Concettualizzazione, quantificazione e valutazione della Multidisciplinarità

SAPIENZA
UNIVERSITÀ DI ROMA

Cinzia Daraio (E-mail: cinzia.daraio@uniroma1.it)

Department of Computer, Control and Management Engineering Antonio Ruberti (DIAG), Sapienza University of Rome

Workshop «ShareScience»

Condivisione delle competenze: Multidisciplinarità, Trasferimento Tecnologico, Diffusione Cultura Scientifica

Sapienza Università di Roma, 30 Ottobre 2019

Outline

- Introduction on the context and recent trends
- Conceptualizing Interdisciplinarity: what is it?
- Assessing Interdisciplinarity: how it can be measured?
- Evaluating Interdisciplinarity research: does it pay? Is it useful? How it is evaluated?
- Conclusions and two suggestions for the Second Workshop «Share science»

The context and recent trends

Category	Description
Changes	1. In the **knowledge production** (Gibbons et al. 1994; Nowotny et al. 2001) 2. The **crisis of technoscience** (Bucchi, 2009) **and science** (Benessia et al. 2016) 3. Advent of the **big data era** (the **computerization** of evaluative informetrics, Moed, 2017) 4. In the **Communication of science** (Bucchi and Trench, 2014)
effects	1. On the *demand* side 2. On the *supply* side 3. On *scholars* 4. On the *assessment process* 5. On the *measurement of productivity/efficiency* within an assessment process

The context and recent trends

Category	Description
effects	**On the demand side**: a) extension to societal value and value for money (evaluation society, Glaser and Whitley, 2007; Dahler-Larsen, 2012) b) performance based funding (Hicks, 2009, Jonkers and Zacharewicz, 2016) and c) requests for new and timely indicators in response to changing needs (Daraio and Bonaccorsi, 2017) d) increase of institutional and internal assessments.
	On the supply side: a) proliferation of rankings (among many others, Hazelkorn, 2011), b) development of Altmetrics (Priem et al. 2010, 2012), open access repositories (Hilbert and López, 2011, Pinfield et al. 2014), c) new assessment tools -both commercial (InCites and Sci-Val) and freely available (Google Scholar citation)-, d) desktop bibliometrics (Katz and Hicks, 1997; Publish or Perish software).

The context and recent trends

Category	Description
effects	**On scholars**: - the increase of "publish or perish" pressure, - impact on the incentives, behaviour and misconduct, - increasing critics against traditional bibliometric indicators (Beyond Bibliometrics Cronin and Sugimoto (2014, 2015); Dora Declaration, Leiden Manifesto (Hicks et al., 2015); Metric Tide report by Wilsdon (2015), Zitt, 2015; Gingras, 2016; Benedictus, Miedema and Ferguson, (2016), Stephan, Veugelers and Wang (2017).
	On the assessment process: - Increasing complexity of the research assessment linked to "the implementation problem" (Daraio, 2017a); - multidimensionality of the assessment of the research (Moed and Halevi, 2015); - problems of data quantification, harmonization and standardization for different evaluation and assessment purposes (Glänzel, 1996, Daraio and Glänzel, 2016; Glänzel and Willems, 2016).
	On the measurement of productivity/efficiency within an assessment process: (extension of the boundaries of the research activity and the interdependence with the society) - a more precise **description and delineation of the boundaries** of the production process whose productivity has to be measured - consider the dynamics of the inputs, outputs and their connection.

Daraio (2018)

Conceptualizing Interdisciplinarity: what is it?

- National Academies of Sciences (2005, p.2) interdisciplinary research is: *a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts and/or theories from two or more* ***disciplines*** *or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice.*
- It is a matter of **Knowledge integration** (Rousseau et al. 2019)

From multidisciplinarity towards convergence

In **multidisciplinary** research the subject under study is approached from different angles, using different disciplinary perspectives, but integration is not accomplished.

Interdisciplinary research leads to the creation of a theoretical, conceptual and methodological identity, hence more coherent and integrated results are obtained.

Transdisciplinary research goes one step further and refers to a process in which ***convergence*** among disciplines is attained.

Some relevant references: Wagner, Roessner, Bobb, Klein, Boyack, Keyton,... & Börner (2011), Liu, Rafols and Rousseau (2012), Ding, Rousseau and Wolfram (2014), Zhang, Rousseau, and Glänzel (2015).

From Convergence towards Knowledge infrastructure

Convergence as «the coming together of insights and approaches from originally distinct fields» «provides power to think beyond usual paradigms and to approach issues informed by many perspectives instead of few» (National Research Council, 2014)

Knowledge infrastructure ("robust networks of people, artifacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds." Edwards, 2010).

Assessing Interdisciplinarity: how it can be measured?

- **TOP-DOWN** approaches: using existing categories
- **BOTTOM-UP** approaches: clusters, includes network

Stirling (2007): diversity consists of three basic concepts: *variety*, *balance* and *disparity*.

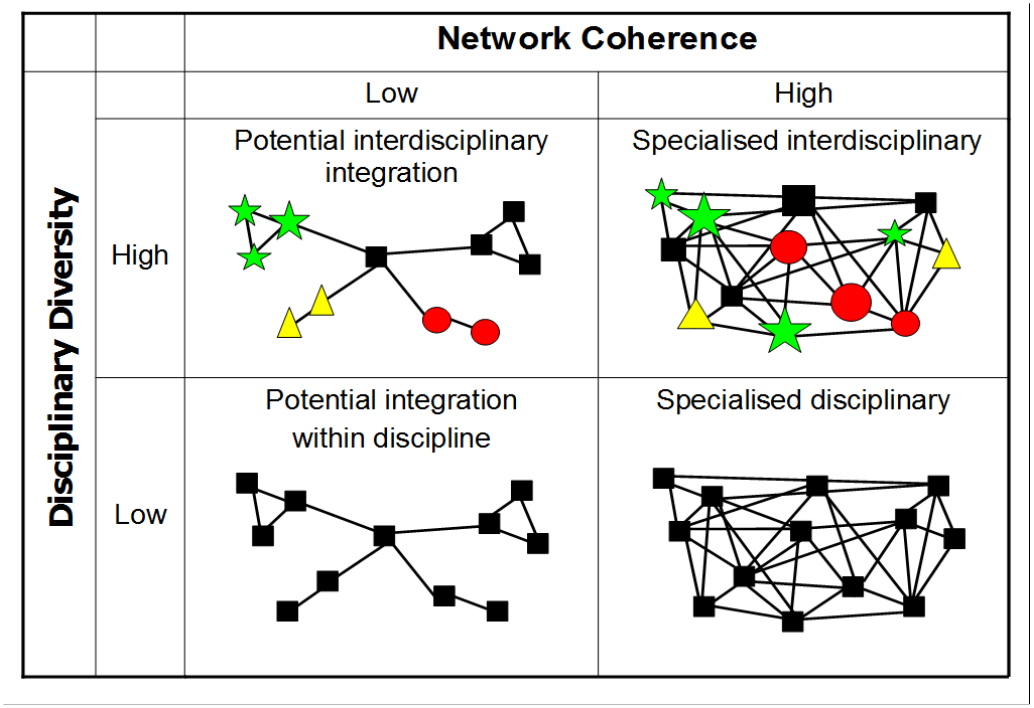
- The key of an acceptable integration score is that it captures *not only* the *number of disciplines* cited by a paper and their degree of concentration but also provides a measure of *how disparate* these disciplines are.
- In order to do so, it relies on a specific metric of distances or similarities between pairs of disciplines. He concludes that the Rao-Stirling measure, which can be interpreted as a *distance-weighted Simpson diversity*, is such an acceptable measure. It is defined as:

$$D = \sum_{\substack{i,j \\ i \neq j}} (d_{ij})^{\alpha} (p_i p_j)^{\beta} \qquad (1)$$

- Here **dij denotes the *dissimilarity* (disparity) between category** i and category j, and pi and pj denote the *proportions* of the total number of items under study in category i and category j, respectively; finally α and β are parameters that adjust the importance given to distances among categories (α) and proportions (β).

Interdisciplinarity: how it can be measured?

- Rafol and Meyer (2010) *combine* *disciplinary diversity* with *network coherence*.



- There are many other recent measures (see references at the end).

Does it pay? Conflicting evidence

- Disciplinary collaborations contribute more to a career than interdisciplinary collaborations (Van Rijnsoever, and Hessels, 2011).
- Interdisciplinary research plays a more important role in generating high impact knowledge (Chen, Arsenault and Larivière, 2015).

Why it is important/useful?

- Convergence is an **enabling factor**
- Convergence interacts with Mixed Methods and Knowledge infrastructure in the 3-dimensional framework (Theory-Method-Data) to assess the efficiency, effectiveness and impact of Education Research and Innovation (Daraio, 2017)
- Convergence is linked to creativity and leadership (Hemlin et al. 2013; Lee, Walsh and Wang, 2015)
- Convergence is related to open science (Nielsen, 2011; OECD, 2015)

10 key characteristics essential for successful interdisciplinary teams (Nancarrow et al., 2013, 6)

1. Leadership and management
2. Effective communication
3. Personal rewards, training and development
4. Appropriate resources and procedures
5. Appropriate skills mix
6. Positive and enabling climate
7. Individual characteristics
8. Clarity of a shared vision
9. Quality and outcomes
10. Respecting and understanding roles

How it is evaluated?

- Interdisciplinarity is a good thing but nobody is sure how to do it efficiently…how to carry out the research, what and how to evaluate…
- Science Europe (research funding and research performing institutions in Europe) Interdisciplinarity - Symposium Report (2018): the evaluation of interdisciplinary research poses a set of problems:
  - Missing common standard and criteria
  - Shortages of peer reviewers
  - Negative impact on career prospects of researchers engaging in interdisciplinary research

Conclusions

- Recognition and careers in the interdisciplinary space (!)
- Leaders, “bridge builders” and “translators of disciplines” needed
- Among other things, it’s a matter of personal skills, opportunity, *trade-offs* and *incentives*, institutional and contextual framework conditions

Two suggestions for the Second Workshop «Share science»

1. Need to finance or create space for people to meet: for instance “lunch seminars with pizza and water offered to participants”
2. Connecting the activities of the workshop to the open calls of European projects: each group might prepare its poster addressing one of the topic of the call and later build the discussion groups around the topics of the calls.

For knowing more: Selected references

Bammer, G. (2017). Should we discipline interdisciplinarity?. *Palgrave Communications*, *3*(1), 30.

Bongioanni I. Daraio C. Ruocco G. (2014), A quantitative measure to compare the disciplinary profiles of research systems and their evolution over time, *Journal of Informetrics*, 8 (3), 710–727.

Carayol, N., & Thi, T. U. N. (2005). Why do academic scientists engage in interdisciplinary research?. *Research evaluation*, *14*(1), 70-79.

Chettiparamb, A. (2007). Interdisciplinarity: a literature review. *report, Interdisciplinary Teaching and Learning Group, University of Southampton*.

Daraio C. (2017), A framework for the assessment of Research and its Impacts, *Journal of Data and Information Science*, Vol. 2 No. 4, 2017 pp 7–42.

Daraio C. (2018), The Democratization of Evaluation and Altmetrics, Technical Report DIAG, 01/2018.

Donina, D., Seeber, M., & Paleari, S. (2017). Inconsistencies in the governance of interdisciplinarity: the case of the Italian higher education system. *Science and Public Policy*, *44*(6), 865-875.

Frodeman, R. (2017). The future of interdisciplinarity. *The Oxford handbook of interdisciplinarity*, 1-8.

Jacob, W. J. (2015). Interdisciplinary trends in higher education. *Palgrave communications*, *1*(1), 1-5.

Klein, J. T. (2008). Evaluation of interdisciplinary and transdisciplinary research: a literature review. *American journal of preventive medicine*, *35*(2), S116-S123.

For knowing more: Selected references

Moschini U. , Fenialdi E., Daraio C., Ruocco G. and Molinari E. (2019) A comparison of three individual multidisciplinarity indices based on the diversity of the Scopus subject areas, of the bibliography and of the citing papers of an author's documents, in Catalano G., Daraio C., Gregori M., Moed H.F., Ruocco G. (2019), *Proceedings of the 17th International Conference on Scientometrics & Informetrics*, 2-5 September 2019, Sapienza University of Rome, Italy, Edizioni Efesto, ISBN: 978-88-3381-118-5, August 2019, pp. 1226-1231.

Nancarrow, S. A., Booth, A., Ariss, S., Smith, T., Enderby, P., & Roots, A. (2013). Ten principles of good interdisciplinary team work. *Human resources for Health*, *11*(1), 19.

National Research Council. (2014). *Convergence: facilitating transdisciplinary integration of life sciences, physical sciences, engineering, and beyond*. National Academies Press.

Rousseau R. Zhang L. (2019), Knowledge integration: its meaning and measurement, in *Springer Handbook of Science and Technology Indicators* edited by Glänzel W., Moed H.F., Schmoch H. and Thelwall M., 69-94.

Ruocco G., Daraio C., Folli V., Leonetti M., (2017), Bibliometric indicators: the origin of their log-normal distribution and why they are not a reliable proxy for an individual scholar's talent. *Palgrave Communications*. 3:17064 doi: 10.1057/palcomms.2017.64.