Social network analysis:
An introduction and application to stem education research

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Social Network analysis (SNA) is a method and a methodology. **Traditional approach**

Variables: Age, Ethnicity, Gender, Height, Weight, etc.

**SNA approach**
- SNA is not the same as social media
- Investigates social context and structure
- Example: Co-authorship networks impact on research creativity

Henderson et al., 2018
Basics of a Network

- Nodes – often individuals but can be groups, buildings, events, etc.
- Ties - relationships between nodes
Introducing an example in education research

Building relational expertise to inform a higher education change initiative (Quardokus Fisher et al., 2019)
Theoretical framework

- Identify nodes
- Identify type of network
  - Egocentric
  - Complete
  - Open
- Identify type of relationship
- Identify strength of relationship
- Analysis (discussed later)

Relational Expertise
Recognize values and mediate across boundaries

- Node: Faculty member
- Network: Open – Faculty members in 7 STEM units
- Relationship:
  - Discussions about teaching
  - Subsets identified by topics of interest
- Strength: Frequency of discussions

Edwards, 2012; Henderson et al, 2018
Options: Survey, observation, publicly available, interview

Concerns: Achieving high response rates, avoiding participant burden and memory challenges

Style: Dropdown list, free response, matrix selection
Please list one person with whom you communicate about teaching and learning. State your colleague’s first and last name. If this colleague does not work at [this institution], please state his or her affiliation. You will be asked follow-up questions regarding this person, and will have the opportunity to list up to ten individuals.

What issues of teaching and learning do you discuss with this person? (Check all that apply)

- Teaching methods—How to teach
- Teaching materials and technologies—How to teach with what
- Curriculum—What to teach
- Curriculum timing—When to teach what
- Assessment—How to measure impact of teaching
- Grading issues
- Student motivation issues
- Student diversity issues
- Policy or accreditation issues
- Teaching issues related to promotion and tenure

(Table reproduced from Quardokus Fisher et al., 2019)
Visualizing and analyzing the data

Step 1 – Response rates
- No hard cutoff of acceptable response rates
- 80% and above is often identified informally (Skvoretz et al., 2018)

Step 2 – Building networks and choosing software
- Matrix or Ego/Alter Input
This network is undirected (reciprocal, symmetric) and binary.
Software Options

- **UCINET/NETDRAW** (https://sites.google.com/site/ucinetsoftware/)
  - Purchase
  - Point and click

- **ORA** (http://www.casos.cs.cmu.edu/index.php)
  - Purchase
  - Point and click

- **R package (igraph, statnet)** (www.r-project.org)
  - Free
  - Coding

- **Node XL** (http://nodexlgraphgallery.org/)
  - Free
  - Excel (but not Mac)
Relational expertise networks

Fig. 2

a All-encompassing network in unit A. b Discussion network of teaching issues related to promotion and tenure in unit A

(Figure reproduced from Quardokus Fisher et al., 2019)
Visualizing and analyzing the data

Step 3 – Identifying metrics

Step 4 – Interpreting meaning
Analysis of the network
See Quardokus and Henderson (2015) for calculations

Node Level
- Degree centrality
- Betweenness centrality
- And many more

Network Level
- Density
- Centralization
- And many more
Analysis to build relational expertise

• Euclidean distance
  • Similar to distance formula
  • Square root of the square of the sum of the differences in degree of each node

Fig. 2
a All-encompassing network in unit A. b Discussion network of teaching issues related to promotion and tenure in unit A

Figure reproduced from Quardokus Fisher et al., 2019
Interpreting meaning

Table 4
Ranking of Euclidean distance of topic networks compared with the all-encompassing networks of each unit

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<th>A</th>
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<th>C</th>
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Bibliography


