  
5

Work on ... results  
3

Take Role: ...  
8

Person 3

Person 4

15 yr olds

### **Roles**

- (1)David: Captain, Decoder
- (2)Stephenie:Work on clue 1,2,3
- (3)Xinyi: Work on clue 4,5,6
- (4)Amanda: Scout, Recorder

### **Clues**

Clue 1:

Where the white bear lives. Where on the map do polar bears live who do NOT belong to any country?

Polar bears live in North Pole

Clue 2:

Arctic Fox

Clue 3:

Answers of person:

- (1)There are 5 colours of red, orange, light green, dark green and yellow with one extra colour white to represent data deficiency
- (2) 5
- (3) 5
- (4) 5

## 11 yr olds

first q is challenging

i can i be the decoder ? there are two colors used in the table . page 15 is very hard !!!!!!!!!!!!!!!!!!!!!!!!!!!!!

Your team's SECRET CODE: XF9

i don't know. i think may should be captin do you guys agree it's jas do you want to be a scout i will jas hmmm aggggggg! ok lets work this out lets vote!me me

capinok i think may should be ca

year i know

how do you want to work it out whos going to be captin

yes

WHAT CAN I DO

Jonathan should be scout

who should should be the decoder

i will ally

i havent got a job

w

who is going to be the captain what does everybody want to be who is the captain may 2 because thereare two colours on the table

i will be capten

than i will be capten

# How to link forward into a new technological environment?

- Q. What is the item for ?

# PRODUCER IN SOCIAL NETWORKS

## Creative producer

Team situational awareness in process

Optimize assembly of distributed contribution to products

Extending advanced models (e.g. business models)

Producing attractive digital products using multiple technologies / tools

Choosing among technological options for producing digital products

## Functional producer

### Establishing and managing networks & communities

Awareness of planning for building attractive websites, blogs, games

Organizing communication within social networks

Developing models based on established knowledge

Developing creative, expressive or complex content artifacts

Awareness of security & safety issues (ethical and legal aspects)

Using networking tools and styles for communication among people

## Emerging producer

Produce simple representations from templates

Start an identity

Use a computer interface

Post an artifact

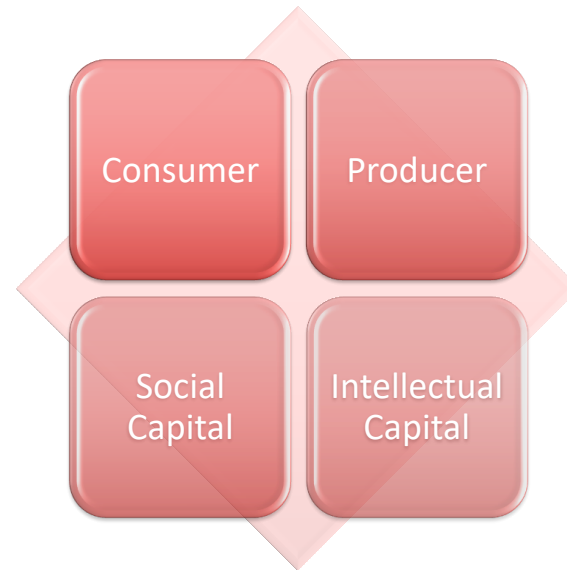


# How to link forwards?

- Q. What is the item for ?
- A. To provide information about the *Functional Producer* level in the *Producer in Social Networks* strand of the learning progression.
- Q. How does this help?
- A. Design new items like this in the new technological environment, and carry out a linking study.

# What is the limit of this?

- So long as the learning progression is still appropriate ...



- ... this is readily accomplished.
- Or, as well, by adding new strands or higher levels to older strands, etc.

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## A **second** problem:

Using a learning progression to relate large-scale and classroom assessment together

- Finding the right grain-size for measurement in the classroom
- *From:*

Wilson, M. (2021, November). *Finding the right grain-size for measurement in the classroom*. The American Educational Research Association's E. F. Lindquist Award 2020 Lecture.

# What do I mean by “grain-size”?

**micro** level ⇔ Fine-grained assessments, within-instruction observations

**meso** level ⇔ Testing for instructional planning in the classroom, narrower standards

**macro** level ⇔ Summative testing, Standardized testing, broader standards

# What do I mean by “grain-size”?

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# Measurement at the meso/micro levels: An Example Project

- NSF Collaborative Research Project: **Modeling Assessment to Enhance Teaching and Learning** (MAETL?)
- Collaboration Among:
  - Rich Lehrer, Leona Schauble and Corey Brady (Vanderbilt University);
  - Mark Wilson and Perman Gochyyev (UC Berkeley)
  - A bunch of graduate students at both universities



# The Modeling Assessment to Enhance Teaching and Learning (MAETL) Project

- Products:
  - A shared conceptual framework for describing instructional goals and valued forms of teaching and learning—i.e., the [learning progression](#)\*;
  - a set of [electronic tools](#) to help educators detect, share, analyze, and interpret data—BASS and TOTs; and
  - classroom and school-level community professional development structures to support and sustain the practice of assessing to guide instruction\*.
- Topics:
  - Measurement of: [Length](#), Area, Volume, Angle, and
  - Measured Quantities as entrée to Rational Numbers (Fractions as quantities, fractions as operators)

\* Lehrer, R. (2021). *Accountable assessment*. Keynote presentation at the 2021 ACER Research Conference (online).

\* Wilson, M., & Lehrer, R. (2021). Improving learning: Using a learning progression to coordinate instruction and assessment. *Frontiers in Education*, 6: 654212. [doi.org/10.3389/feduc.2021.654212](https://doi.org/10.3389/feduc.2021.654212)

# Having something to measure

- The Construct: **ToML**—*Theory of Measurement--Length*
- Describes how children come to constitute a theory of measure to compare magnitudes (extents) of lengths.
  - A theory of measure refers to the web of “big ideas” and procedures involved in developing these comparisons.
  - Expressed using a “construct map”

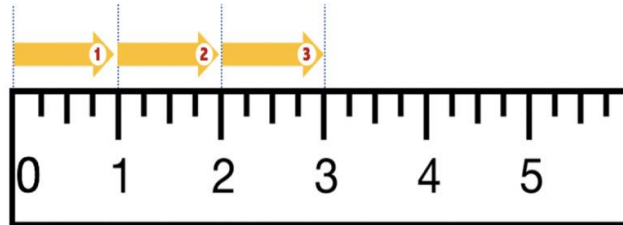


# The Levels of the Construct Map: **ToML**—*Theory of Measurement- Length*

6. Generalizing relationships (e.g., Measure of A in B is the reciprocal of measure of B in A)
5. Partitioning and symbolizing involving 3-splits and composition of 2- and 3-splits
4. Partitioning, iterating, symbolizing partitioned units—2-splits
3. Iterating units and symbolizing distance traveled
2. Explaining properties of units and their role in accumulation
1. Directly comparing

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- For example, 3 on a standard ruler is marked at the endpoint of the third unit **not at the center**.
- This spacing distinguishes interpretation of a length as **distance traveled** rather than as merely counting a collection of units.
- The understandings constitute the beginnings of understanding a **measurement scale**—a way of specifying relations among units to mark quantities.
- Students understand that a measure of  $10u$  means that the measured length is 10 times as long as the length of 1 unit ( $u$ ). Also, a measure of  $10u$  implies that the length can be subdivided into 10 congruent parts.
- However, they may not yet routinely understand the **reciprocal** relation, that 1 unit is  $1/10$  as long as 10 units.

# *Meso* Level Online Assessment

- Delivered online using the *Berkeley Assessment System Software* (BASS)
- Data analysis conducted as a multidimensional Rasch model using both Conquest and BASS software
- One dimension for each construct map: Length, Area, Volume, Angle.

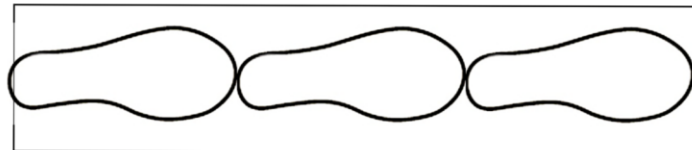
# An **item** at level 3: Labeling Foot Ruler

Here is one of Maria's footprints.



Maria used copies of her footprint to make this foot-ruler. But Maria forgot to label her foot-ruler.

**Drag the numbers onto the foot-ruler to label the units. Use only the numbers that you need**

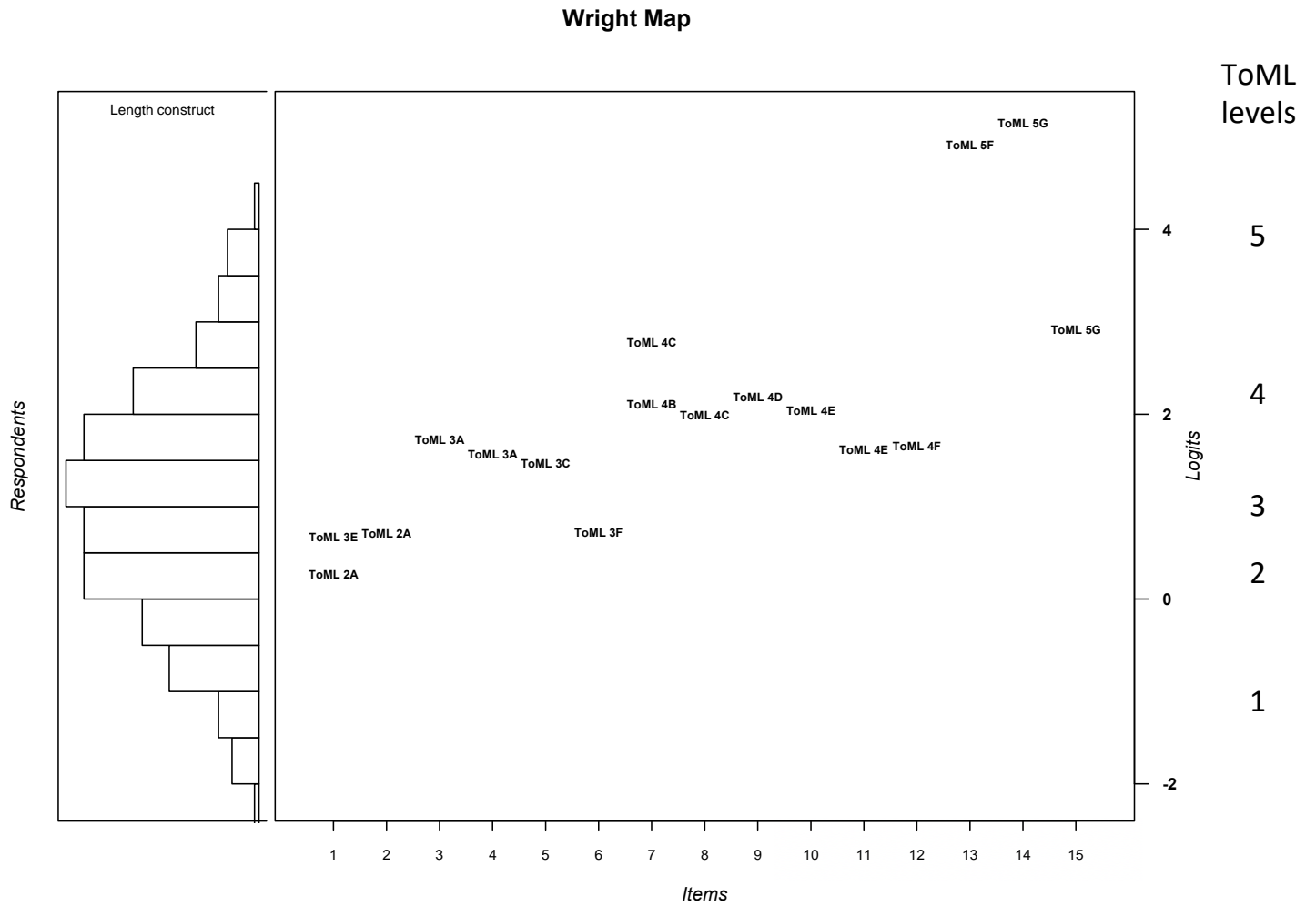


0 1 2 3 4



Figure X.

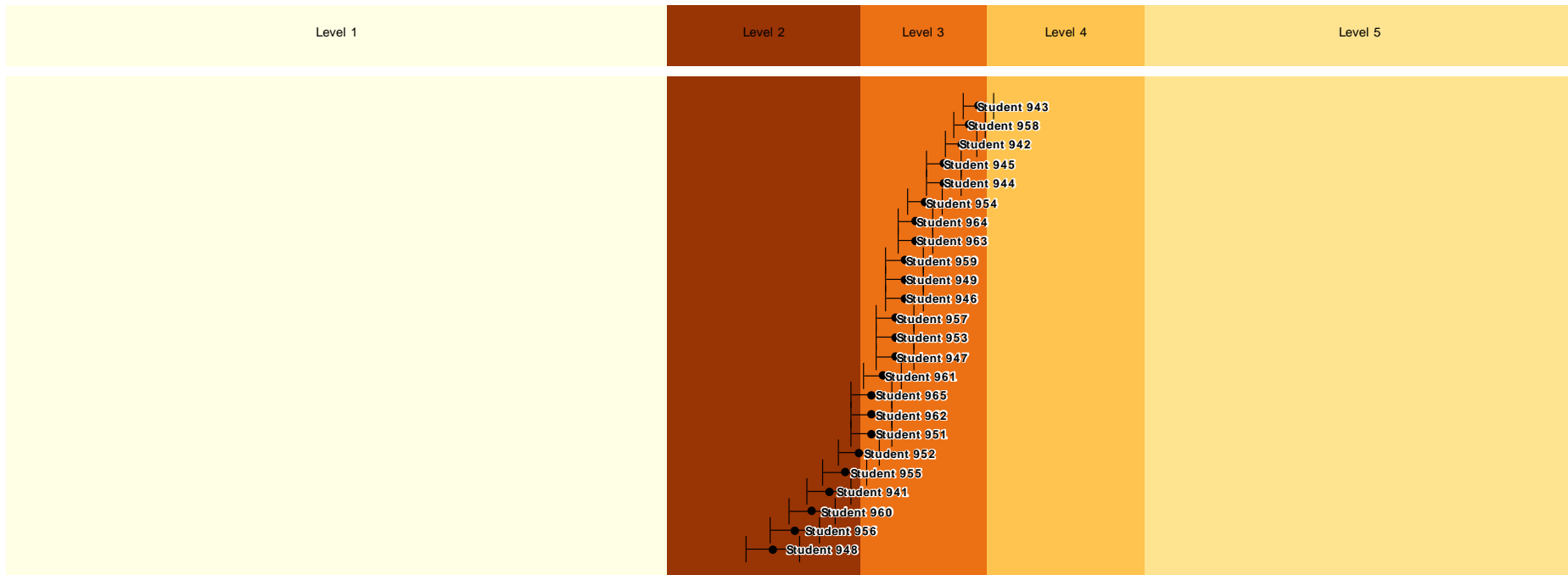
BASS  
Wright  
Map:  
Results  
from  
2019  
posttest



# Example BASS Report for a class

(2018/19 ToML data)

- Level 5
- Level 4
- Level 3
- Level 2
- Level 1



# *Micro* Level Online Assessment

- A teaching/learning context-Day 1:
- In previous classroom activity, the teacher had students **measure a distance in the hallway** with clipboards, or with dowel rods, or with their feet.
- These activities were aimed primarily at ToML Level 2 with support for **“edging” into** Level 3.
- There were more than 1 of each type of unit (feet, naturally, were in inexhaustible supply).

# A teaching/learning context-Day 1

- The **class observed** children as they conducted their measurements.
- With whole class conversation that followed the class established that **shorter units resulted in greater measure of the same distance** (and why),
- And they explained that the units had to be translated so that there were no *gaps or laps*.



# “When is 4 feet 4 feet?”-Day 2

- New challenge (from teacher)
  - using just one standard unit, the **length of her foot** ( $u$ ), create a path with measure  $4u$ .
- Teacher took photos of student strategies
  - class discussed problems and prospects of a few of these strategies\*.
- Each pair cut a strip of paper just as long as the path—**what happened when they were compared?**
- The class used the teacher’s photos to try to investigate why.



\*She was looking for evidence of ToML 3A.

# *Micro Levels of the Construct Map*

## Earlier Levels as Resources for Current Level

·  
·

* 3A	Re-use (iterate) a unit to measure.
2F	Qualitatively predict the inverse relation between size of unit and measure.
2E	Consider suitability of unit and explain why.
2D	Count with reservoir of identical units to tile a length and represent measure by the total. If units are not identical, distinguish among them.
2C	Use identical units and explain why.
* 2B	Tile and explain why (the explanation is required).
2A	Associate measure with count.
1F	Develop and use local (classroom) conventions to distinguish or order two or more objects by a single attribute.

·  
·  
·

# Measurement at the micro level :

## *TOTs*

- TOTs = “ Teacher Observation Tools ”
- A **mobile data-gathering** *ipad* application
- Designed for teacher use **while teaching** in their classrooms
- A sample screenshot ...



No constructs

### Learning Construct Details

Once you select a learning construct using the toggle buttons above, the description will be displayed here.

### Observation date

2020-04-03

### Students

Yareli O

Faroman W

Asher S

Phil B

Nelli M

Raina P

Jaquelin C

Robert A

Alivia F

Perla M

Kevin M

Thiago A

Evie F

Aaron E

Allen C

Jabe J

Roemia C

### Notes

Add Video/Audio note

Nice iteration of a unit; however, the pencils made gaps. This group's tape measure was used for discussion and we could see the pencils accounted for the "extra" length on their paper tape.

### Add URL to video

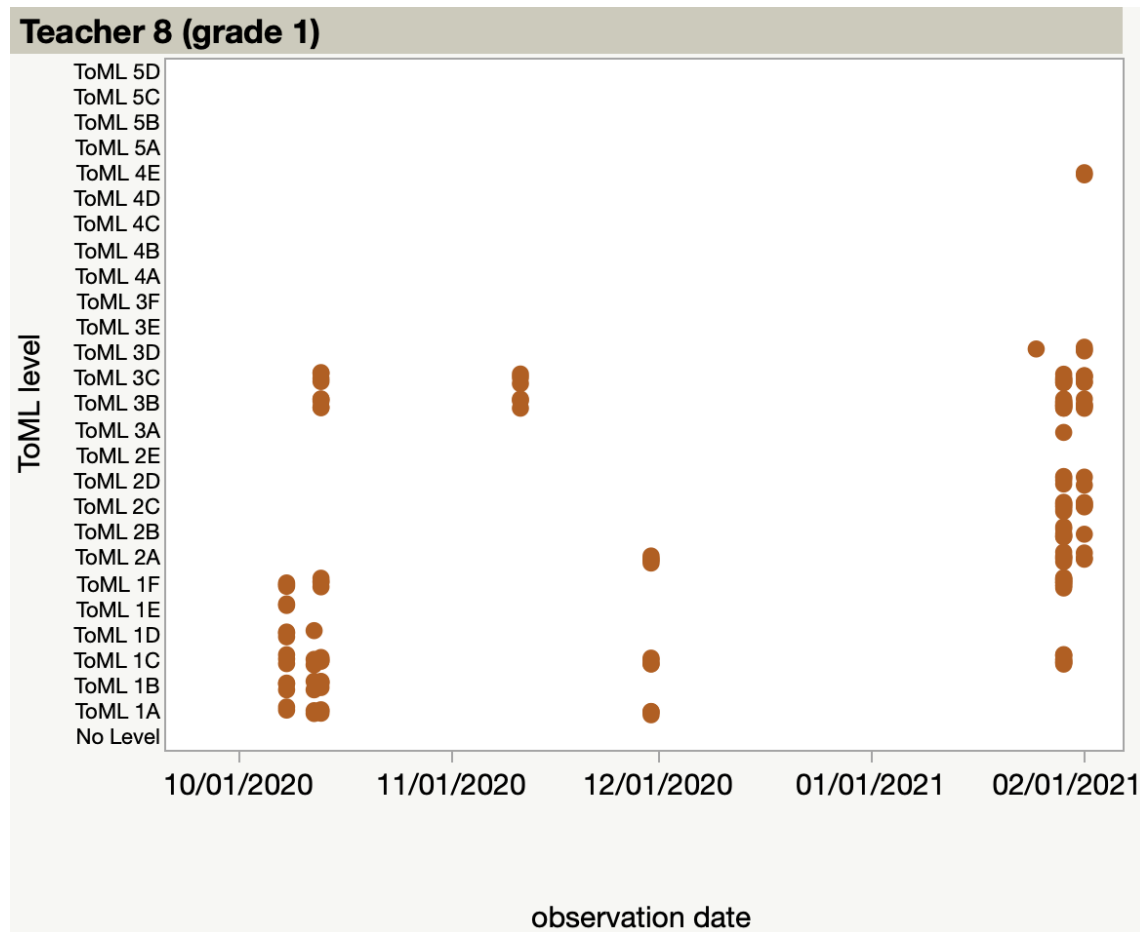
### Learning Construct Examples ToML 3A

"I just had one unit so I marked its end and then used it again, marked its end again, and kept doing that. It's 8 paper clips long" Note:





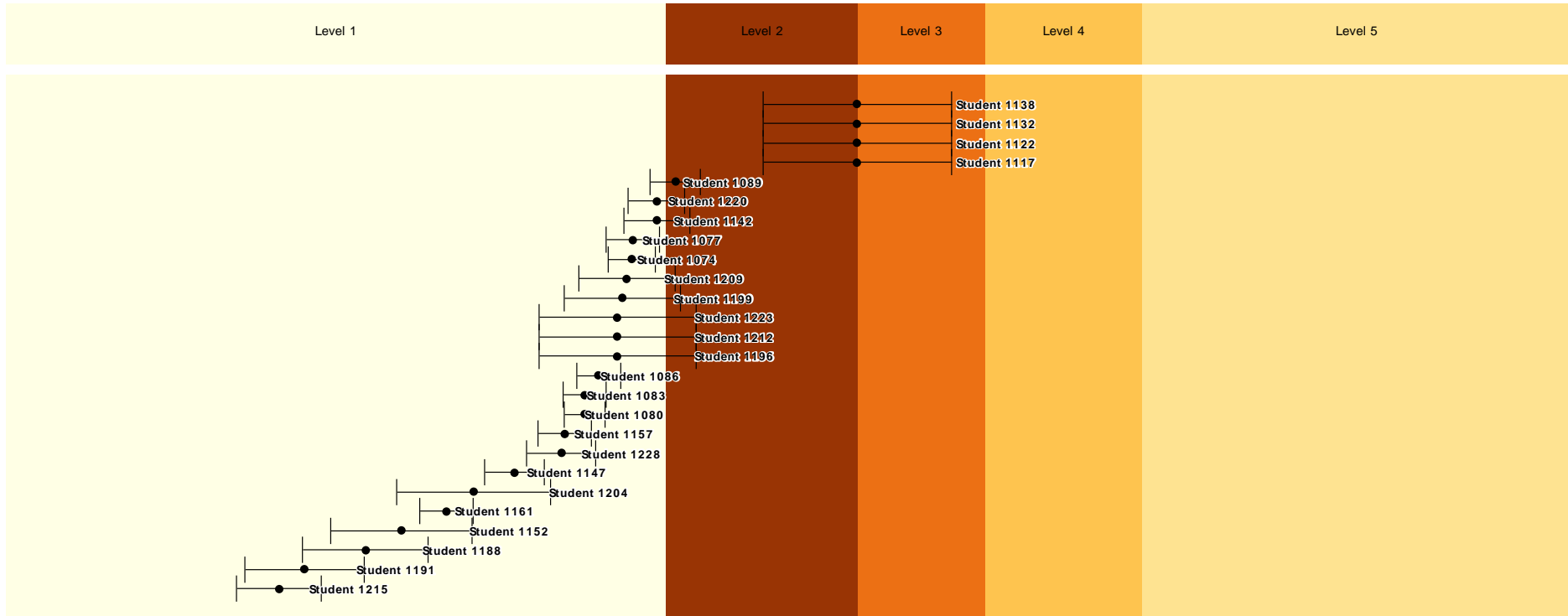
# 2020/21 Data: Evaluations across time for one class



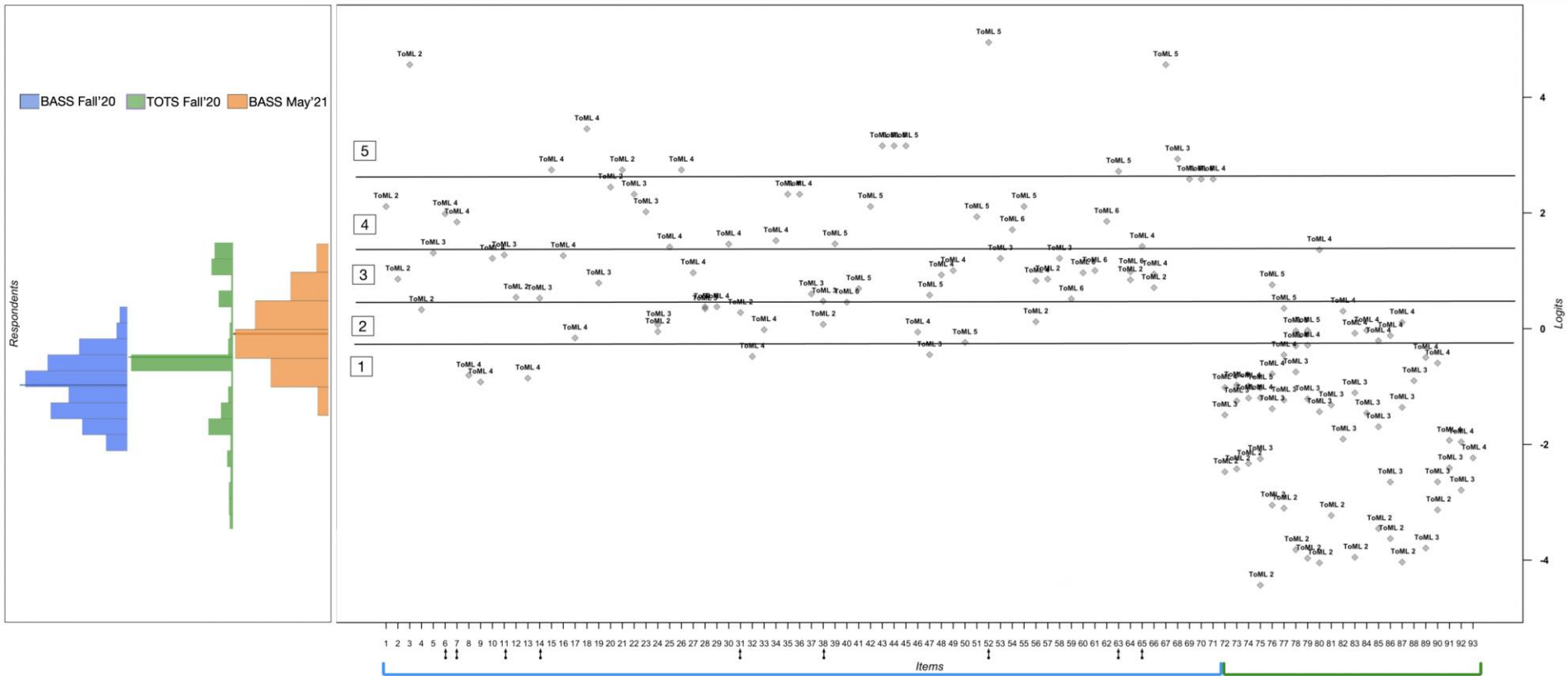
# 20/21 Data: BASS Report for TOTs

— | — | —

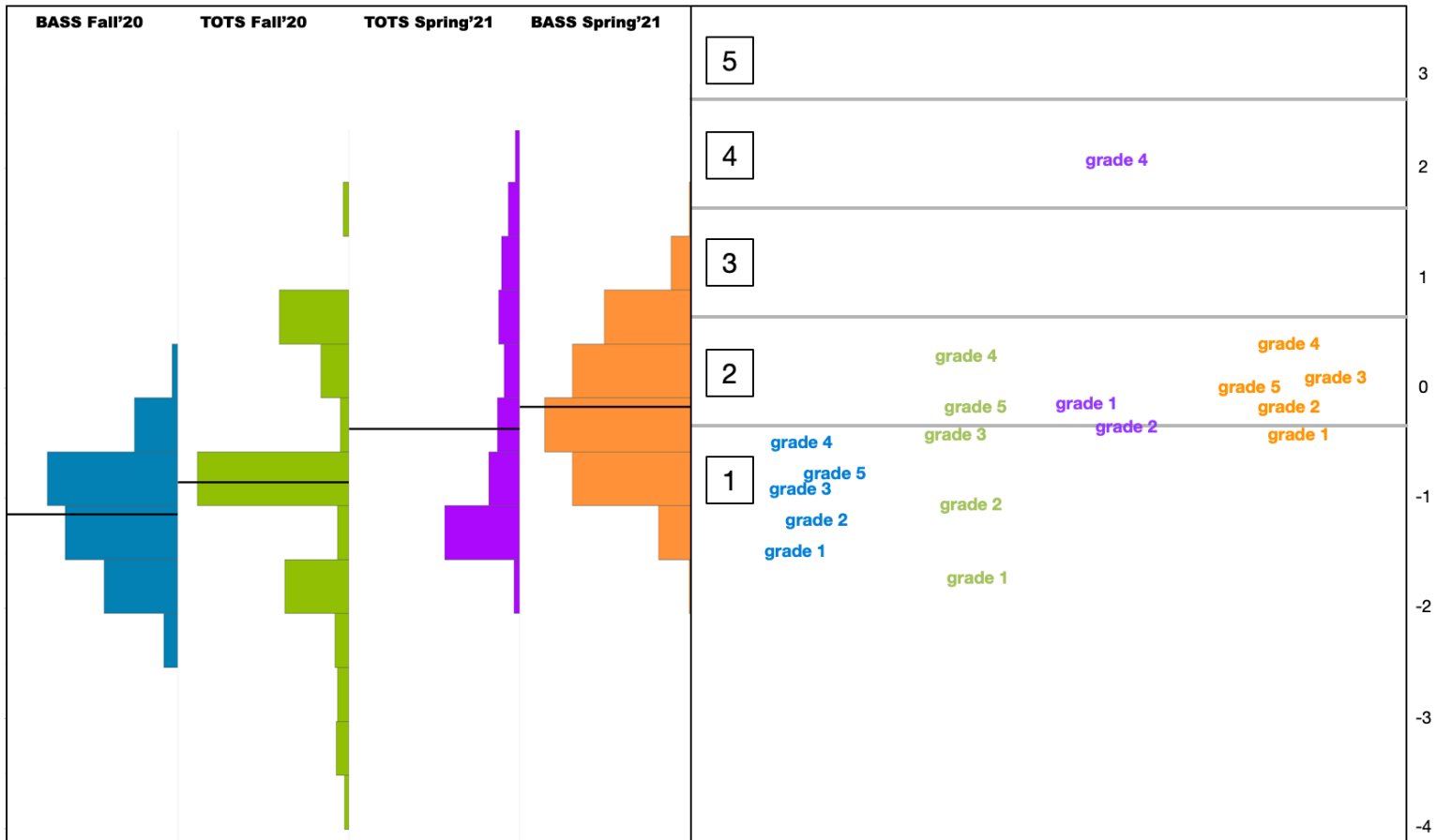
- Level 5
- Level 4
- Level 3
- Level 2
- Level 1



2020/21 Data: **BASS Pretest**  
**TOTs during year**  
**BASS Posttest**



# Grade means



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# Conclusion

- Learning progressions can be used as a setting in which to solve many curriculum, instruction and assessment issues.
- This applies to 21<sup>st</sup> Century skills as much as to more traditional subject areas.
- I have illustrated how this strategy can work for two such issues in the assessment domain:
  - Problem of technology change over time
  - Problem of grain-size of assessments in the classroom.
- Its not just a matter of invoking the idea of a LP—there are better and worse ways to do it, and
- the better ways will often involve more hard work on the parts of the developers and teachers involved.

# Thank You!

- Mark Wilson: [MarkW@berkeley.edu](mailto:MarkW@berkeley.edu)
- BEAR Center Website:
  - <https://bearcenter.berkeley.edu>

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