Identification of the Nature of Scientific Specialties in Conference Proceedings

By

Vandy Pacetti-Donelson, EdD
Director of the Library/Archivist

United States Sports Academy
One Academy Drive
Daphne, AL 36526
Email: vpackettidonelson@ussa.edu
vandylpd@gmail.com
Phone: 251-626-3303 ext. 7268
Cell: 863-307-1222
Abstract

Identifying the nature of scientific specialties is a fundamental challenge for information science. Co-citation studies of peer-reviewed journal articles recorded in scientific databases, such as Web of Science, are the most common methodology used to identify science and make informed purchasing, tenure, and science policy decisions. With the expanding opportunities to publish outside peer-reviewed journals, especially for technology-related fields, a method to study scientific specialties that coalesce outside the established publication record is overlooked. The goal of this study was to employ a custom database solution to conduct co-citation analyses of a non-traditional oeuvre in order to visually map its development as a knowledge domain and validate Instructional/Educational Technology as a scientific specialty and identify its nature as a field.

The theoretical framework for this study, Kuhn’s seminal work, The Structure of Scientific Revolutions, emphasized the importance of community in the development of science in that paradigmatic development occurs with shared practices of inquiry. Scientific specialties form communities of practice most often with a convergence of the community in technology sectors through conference attendance. The Association for Educational Communications and Technology (AECT) is an international organization of instructional/educational technologists that has published its annual conference proceedings since 1979. These conference proceedings provide 35 years of published papers in this specialty that are not indexed in traditional journal databases and therefore provide an overlooked knowledge domain worthy of study for the identification of the nature of this scientific specialty.

Bibliometric indicators were extracted and collected into custom databases for co-citation analyses and multidimensional graphing. The data was divided into 5-year sets and Gephi 0.9.2 software was used to create multidimensional graphs to identify developmental and incremental change within the knowledge domain with the purpose of understanding the developmental pattern of the specialty. The graphs, taken as a series, employ Betweenness Centrality from Network Theory to display co-citation connections. Seminal works, leading institutions, and researchers at the research front in each data set were identified and exhibit indicators for decision making. Further, Characteristic Scores and Scales identified in the data demonstrated lognormal distribution which has been identified as a persistent pattern across scientific fields validating conference proceedings, in this case, as a worthy oeuvre for the identification of a subject specialty (Viiu, 2018).

This study demonstrated that the nature of scientific specialties can be identified in knowledge domains outside of the traditional publication record and proposes a methodology to collate data and complete an analysis without traditional database usage.
Introduction

Where does scientific specialty begin? How and when do scientific specialties emerge in a discipline? At what point in development does a specialty become a field or a discipline in and of itself? Identifying the nature of scientific specialties is a fundamental challenge for information science. Morris and Van der Veer-Martens (2008) break scientific specialty into three components for the purposes of modeling: researchers, base knowledge, and formal literature thereby representing the social, cognitive, and communitive processes in a specialty. When scientific specialty is studied in information science, researchers are studied through citation practices, the knowledge base is studied through content analyses, and communication is studied through co-citation and bibliographic coupling.

Indeed, co-citation studies of peer-reviewed journal articles recorded in scientific databases, such as Web of Science, are the most common methodology used to identify science and make informed purchasing, tenure, and science policy decisions; but are they the most effective way to identify scientific specialties? “In a global citation analysis, the researcher examines how often a particular publication or a selection of discipline-specific publications are cited without regard to the citing authors’ institutional affiliations or geographic regions” (White 2019). Not every bit of science is written about and published in traditional scientific journals indexed in traditional databases. Conversely, local citation studies focus on the citation habits of users affiliated with a particular institution and studies of this nature demonstrate a high percentage of coverage of faculty citations within affiliated libraries employing this methodology. In short, we buy or provide access to the science that our faculty write about and cite. This phenomena may not provide insight about emerging specialties. Further, with the expanding opportunities to publish outside peer-reviewed journals, especially for technology related fields, a general absence of specialty emergence may occur within a local library collection. A method to study scientific specialties that coalesce outside the established publication record should be considered.
Theoretical Background

Kuhn’s seminal work, *The Structure of Scientific Revolutions*, emphasized the importance of community in the development of science in that paradigmatic development occurs with shared practices of inquiry. Science, in its purest iteration, is a shared social practice and depends on a shared professional context or “selection environment” (Leydesdorff, Wagner, & Bornmann, 2018). “Research specialties consist of relatively small self-organizing groups of researchers that tend to study the same research topics, attend the same conferences, publish in the same journals, and also read and cite each other’s research papers” (Morris & VanderVeer-Martens, 2008, p.213).

According to Rons (2018), “Sufficient bibliometric focus at the specialty level requires an aggregation of publications that is more fine-grained than the broad subject categories grouping interrelated journals that form the backbone of commonly used global publication and citation indexes” (p. 114). Global publication and citation indexes overlook some publications until such time that the publication has sufficient global appeal. Conference proceedings, which are not often indexed in global indexes, provide a set of publications that focus on the interactions of a self-organizing research community that are often overlooked but provide a sufficient oeuvre for the identification of scientific specialties in that conference proceedings provide a view at the convergence of community.

The goal of this study was to conduct bibliometric analyses of a non-traditional oeuvre from a self-organizing group of researchers--conference proceedings--in order to inform about its nature as a specialty by measuring its growth through lognormal distribution and visually mapping its development through network analysis as a knowledge domain.
Methods

Scientific specialties form communities of practice most often with a convergence of the community in technology sectors through conference attendance. The Association for Educational Communications and Technology (AECT) is an international organization of instructional/educational technologists and researchers that has published its annual conference proceedings since 1979. These conference proceedings provide 35 years of published papers in this specialty that were not indexed in traditional journal databases and therefore provide an overlooked knowledge domain worthy of study for the identification of the nature of this scientific specialty.

Bibliometric indicators were extracted and collected into custom databases for truncation into Characteristic Scales and Scores (CSS), co-citation analyses, and multidimensional graphing. Mean citation rates and distribution were calculated in 5-year sets. The application of the CSS method took into account the full set of citation counts where all authors were considered equal. Lognormal distribution was iteratively generated following a specific parametrization where the CSS algorithm was applied to each sample and the values were identified at the point of convergence.

Co-citation was tracked in custom databases in 5-year dispersions in order to conduct visual network analysis. Gephi 0.9.2 software was used to create multidimensional graphs to identify developmental and incremental change within the knowledge domain with the purpose of understanding the developmental pattern of the specialty.
Results

Seminal works, leading institutions, and researchers at the research front in each data set were identified and exhibit indicators for decision making.

Lognormal Distribution

Characteristic Scales and Scores (CSS) offered a straightforward measure for benchmarking the citation performance of individual authors in relation to their peers and the overall population based on a common framework of algorithmically constructed performance classes. This methodology relied on “a recursive procedure of iteratively truncating a sample according to mean values from the low-end up to the high-end” (Glanzel 2011, p.42). While citation studies have relied on the Pareto Distribution (80/20 rule) since the 1960’s, a recent study by Viu (2018), found that “irrespective of scientific field and citation window, CSS tend to uncover an extraordinarily stable distribution of papers across predefined classes of citedness. Virtually all empirical studies using CSS show that with most fields of science about 69-70% of papers seem to be poorly cited, 21% of papers seem to be fairly cited, only about 6-7% seem to be remarkably cited, and only about 2-3% seem to be outstandingly cited.” Viu, 2018, p.402) CSS identified in the data demonstrated lognormal distribution.

Network Analysis

According to Citron and Way (2018), “Co-authorship networks are a measureable representation of the communities that assemble in order to work in a particular area of research (p. 181). In network theory, centrality focuses on the interaction between individual participants within a network. Betweenness Centrality (BC), the most prominent measure of centrality in network analysis, measures
the relative number of times that a node (individual participant) is part of the shortest distance (the cocitation connection) between nodes (individual participants) in a network (Leydesdorff, Wagner, & Bornmann, 2018). The graphs, taken as a series, employ Betweenness Centrality to display co-citation connections. A topological transition was apparent as the author co-citation networks moved from a simple disjointed aggregate into a dense giant connected component to the....

Insert graphic here
Conclusion

The nature of scientific specialties can be identified in knowledge domains outside of the traditional publication record of global indexes. “Disciplinary communities have been described as tribes each with its own norms, categorizations, bodies of knowledge, sets of conventions, and modes of inquiry, which compromise a recognizable culture” (Hyland & Salager-Meyer, p. 311). This study provided on one level a simple working model of specialty identification at the convergence of community that included the network of researchers, the base knowledge, and the specialties’ formal literature.

On another level, specialty identification was confirmed by the lognormal distribution of Characteristic Scales and Scores. Virtually all fields of science are shown by CSS to be fundamentally similar in that they share an approximate 70-21-6-3% distribution of their papers across the four CSS citation performance classes (Viiu, 2018). Since it has been established that all scientific fields are shown by CSS to be fundamentally similar, the presence of CSS 70-21-9 distribution of citation counts within the domain confirms the presence of a scientific specialty.
References


