IASE Satellite meeting on Assessing Student Learning in Statistics
Guimaraes, Portugal, Aug 2007

http://www.stat.auckland.ac.nz/~iase/publications.php?show=sat07

Critical areas for assessing skill transfer: Statistics education and PIAAC

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What is important to assess in statistics education? Usually the answer is derived from course content, i.e., teachers assess key elements of what they have taught. This talk focuses on critical statistical skills needed by adults as part of general everyday or workplace functioning. The talk is motivated by emerging plans by the Organisation for Economic Cooperation and Development (OECD) for a new Program for International Assessment of Adult Competencies (PIAAC) in coming years. PIAAC will be somewhat similar in general terms to the PISA assessment program of high-school students which is now implemented in dozens of countries on a cyclical basis, but will focus on the skills of adults who are outside formal schooling, and on their economic and social participation.

One of the several domains assessed in PIAAC will be numeracy, and one of the strands in it will be knowledge of statistics (data and chance). We need to identify core knowledge areas expected of adults in data/chance which are valued enough to spend precious assessment time on in multiple countries, using realistic stimuli or authentic tasks which are likely to arise in the lives of many adults. The talk presents some of the design principles of the numeracy assessment in PIAAC, and may solicit suggestions for possible assessment tasks related to statistical literacy. The discussion will emphasize the need for linking class assessments and real-life demands, in order to enhance learners' ability to transfer learned skills and cope effectively with functional statistical demands in the real world. The discussion highlights the relevance of large-scale assessments (their domain definitions, design principles, item types, scoring approaches, etc.) and of their findings, to the creation of valid and reliable class-level assessments, to setting some curricular goals, and to the need to attend to skill transfer in statistics education.

Note: A full paper for this talk is not provided since as at this time (Summer 2007) final decisions about the design of PIAAC's assessment scales are still pending.

Further official information about PIAAC appears on the OECD's website:
http://www.oecd.org/document/57/0,3343,en_2649_33927_34474617_1_1_1_1,00.html

See also some information about PIAAC in a DELSA newsletter:
http://www.oecd.org/dataoecd/4/39/37355461.pdf

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Levels/units of analysis when assessing stat knowledge & skills

Individual learner
Class / Course
Program / Curriculum

School / State / Nation

International
TIMSS, PISA PIAAC

Key challenge:
How to assess?
(content already determined by curriculum/teacher)

What to assess?
(the definition of target skills is itself a topic for discussion and consensus-building)

OECD surveys

PISA: Program for International Student Assessment

Age 15 students "…are prepared to meet the challenges of today's knowledge societies… what they can do with what they learn at school…"

Literacy, Math, Science Cycle: 3 years.

PIAAC: Program for International Assessment of Adult Competencies

Prior non-OECD surveys: ALL (Adult Literacy and Lifeskills survey)
IALS (International Adult Literacy Survey)

PIAAC methodology & Content

(tentative, as of summer 2007)

Adults ages 16 to 65+.
Household survey interview (CAPI + written)
Cycle: 5 years.

Competencies:

- **Document Literacy** (forms, graphs, tables, …)
- **Numeracy** Number, Dimension & shape, Patterns & relationships, Data & Chance
- **Problem-solving in technology-rich env.??**
- **…**
- **Background Questionaire: bio-data, economic & social outcomes, …**

PIAAC 'competency': Interest, attitude, and ability of individuals to access, manage, integrate, and evaluate information, construct new knowledge, and communicate with others in order to function effectively in the information age

Numeracy (tentative): The ability to access, use, apply, interpret, and communicate mathematical information and ideas, in order to effectively manage and respond to the mathematical demands of diverse situation in the information age.

Enabling processes: attitudes, beliefs, interests

Questions & Challenges

1. **What are critical areas in which <u>adults</u> should possess statistical literacy** (as part of Numeracy and Document Literacy competencies)**?**
2. **What are good tasks for assessing key statistical literacy (data, probability) of adults:**

a. relevant & realistic across countries

b. elicit open responses that can be scored reliably

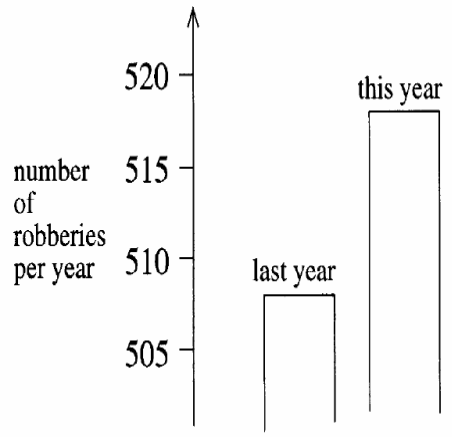
c. suitable for household interview (computer/ written)

d. show good psychometric properties (validity, reliability, fairness)

TIMSS 1996
Mathematical Literacy
Final year

A TV reporter showed this graph and said:

"There has been a huge increase in the number of robberies this year"



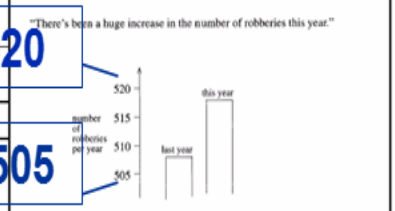
Do you consider the reporter's statement to be a reasonable interpretation of the graph?

Briefly explain.

Percent Correct for Example Item 6
Final Year of Secondary School*

Country	Percent Partially Correct	Percent Fully Correct	TCI
² Cyprus	13 (2.2)	5 (1.7)	48%
Czech Republic	26 (2.1)	6 (1.2)	78%
Hungary	25 (1.0)	4 (0.7)	65%
¹ Lithuania	17 (2.6)	2 (0.4)	43%
¹ New Zealand	38 (3.2)	33 (3.2)	70%
² Russian Federation	13 (1.8)	7 (1.8)	48%
Sweden	29 (1.8)	37 (2.2)	71%
Switzerland	27 (2.2)	23 (1.5)	82%
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix B for Details):			
Australia	39 (2.3)	26 (2.8)	68%
² Austria	28 (2.4)	19 (2.4)	76%
Canada	35 (2.6)	23 (1.5)	70%
France	25 (2.7)	22 (2.3)	84%
Iceland	25 (1.4)	38 (1.9)	55%
¹ Italy	13 (1.9)	12 (2.1)	52%
Norway	24 (1.3)	34 (1.4)	84%
United States	41 (1.8)	14 (1.3)	63%
Countries with Unapproved Student Sampling (See Appendix B for Details):			
³ Germany	26 (2.8)	20 (2.4)	75%
Countries With Unapproved Sampling Procedures and Low Participation Rates (See Appendix B for Details):			
Denmark	25 (1.7)	26 (1.9)	58%
² Netherlands	27 (2.0)	30 (2.6)	78%
Slovenia	31 (2.1)	6 (1.4)	88%
South Africa	12 (2.1)	3 (1.0)	49%
International Average Percent Correct	26 (0.5)	19 (0.4)	

Example 6
Graph with robberies per year.



USA:
41% partial
14% full

Relevance of large-scale assessments for class assessments

- show that it is possible to reliably assess levels of performance/understanding (partial credit rubrics)

- provide frameworks/theories of domains for assessment of relevance to society, policy makers, and educators

- illustrate "complexity schemes", i.e., maps of factors that contribute to task difficulty
(important for task development *and* interpretation)

Document Literacy

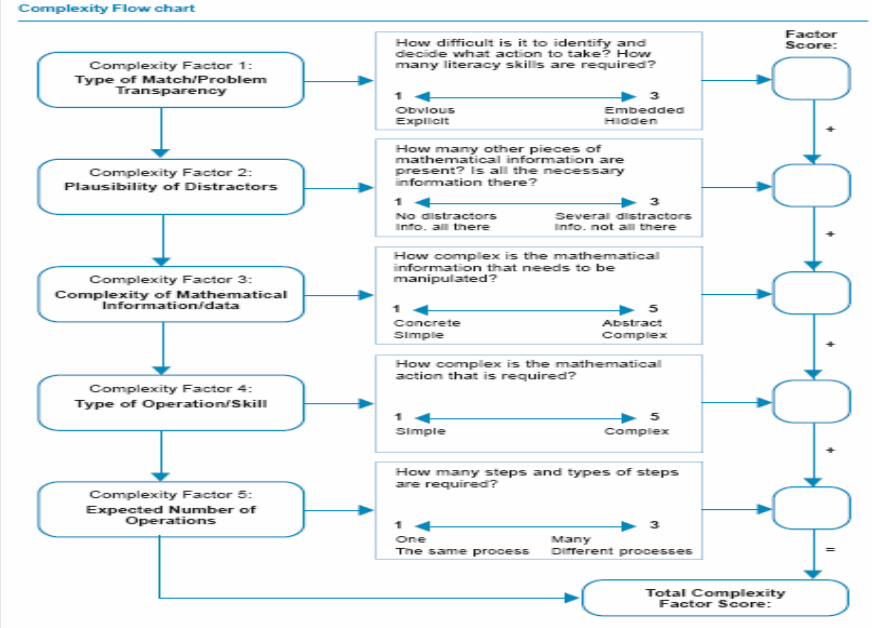
(Kirsch & Mosenthal, 1985 - 2004)

The knowledge and skills required to locate and use information contained in various document formats (applications, forms, schedules, maps, tables, graphs).

simple lists
combined lists
intersecting lists
nested lists

Cognitive processes: Locating / matching - cycling - integrating - generating – inferring

ALL: complexity scheme for numeracy items (tentative)



Challenges for the future

1. **What are the critical areas in which adults should possess statistical literacy?** (general, specific)
   - **Can we identify central tasks adults face?**
2. **How can we <u>prepare</u> students for "skill transfer" to such tasks / areas?**
   - **How can we <u>assess</u> "skill transfer" in this regard?** (performance + understanding, argumentation, …)
3. **How can we <u>evaluate</u>, and <u>improve</u>, the reliability, validity, interpretability, and relevance of assessments, to: students, teachers, society?**