Perspectives in Measurement (State-of-the Art)

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Content

- Motivation & Goals
- Definition & Fundaments
- Value (the concept of)
- Language
- Measurement as a methodological key-word
- Measurement practices
- Conclusion

Motivation & Goal

- A keynote of the 13th IWKM
- Potential for different disciplines informing each other (we're facing the same problem)

- Look at the problem from various perspectives
- Provide non-exhaustive brief description of some contemporary positions in the matter of measurement
- An invitation to a Post-Conference Monograph

Definition & Fundaments

Definitions

- Field specific
- No single one generally accepted
- Some agreement on: "…. *activity that involves interaction with a concrete system with the aim of representing aspects of that system in abstract terms*" (Tal, 2017)

Definition & Fundaments (cont.)

- what is measurable ?
- quantity & quantification
- which conditions make measurement possible?
- dealing with *quantifiable world*?
- when/how can *relations among numbers* map *relations among objects*?
- levels of an *acceptable error*
- operationalization (e.g. *fuzzy* → *quantity*)

Value (the concept of)

Value:

- Variable
- Number
- Axiological category

- whether math operations with the values make sense (Stark, 2018)
- mea. is theory loaded/contextual *(attribute)*
- *true value*: e.g. acc: value in a mathematical sense vs. value as a social concept
- problem of *"average household"*

Language

- the linguistic representations can be seen as *compression algorithms*, which economically condense vast amounts of information into a symbolic formula (Evers and Lakomski, 2000)
- mea. characterization also fits various kinds of perceptual and linguistic activities (Tal, 2017)

- mea. as *representation*
- mea. as *metaphor*

Mea. as a methodological key-word

- historically a demarcation lane between *natural* and *social* sciences (humanities)
- principles of *predictive science*

Issues:

- mea. vs. empirical information
- sources and representations of *variation* (inherent and induced)

e.g. in biological/social systems

Mea. as a methodological key-word (cont.)

- mea. where the entities under study have a *dubious ontological grounding*
- mea. outcomes reflect *facts* about nature or about human *tools* and *concepts*?
- level of *acceptable error*
- when measuring instruments *disagree*, is it always possible to ascertain which one is in *error*?

(Mitchell, Chang, Tal, 2015)

Mea. as a methodological key-word (cont.)

- validities (e.g. construct val.) and precision
- conditions under which relations among *numbers* can be used to express relations among *objects*
- numerical intervals do not always carry empirical information
- [if (a=b & b=c) then a=c]

empirical comparisons among physical magnitudes reveal only *approximate equality*, which is not a *transitive relation*

(Tal, 2017)

Mea. as a methodological key-word (cont.)

- understanding of mea. is key to:

→ interpretation of research results

→ validity of theory

→ acceptation/refusal of statements

→ correct comparison of measurements

…. *discrepancies between theory and accurate measurements led to the development of new theories. Such slight discrepancies would not even have been detected if we had been content with a merely qualitative explanation of the phenomena.* (Symon, 1964)

Mea. practices

- mea. standards accurate by virtue of fact or convention? (Mitchell, Chang, Tal, 2015)
- expected revision of the *International System of Units (SI)*
- *The General Conference on Weights and Measures* (13-16 November 2018)
- effective from 20 May 2019, SI is the system of units (s;m;kg;A; K; mol; cd) in which:

Mea. practices (cont.)

- the unperturbed ground state hyperfine transition frequency of the caesium 133 atom $\Delta\nu Cs$ is 9 192 631 770 Hz
- the speed of light in vacuum c is 299 792 458 m/s
- the Planck constant h is 6.626 070 15 × 10−34 J s
- the elementary charge e is 1.602 176 634 × 10−19 C
- the Boltzmann constant k is 1.380 649 × 10−23 J/K
- the Avogadro constant NA is 6.022 140 76 × 1023 mol−1
- the luminous efficacy of monochromatic radiation of frequency 540 × 1012 Hz, Kcd, is 683 lm/W

(CGPM,2018)

Conclusion

- Definition & Fundaments
- Value
- Language
- Mea. as a methodological key-word
- Mea. practices

- Cornerstone of Science
- What does it mean to measure something?

Resources

- Evers, C.W., Lakomski, G. (2000) Doing Educational Administration: A Theory of Administrative Practice, Pergamon Press, New York
- Keith R. Symon, *Mechanics, (1964)* Addison-Wesley Publishing Company, *Second Edition*
- Mitchell, J.D., Chang, H., Tal, E. (2015) The Making of Measurement. https://doi.org/10.1016/j.shpsa.2017.10.001
- Stark, B.P. (2018) SticiGui, https://www.stat.berkeley.edu
- Tal, E. "Measurement in Science", *The Stanford Encyclopedia of Philosophy* (Fall 2017 Edition), Edward N. Zalta (ed.), https://plato.stanford.edu
- The General Conference on Weights and Measures (2018), https://www.bipm.org

Thank you!

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