# Visualizing the Eras of IS Education: A Co-occurrence Analysis of the Information Systems Education Journal

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## Abstract

The *Information Systems Education Journal* has published uninterrupted since 2003. Over its publication history, it has covered myriad topics related to information systems education including model curriculum, outcomes assessment, online learning, capstone courses, service learning, data analytics, and cybersecurity, just to name a few. This, first of its kind, study conducts a co-occurrence analysis using article keywords on the corpus of the journal for the years 2003 through 2024. The results are presented in terms of five eras and present frequency counts, clusters, and term maps of the key topics. This paper presents a worthwhile endeavor of examining the past and looking forward to the future. While the future of information systems education is unknown, the *Information Systems Education Journal* provides a consistent outlet to keep information systems educators and researchers abreast of the latest trends and developments.

Keywords: Co-occurrence analysis, cluster analysis, bibliometric review, term map, *ISEDJ*.

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# Visualizing the Eras of IS Education: A Co-occurrence Analysis of the Information Systems Education Journal

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## 1. INTRODUCTION

The study of individual journals or groups of journals is well established and quite common across various disciplines, information systems (IS) notwithstanding (e.g., Krauskopf, 2018; Flis & van Eck, 2018; Liu & Myers, 2011; Merigo, Pedrycz, Weber, & de la Sotta, 2018; Mustafee, 2011; Oskos & Gencer, 2017). Often, one or more techniques under the umbrella of bibliometrics or bibliometric analysis are employed to gain insight into impact, authorship, citations, publications, themes, trends, and patterns (Broadus, 1987; Pritchard, 1969). In that tradition, the purpose of this paper is to conduct a co-occurrence analysis of articles published in the *Information Systems Education Journal (ISEDJ)* from 2003-2024 to identify topics over the course of time as well as look forward to the future of IS education.

*ISEDJ* published its first volume on September 8, 2003, and has published uninterrupted through its current Volume #22 (2024). As a double-blind peer-reviewed academic journal focused on information systems (IS) education, it covers a wide-array of topics including, but not limited to, model curriculum, outcomes assessment, online and distance education, capstone and service-learning projects, networking, data analytics, and cybersecurity (About, n.d.). *ISEDJ* is listed in Cabells and indexed in ERIC Institute of Education Services. As a publication of the Information Systems and Computing Professionals (ISCAP), the submission process for *ISEDJ* is integrated as a part of the ISCAP Conference and reports a 36% acceptance rate. Per ERIC, 17,800 articles from *ISEDJ* were downloaded in 2022 (Impact, n.d.). Since its inception, five individuals have served as chief editor(s): Donald Colton, Emeritus (2003-2010), Wendy Ceccucci (2011-2012), Nita Brooks (2013-2015), Jeffry Babb, Emeritus (2016-2021), and Paul Witman (2021-present).

## 2. BACKGROUND

When a journal celebrates a notable anniversary, researchers often conduct a bibliometric-based study to commemorate this important event. This was the case for both the *European Journal of Marketing* and *Information Sciences* when each reached 50 years of publications, respectively (Martinez-Lopez, Merigo, Valenzuela-Fernandez, & Nicolas, 2018; Merigo, Pedrycz, Weber, & de la Sotta, 2018). In each of these studies, various bibliometric techniques were employed including publication counts, bibliographic coupling, citation and co-citation analysis, and co-occurrence analysis of keywords.

Large-scale discipline-specific studies commonly necessitate bibliometric studies as well. For example, Flis and van Eck (2018) conducted a co-occurrence analysis of psychology literature between the years ranging from 1950 to 1999, representing 676,393 articles, while White and McCain (1998), conducted an author co-citation analysis of the information science discipline from the period of 1972 to 1995. Smaller scale studies often examine a specific field, such as Ozkose and Gencer (2017) who analyzed the field of management information systems using bibliographic mapping.

Other well-established approaches include analyzing a single journal such as the case of the *Journal of Infection and Public Health* (Krauskopf, 2019), comparing two journals such as the *European Journal of Information Systems* and *Management Information Systems Quarterly* (Mustafee, 2011), or examining a group or "basket" of journals. For example, the Association for Information Systems (AIS) basket of journals (Bernroider, Pilkington, & Cordoba, 2013; Liu & Myers, 2011). These types of studies are not limited only to journals, as others have analyzed various conference proceedings as well (Olbrich, 2009). Finally, researchers may examine a specific research topic or area such as cybersecurity (Mandani & Ramirez, 2019), ethics and corporate social responsibility (Weiss, 2017), or gender (Zhou & Loiacono, 2023).

## 3. METHOD

For our study we employed co-occurrence analysis. Co-occurrence networks are defined as the interconnectedness of terms based on their joint presence within a specific text unit. These networks are formed by linking pairs of terms according to criteria that define co-occurrence. For instance, terms A and B are considered to "co-occur" if they both appear in the same article. Or

in our case, in the author-supplied keywords. Another article might include terms B and C. By connecting A to B and B to C, a co-occurrence network of these three terms is created. The criteria for defining co-occurrence within a text corpus can be adjusted as needed. For example, a stricter criterion might require that the terms appear in the same sentence or in the author supplied keywords. Co-occurrence networks are particularly useful for analyzing large text datasets and big data, such as identifying main themes and topics in numerous social media posts, uncovering biases in text like news coverage, or mapping the entirety of a field of research (Segev, 2022). We applied co-occurrence analysis to the author-produced keywords of the corpus of *ISEDJ*.

For this paper, we looked at all of the articles published in *ISEDJ* from 2003 to 2024, a total of 1076 articles. We then focused on the author produced key words (the key words submitted with each article) as our primary data, in addition to year. We then chose to group the years into units of five years to make it more digestible, as shown in Table 1.

| Grouping Years | Number of Articles |
|---|---|
| 2003-2007 | 288 |
| 2008-2012 | 332 |
| 2013-2017 | 222 |
| 2018-2022 | 174 |
| 2023-2024 | 60 |

Table 1: Grouping by Years

We defined the importance of a key word based on simple frequency counts and link strength. A connection between two items is called a link. The strength of a link is represented by a numerical value, such as the number of articles in which two keywords occur together. A visualization of the importance of the key words (called a term map) was then created. A term map shows the relatedness of terms as a function of the distance between them. The more co-occurrences of two terms, the smaller the distance between them. The more articles in which a term occurs, the more prominently the term is displayed in the term map, such as with a larger font size and larger sphere. The terms are also grouped into clusters.

Six term maps were created to get a glimpse into topics academics published in *ISEDJ*. We constructed term maps based on four five-year groupings (2003-2007, 2008-2012, 2013-2017, 2018-2022) and one for the new unfinished group (2023-2024), and one for the entire data. We hoped the groups would yield a picture of the evolution of topics published in *ISEDJ*. The term maps were created using the VOSviewer software (van Eck & Waltman, 2010, 2014). Part of the term map construction was choosing the minimum number of key word term co-occurrence frequency that would be considered "interesting enough" to use. We choose a minimum number of occurrences as three for the evolutionary term maps, and five for the term map of the full data.

Based on the co-occurrence frequency counts VOSviewer constructed term maps where distance between term indicated relatedness, and color was used to cluster the terms into topic areas. VOSviewer uses both a mapping technique (to determine the layout of terms in the term map) and a clustering technique (which assigns frequently co-occurring terms to the same cluster). The mapping technique is called VOS and is related to multidimensional scaling (Borg & Groenen 2005; van Eck, Waltman, Dekker, & van den Berg 2010). The clustering technique used by VOSviewer is related to modularity-based clustering (Newman, 2004; Newman & Girvan, 2004; Waltman et al. 2010).

## 4. RESULTS

The results of the co-occurrence analysis are presented below for each of the year range groupings including the frequency counts, clusters, and term maps. The colors assigned in the term maps for each era were randomly generated by the VOSviewer software. Unfortunately, we did not have the ability to alter these assigned colors to use the same color for the same topics across eras. We did, however, attempt to match the color in the associated tables for frequency count and clusters.

### 2003-2007: IS Education

We used the rule that the keyword must occur a minimum of three times to be "interesting" (of 989 keywords, twenty-six met the threshold). Of the twenty-six keywords, 14 (54%) are "education" words such as variants of curriculum, assessment, and pedagogy. See Appendix A, Table 2 for frequency counts. The clusters are made up of the terms that are closest to each other, yet also farther away from other terms. Nine clusters were found as shown in Appendix A, Table 3. The term map is provided in Appendix B, Figure 1.

### 2008-2012: Pedagogy and Student Issues

We used the rule that the keyword must occur a minimum of three times to be "interesting" (of

1117 keywords, 101 met the threshold). The thirty-five keywords with a total link strength of 10 or greater are shown in the table below. Looking at the top thirteen for the 2003-2007 vs 2008-2012 we see a movement from plain vanilla curriculum and assessment issues to broader pedagogy and student issues such as mentoring, retention, scholarships, women, and minorities. See Appendix A, Table 4 for frequency counts. The clusters are made up of the terms that are closest to each other, yet also farther away from other terms. Twelve clusters were found as shown in Appendix A, Table 5. The term map is provided in Appendix B, Figure 2.

2013-2017: Cybersecurity-Big Data-Analytic
We used the rule that the keyword must occur a minimum of three times to be "interesting" (of 735 keywords, sixty-five met the threshold). There were thirty-nine keywords with a total link strength of 5 or greater. The clusters are made up of the terms that are closest to each other, yet also farther away from other terms. See frequency counts in Appendix A, Table 6. Seven clusters were found as shown in Appendix A, Table 7. The term map is provided in Appendix B, Figure 3.

2018-2022: COVID Impact on IS Education
We used the rule that the keyword must occur a minimum of three times to be "interesting" (of 543 keywords, fifty-six met the threshold). The thirty keywords with a total link strength of 5 or greater are shown in Appendix A, Table 8. The clusters are made up of the terms that are closest to each other, yet also farther away from other terms. Eight main clusters were found, in addition to five smaller clusters as shown in Appendix A, Table 9. We combined the smaller clusters with the larger cluster. Some of the fifty-six keywords in the network were not connected to each other. The largest set of connected items consists of thirty-eight items. The fracturing (or less cohesiveness) is interesting. This may be due to the impact of the COVID-19 pandemic. The term map is provided in Appendix B, Figure 4.

2023-2024: Artificial Intelligence
We used the rule that the keyword must occur a minimum of three times to be "interesting" (of 215 keywords, eighteen met the threshold). All eighteen keywords are shown in Appendix A, Table 10. The clusters are made up of the terms that are closest to each other, yet also farther away from other terms. Three clusters were found as provided in Appendix A, Table 11. The term map is presented in Appendix B, Figure 5.

2003-2024: Full Network
We used the rule that the keyword must occur a minimum of five times to be "interesting" (of 2827 keywords, 115 met the threshold). The fifty keywords with a total link strength of 16 or higher are shown in Appendix A, Table 12. The clusters are made up of the terms that are closest to each other, yet also farther away from other terms. Nine clusters were found as shown in Appendix A, Table 13. The term map is presented in Appendix B, Figure 6. Appendix B, Figure 7 shows the time overlay for the full network.

## 5. DISCUSSION

For the purpose of discussion each grouping of years is defined as an era. An examination of the topics and factors affecting the choice of topics during each era is then presented.

Era 1: 2003-2007
The first era of *ISEDJ* is characterized by topics associated with IS education. Topics such as curriculum, assessment, and information systems, accreditation, ethics, and pedagogy round out the top three occurrences of keywords. As mentioned previously, these topics represent "education" words. Ethics may be considered a bit of an outlier, however; it is hoped that ethics underlies all aspects of IS education. Also interesting was the separation of curriculum assessment and accreditation as seen in the term map. As a young discipline in this era there was greater interest in solidifying the curriculum, with accreditation just starting to be an important issue. It might be noted that in these early years of the journal, all articles were included in a single volume, without the use of individual issue numbers. Perhaps this was due to a more heterogenous set of topics and less diversity of topics at the time.

Era 2: 2008-2012
The evolution from Era 1 to Era 2 experienced several changes. First, security curriculum development dropped out of the topics. Perhaps, this area matured to the point that educators felt they had gained a good grasp of security curricula. Not surprisingly, retention, social networking, and outsourcing appeared in this era. With the 2008 financial crisis, it is quite possible that the current emphasis on retention began. It is common sense that when students have financial difficulties they often must drop out of school to take care of their responsibilities. The 2010s saw the growth of numerous social networking platforms including Facebook, LinkedIn, Snapchat, and Twitter. Consequently, the use of these platforms in higher education and

in IS education research saw subsequent growth. Interestingly, from Era 1 to Era 2, ethics grew into own cluster. Traditional topics such as programming, assessment, accreditation, and IS curriculum continued into this era. In the term map we see the merging of assessment and accreditation with the emergence of terms such as learning outcomes and program assessment. Perhaps this era shows the focus shift from curriculum assessment to program assessment and accreditation. Also in this era, Volume 11 - 2009, was the beginning of creating separate issue numbers rather than publishing all articles in a single volume.

Era 3: 2013-2017

The evolution from Era 2 to Era 3 saw the loss of social networking, retention, outsourcing, and ethics. Perhaps the ubiquitous nature of social networking led to its absence in this area. It had simply become a normal part of life and education. The tumultuous times created by the 2008 financial crisis were subsiding and students were returning to continue their education lessening the overall emphasis on retention. After two eras, ethics fell out of the topics. It is hard to say ethic was no longer important, but again, perhaps it had become ingrained in the context of IS education. Era 3 saw the reemergence of cybersecurity into its own cluster. The continued growth of the Internet and the Web and numerous data leaks and security breaches throughout the era contributed to the growth and popularity of cybersecurity. Pedagogy and big data/analytics also saw the formation of their own clusters. Along with cybersecurity, this era saw the growth and popularity of big data/analytics. In fact, a common movement at the time was for IS programs to rebrand as Business Analytic programs. As in previous eras, programming, assessment, IS curriculum, and online learning continued to be common topics. Interestingly when looking at the term map we see a refocus of assessment from program assessment back to curriculum assessment, especially the assessment of experiential learning.

Era 4: 2018-2022

The evolution from Era 3 to Era 4 experienced a notable shift. The long-standing topics of programming and assessment were absent. While a direct connection may not be possible, it is interesting to note that a significant change in the *IS 2010 Curriculum Guidelines for Undergraduate Degree Programs in Information Systems* (Topi et al., 2010) was the removal of application development (IS 2002.5 Programming, Data, File, and Object Structures) from the previous curriculum guidelines. A clear explanation for the loss of assessment is a bit more difficult to identify. New developments include the splitting of analytics into two clusters: business analytics and data analytics. This split certainly reflects the growth and popularity of this area. It also saw the movement of business analytics as primarily housed within the College of Business and data analytics housed in various places such as Business, Mathematics, Statistics, and Engineering. This era also saw the appearance of topics related to the COVID-19 pandemic. In particular the growth of topics related to attendance and attentiveness might have been a direct result. While the capstone course was a regular topic in previous eras, it became its own cluster in Era 4. Cybersecurity, pedagogy, online learning, and IS curriculum remained consistent in this era. Assessment fell out of importance except as a part of cybersecurity, which makes sense as the need to assess and solidify the new cybersecurity curriculum was important.

Era 5: 2023-2024

The evolution from Era 4 to Era 5 saw the loss of several long-standing topics including cybersecurity, online learning, assessment, attendance, attentiveness, IS Curriculum, and capstone course. The number of clusters moved from 8 to 3 (Pedagogy, Analytics, and AI). This may be due simply to natural attrition. That is, these topics are so much a normal part of IS education that the novelty has worn off a bit and so they fall out of favor as research topics. It should be noted, in regard to cybersecurity in particular, that ISCAP introduced the *Cybersecurity Pedagogy and Practice Journal (CPPJ)* in 2022 as a publication outlet associated with the ISCAP Conferences. This may account for the absence of cybersecurity-related topics in *ISEDJ*. With the release of ChatGPT in 2022 and numerous other Generative Artificial Intelligence platforms to follow since, it is not a surprise that artificial intelligence appeared. Analytics and pedagogy continued their inclusion.

It should be noted that Era 5 only presents two years.

Looking at the movement or ranking changes of themes through the eras we see that Assessment/Accreditation went from 1 to 5 to 3 to 5 to null (went from first to middle ranking). Pedagogy went from 4 to 1, to 1 to 1 to 2 (highest overall ranking). Programming went from 5 to 9 to 6 to partial 3 to null (lower-middle ranking). Cybersecurity really started in Era 3 and was ranked 4 then 5 then null (middle ranking). Analytics really started in Era 2 and was ranked 7 then 5 and 7 then 6 then 1 (moved from middle to first). Student Issues came to the foreground

in Eras 2 and 4 ranked 3 and 4 (Era 2 blossoming concern for students, COVID-19 era concern for students). See Appendix A, Table 14 for the rank changes from Eras 1 to 5.

From the viewpoint of the number of clusters each term map shows for each era we see that era 1 had 9 clusters, era 2 had 12, era 3 had 7, era 4 had 8, and finally era 5 had just 3. It would appear that era 2 from 2008-2012 was the richest and most diverse era of IS education scholarship. Also, although era 5 is only half-way completed, it would appear that the diversity of IS education has shrunk.

Lastly, the Full Network Term Map (Figure 6) shows the wonderful growth and diversity of IS Education scholarship produced in that past 22 years. We are struck by the continuous central focus of work produced in the areas of pedagogy and curriculum, which are at the heart of student success. It is in a way a painting of the IS Educator landscape, a landscape probably vastly different from that of the IS Researcher producing work in the Basket of Eight.

## 6. CONCLUSION

This is the first known study to examine the full corpus of *ISEDJ* available at the time it was conducted. To see how IS education has changed as well as has stayed the same over the years is quite interesting and serves to honor the past as well as inform the future.

### Limitations

The study is not without its limitations. The most obvious is that the co-occurrence analysis relies solely on author-supplied keywords. Inherent in this methodology is a potential bias toward the terms and buzzwords of any given era. Another potential limitation is the publishing of special issues of *ISEDJ* such as teaching cases which may serve to artificially inflate the occurrence of a term(s) in a particular era. Because of the potential limitation resulting from the sole use of author-supplied keywords, future research might include the addition of title and abstract to the co-occurrence analysis to increase the likelihood of otherwise unforeseen or obvious topics.

### Future Directions

For over two decades *ISEDJ* has kept up with the dynamic nature of IS education as shown by the evolutionary nature of the topics contained in each era of its 1,076 articles published between 2003-2024. In this particular study, the authors chose to establish predefined five-year groupings for analysis and determination of "eras". In future research, the authors plan to implement a more organic approach, by allowing the data itself to establish "eras" of topicality. Furthermore, with the continued growth and popularity of artificial intelligence, in general, and generative artificial intelligence, specifically, continued co-occurrence analysis of ISEDJ may reveal a preponderance of research in this area in the future.

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## APPENDIX A
## Frequency Count and Cluster Tables

| Keyword | Occurrences | Total link strength | Keyword | Occurrences | Total link strength |
|---|---|---|---|---|---|
| curriculum | 21 | 19 | electronic commerce | 6 | 4 |
| assessment | 15 | 15 | is curriculum | 8 | 4 |
| information systems | 12 | 14 | model curriculum | 5 | 4 |
| accreditation | 5 | 11 | curriculum development | 8 | 3 |
| ethics | 10 | 10 | distance education | 6 | 3 |
| pedagogy | 9 | 9 | service learning | 7 | 3 |
| database | 8 | 8 | computer information systems | 5 | 2 |
| education | 8 | 8 | distance learning | 11 | 2 |
| information technology | 8 | 8 | e-commerce | 6 | 2 |
| computer literacy | 5 | 5 | project management | 8 | 2 |
| is education | 8 | 5 | technology | 5 | 2 |
| systems analysis and design | 7 | 5 | information systems curriculum | 5 | 1 |
| course design | 5 | 4 | programming | 6 | 1 |

Table 2: 2003-2007 Frequency Counts

| Curricula | Programming | Assessment | e-learning/ e-commerce | IS Core | Systems Analysis & Design | IST Computer Literacy | Security Curriculum Development | Accreditation |
|---|---|---|---|---|---|---|---|---|
| case study | .net | assessment | collaborative learning | curriculum design | capstone course | capstone | curriculum development | accreditation |
| cis | abet | certification | distance learning | gis | course design | computer literacy | information security | |
| computer information systems | application development | computer | e-business | is curriculum | methodology | higher education | is model curriculum | |
| distance education | cobol | curriculum | e-commerce | is education | project management | information systems | pedagogy | |
| information systems curriculum | database | education | electronic commerce | open source software | service learning | information technology | | |
| information systems education | grading | innovation | ethics | sdlc | significant learning | usability | | |
| is 2002 model curriculum | is accreditation | model curriculum | internet | software engineering | systems analysis and design | | | |
| is curricula | java | security | privacy | systems analysis | | | | |
| it curriculum | programming | technology | small college | web design | | | | |
| it education | software tools | testing | | | | | | |
| mis | systems development | | | | | | | |
| online education | | | | | | | | |
| outsourcing | | | | | | | | |

Table 3: 2003-2007 Clusters

| Keyword | Occurrences | Total link strength | Keyword | Occurrences | Total link strength |
|---|---|---|---|---|---|
| pedagogy | 25 | 43 | abet | 8 | 14 |
| information systems | 15 | 33 | accreditation | 9 | 14 |
| information systems education | 15 | 24 | management information systems | 8 | 14 |
| mentoring | 5 | 22 | assessment | 10 | 13 |
| retention | 6 | 22 | is curriculum | 12 | 13 |
| scholarships | 4 | 21 | is education | 8 | 13 |
| women | 5 | 21 | learning | 9 | 13 |
| computer science | 6 | 20 | database | 7 | 12 |
| education | 11 | 20 | distance education | 10 | 12 |
| web 2.0 | 10 | 20 | enterprise systems | 6 | 12 |
| minorities | 4 | 19 | ethics | 12 | 12 |
| computer literacy | 12 | 18 | outsourcing | 7 | 12 |
| graduates | 3 | 18 | social networking | 4 | 11 |
| curriculum | 17 | 17 | business intelligence | 6 | 10 |
| higher education | 7 | 17 | curriculum design | 7 | 10 |
| information technology | 9 | 17 | information systems curriculum | 5 | 10 |
| software engineering | 5 | 16 | systems analysis and design | 7 | 10 |
| mathematics | 4 | 15 | | | |

Table 4: 2008-2012 Frequency Counts

| Computer-mediated learning | IS Curriculum | Data (base) (analytics) | Retention | Social Networking | Systems Analysis & Design | IST Education | Assess/Accred | Programming | Outsourcing | Pedagogy | Ethics |
|---|---|---|---|---|---|---|---|---|---|---|---|
| blackboard | capstone experience | business intelligence | framework | collaborative learning | active learning | case studies | abet | alice prog lang | is 2002 | is research toward educators | copyright |
| capstone | curriculum design | computer literacy | gestalt | is pedagogy | capstone course | distance learning | accreditation | intro prog | it workers | is undergrad curriculum | ethics |
| cloud computing | curriculum dev | data mining | graduates | instant messaging | cis | is education | assessment | java | offshoring | pedagogy | |
| computer science | design | data modeling | mathematics | internet | curriculum | information technology | assurance of learning | programming | outsourcing | | |
| computers | erp | database | mentoring | mobile computing | is 2002 | motivation | information literacy | prog lang | skills | | |
| distance ed | enterprise systems | database design | minorities | outcomes assessment | project management | online education | learning outcomes | security | | | |
| education | faculty | feedback | retention | privacy | service learning | soft skills | | security educ | | | |
| elearning | higher ed | knowledge management | scholarships | social networking | systems analysis & design | | | | | | |
| entrepreneurship | information systems | laboratory-based learning | tutoring | twitter | | | | | | | |
| is curr | is curriculum | mis | women | | | | | | | | |
| learning | model curriculum | normalization | | | | | | | | | |
| learning management system | sap | | | | | | | | | | |
| online learning | software engineering | | | | | | | | | | |
| service-oriented architecture | | | | | | | | | | | |
| technology | | | | | | | | | | | |
| web 2.0 | | | | | | | | | | | |
| web services | | | | | | | | | | | |

Table 5: 2008-2012 Clusters

| Keyword | Occurrences | Total link strength | Keyword | Occurrences | Total link strength |
|---|---|---|---|---|---|
| active learning | 14 | 26 | assessment | 7 | 7 |
| is curriculum | 11 | 18 | curriculum | 7 | 7 |
| pedagogy | 11 | 15 | e-learning | 3 | 7 |
| online learning | 9 | 14 | engagement | 4 | 7 |
| experiential learning | 8 | 13 | java | 4 | 7 |
| information systems education | 6 | 13 | problem solving | 3 | 7 |
| cyberbullying | 4 | 12 | security | 4 | 7 |
| privacy | 6 | 12 | social media | 7 | 7 |
| programming | 9 | 12 | business analytics | 5 | 6 |
| social networking | 5 | 12 | business intelligence | 5 | |
| analytics | 6 | 11 | information technology | 4 | 6 |
| big data | 8 | 11 | learning styles | 3 | 6 |
| flipped classroom | 6 | 11 | online education | 3 | 6 |
| cybersecurity | 6 | 10 | abet | 3 | 5 |
| it strategy | 5 | 10 | accreditation | 3 | 5 |
| inverted classroom | 3 | 9 | course design | 3 | 5 |
| systems analysis and design | 7 | 9 | data science | 3 | 5 |
| cyberharassment | 3 | 8 | teaching | 3 | 5 |
| distance education | 4 | 8 | team-based learning | 3 | 5 |
| higher education | 4 | 8 | | | |

Table 6: 2013-2017 Frequency Counts

| Cybersecurity | Programming | Online Learning | Big Data | Pedagogy | IS Curriculum?? | Assessment |
|---|---|---|---|---|---|---|
| classroom innovation | collaborative learning | course design | big data | active learning | analytics | abet |
| curriculum development | curriculum | distance education | business analytics | cloud computing | database design | accreditation |
| cyberbullying | it strategy | e-learning | business intelligence | flipped classroom | engagement | assessment |
| cyberharassment | java | erp | community engagement | information systems education | entrepreneurship | database |
| cybersecurity | music | learning styles | data science | inverted classroom | information systems | experiential learning |
| education | programming | online classes | information systems curriculum | is curriculum | problem solving | is education |
| higher education | project management | online education | is2002 model curriculum | pedagogy | social media | |
| information technology | python | online learning | privacy | student engagement | systems analysis and design | |
| instructional design | team-based learning | teaching | teaching case | | | |
| security | | | | | | |
| social networking | | | | | | |

Table 7: 2013-2017 Clusters

| Keyword | Occurrences | Total link strength | Keyword | Occurrences | Total link strength |
|---|---|---|---|---|---|
| pedagogy | 22 | 32 | scrum project | 3 | 12 |
| online learning | 7 | 26 | student performance | 3 | 12 |
| pandemic | 6 | 26 | learned helplessness | 5 | 10 |
| covid 19 | 5 | 25 | procrastination | 6 | 10 |
| faculty | 5 | 25 | data analytics | 12 | 10 |
| grading impact | 5 | 25 | apprenticeship | 3 | 9 |
| remote learning | 5 | 25 | assessment | 4 | 6 |
| capstone course | 4 | 13 | education | 4 | 6 |
| scrum | 4 | 13 | information systems | 6 | 6 |
| asp.net mvc | 3 | 12 | work-based learning | 3 | 6 |
| attendance | 3 | 12 | business analytics | 7 | 5 |
| attentiveness | 3 | 12 | certification | 3 | 5 |
| cybersecurity | 12 | 12 | coding bootcamps | 3 | 5 |
| distraction | 3 | 12 | content analysis | 3 | 5 |
| participation | 3 | 12 | data science | 3 | 5 |

Table 8: 2018-2022 Frequency Counts

| Cybersecurity | Pedagogy | Business Analytics | Online Learning | Data Analytics | Attendance-Attentiveness | IS Curriculum | Capstone Course |
|---|---|---|---|---|---|---|---|
| apprenticeship | active learning | business analytics | covid 19 | data analytics | attendance | competency | agile |
| assessment | certification | coding bootcamps | faculty | data science | attentiveness | curriculum | asp.net mvc |
| cybersecurity | computing education | content analysis | grading impact | education | distraction | information systems | capstone course |
| digital badge | covid-19 | education in data analytics | online learning | retention | participation | information systems curriculum | scrum |
| digital literacy | pedagogy | is curriculum | pandemic | stem | student performance | project management | scrum project |
| learning outcomes | raspberry pi | programming | remote learning | teaching strategies | | higher education | |
| online education | systems analysis and design | student satisfaction | | | learning | | |
| work-based learning | | | | | self-regulated learning | | |
| | learned helplessness | | | | disabilities | | |
| | procrastination | | | | | | |

Table 9: 2018-2022 Clusters

| Keyword | Occurrences | Total link strength | Keyword | Occurrences | Total link strength |
|---|---|---|---|---|---|
| experiential learning | 7 | 21 | data literacy | 3 | 8 |
| data analytics | 7 | 19 | tableau | 3 | 8 |
| pedagogy | 8 | 18 | artificial intelligence | 6 | 6 |
| curriculum development | 4 | 16 | information systems | 4 | 5 |
| interdisciplinary | 3 | 15 | business education | 3 | 3 |
| practicum | 3 | 15 | curriculum | 3 | 3 |
| analytics | 4 | 11 | chatgpt | 3 | 2 |
| data visualization | 6 | 9 | cybersecurity | 4 | 2 |
| excel | 3 | 9 | machine learning | 4 | 2 |

Table 10: 2023-2024 Frequency Counts

| Analytics/Data Viz | Pedagogy | AI |
|---|---|---|
| analytics | curriculum development | artificial intelligence |
| business education | data analytics | chatgpt |
| curriculum | experiential learning | cybersecurity |
| data literacy | interdisciplinary | information systems |
| data visualization | pedagogy | machine learning |
| excel | practicum | |
| tableau | | |

Table 11: 2023-2024 Clusters

| Keyword | Occurrences | Total link strength | Keyword | Occurrences | Total link strength |
|---|---|---|---|---|---|
| pedagogy | 75 | 106 | business intelligence | 14 | 24 |
| curriculum | 51 | 63 | is education | 21 | 23 |
| information systems | 45 | 62 | distance education | 20 | 22 |
| online learning | 26 | 51 | abet | 14 | 21 |
| assessment | 37 | 44 | computer literacy | 18 | 21 |
| information systems education | 25 | 44 | online education | 15 | 21 |
| information technology | 23 | 42 | security | 15 | 21 |
| is curriculum | 37 | 42 | social networking | 9 | 20 |
| education | 27 | 39 | information systems curriculum | 17 | 19 |
| faculty | 10 | 39 | retention | 11 | 19 |
| accreditation | 19 | 37 | service learning | 15 | 19 |
| active learning | 26 | 37 | student perceptions | 9 | 19 |
| data analytics | 20 | 35 | analytics | 11 | 18 |
| pandemic | 8 | 32 | curriculum design | 14 | 18 |
| privacy | 16 | 32 | cybersecurity | 22 | 18 |
| ethics | 25 | 31 | internet | 8 | 18 |
| experiential learning | 19 | 31 | learning | 15 | 18 |
| covid 19 | 6 | 30 | software engineering | 12 | 18 |
| grading impact | 6 | 30 | web 2.0 | 13 | 18 |
| remote learning | 6 | 30 | business analytics | 14 | 17 |
| systems analysis and design | 24 | 29 | capstone course | 14 | 17 |
| computer science | 11 | 28 | cyberbullying | 6 | 17 |
| higher education | 19 | 26 | entrepreneurship | 11 | 17 |
| curriculum development | 19 | 25 | big data | 10 | 16 |
| database | 19 | 25 | certification | 10 | 16 |
| programming | 24 | 25 | distance learning | 17 | 16 |

Table 12: Full Network Keyword Frequency and Total Link Strength
(sorted by Total Link Strength)

| Ethics/Privacy Social Net | Curriculum Assessment | Analytics | Pedagogy | Distance Ed Learning | MIS Ed Issues | IS Topics | COVID impact on Online Learning | Programming |
|---|---|---|---|---|---|---|---|---|
| capstone | abet | analytics | active learning | computer literacy | computer science | enterprise systems | covid 19 | intro programming |
| cloud computing | accreditation | artificial intelligence | agile | course design | design | higher education | faculty | java |
| collaborative learning | assessment | big data | capstone course | distance education | education | information systems | grading impact | programming |
| cyberbullying | case study | business analytics | covid-19 | distance learning | enrollment | information systems curriculum | online learning | programming language |
| e-commerce | certification | business intelligence | curriculum development | e-learning | is curricula | information technology | pandemic | python |
| electronic commerce | computer information systems | critical thinking | experiential learning | erp | management information systems | instructional design | remote learning | |
| entrepreneurship | curriculum | curriculum design | is curriculum | flipped classroom | mentoring | learning outcomes | erp | |
| ethics | database | cybersecurity | is education | framework | outsourcing | simulation | information systems curriculum | |
| information systems curriculum | database design | data analytics | it strategy | information systems education | retention | software engineering | | |
| innovation | is 2002 model curriculum | data mining | motivation | learning | scholarships | | | |
| internet | is model curriculum | data science | online teaching | learning styles | skills | | | |
| mobile computing | it curriculum | data visualization | pedagogy | online education | women | | | |
| privacy | it education | information security | procrastination | teaching | | | | |
| social networking | normalization | machine learning | project management | | | | | |
| technology | project based learning | social media | service learning | | | | | |
| web 2.0 | security | student perceptions | student engagement | | | | | |
| web development | soft skills | | | | | | | |
| web services | systems analysis and design | | | | | | | |

Table 13: Full Network Clusters

| Rank | Era 1 | Era 2 | Era 3 | Era 4 | Era 5 |
|---|---|---|---|---|---|
| 1 | curriculum, assessment, accreditation, model curriculum | pedagogy | pedagogy | pedagogy, Covid 19 | analytics, data viz |
| 2 | ist computer literacy | IS curriculum | online learning | online learning, pandemic, faculty, grading impact, remote learning | pedagogy |
| 3 | ethics, e-learning, e-commerce | Student Issues: mentoring, retention, scholarships, women, minorities | assessment, experiential learning | capstone course, scrum, asp.net mvc, scrum project | AI |
| 4 | pedagogy, curriculum development | online education | cybersecurity, cyberbullying, social networking | attendance, attentiveness, distraction, participation, student performance | |
| 5 | programming, database | accreditation, assessment | analytics, privacy | cybersecurity, apprenticeship, assessment | |
| 6 | IS core | IS education | programming | data analytics, education, data science | |
| 7 | SAD, course design, service learning, project management | Database, data analytics | analytics, engagement, problem solving, social media | business analytics, coding bootcamps, content analysis | |
| 8 | Curriculum variations | Ethics | | | |
| 9 | | Programming | | | |

Table 14: Rank Changes from Eras 1 to 5

APPENDIX B
Term Maps

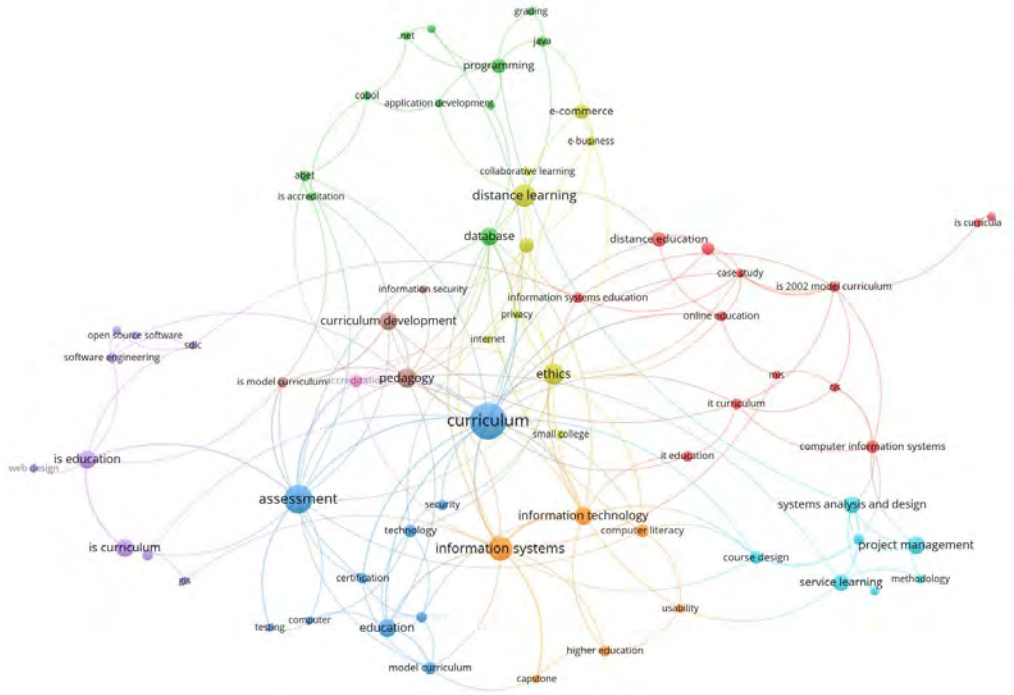


Figure 1: 2003-2007 Term Map

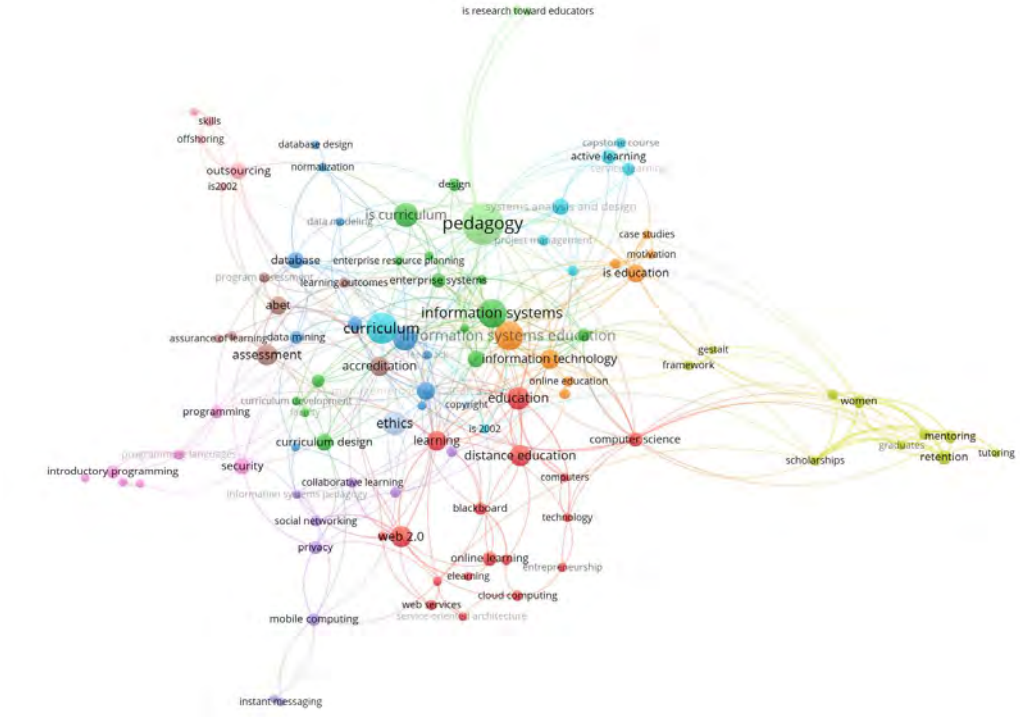


Figure 2: 2008-2012 Term Map

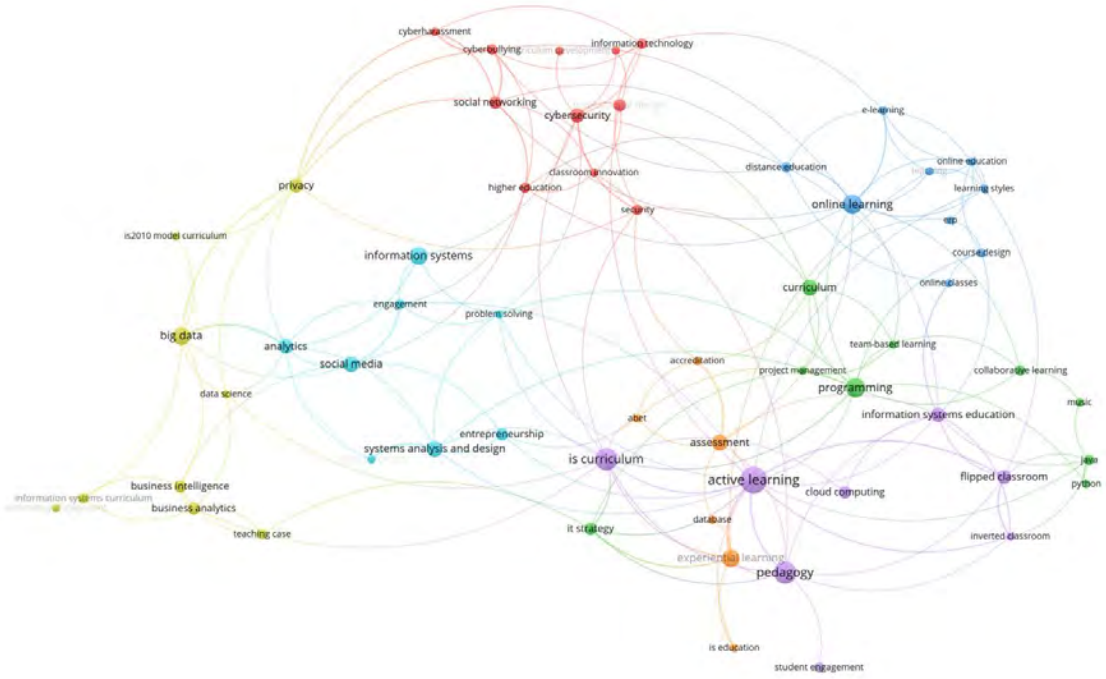


Figure 3: 2013-2017 Term Map

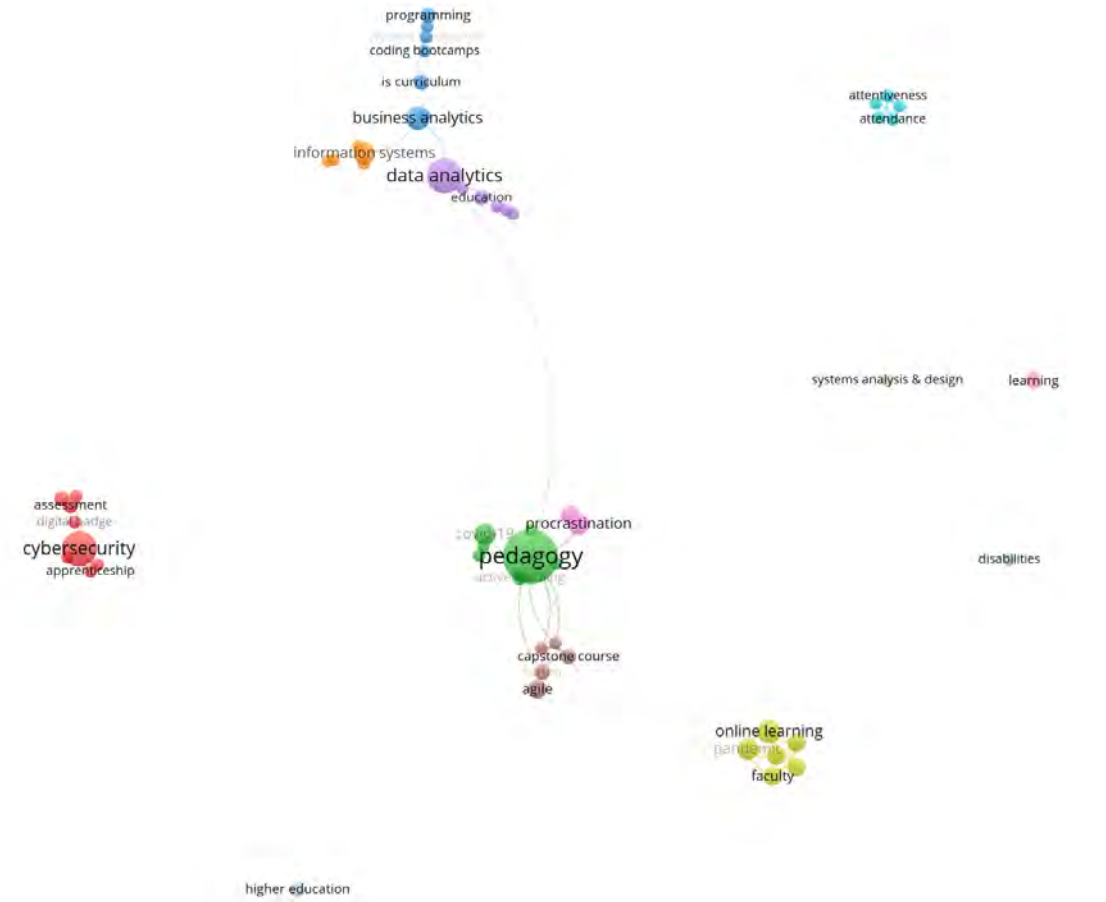


Figure 4: 2018-2022 Term Map

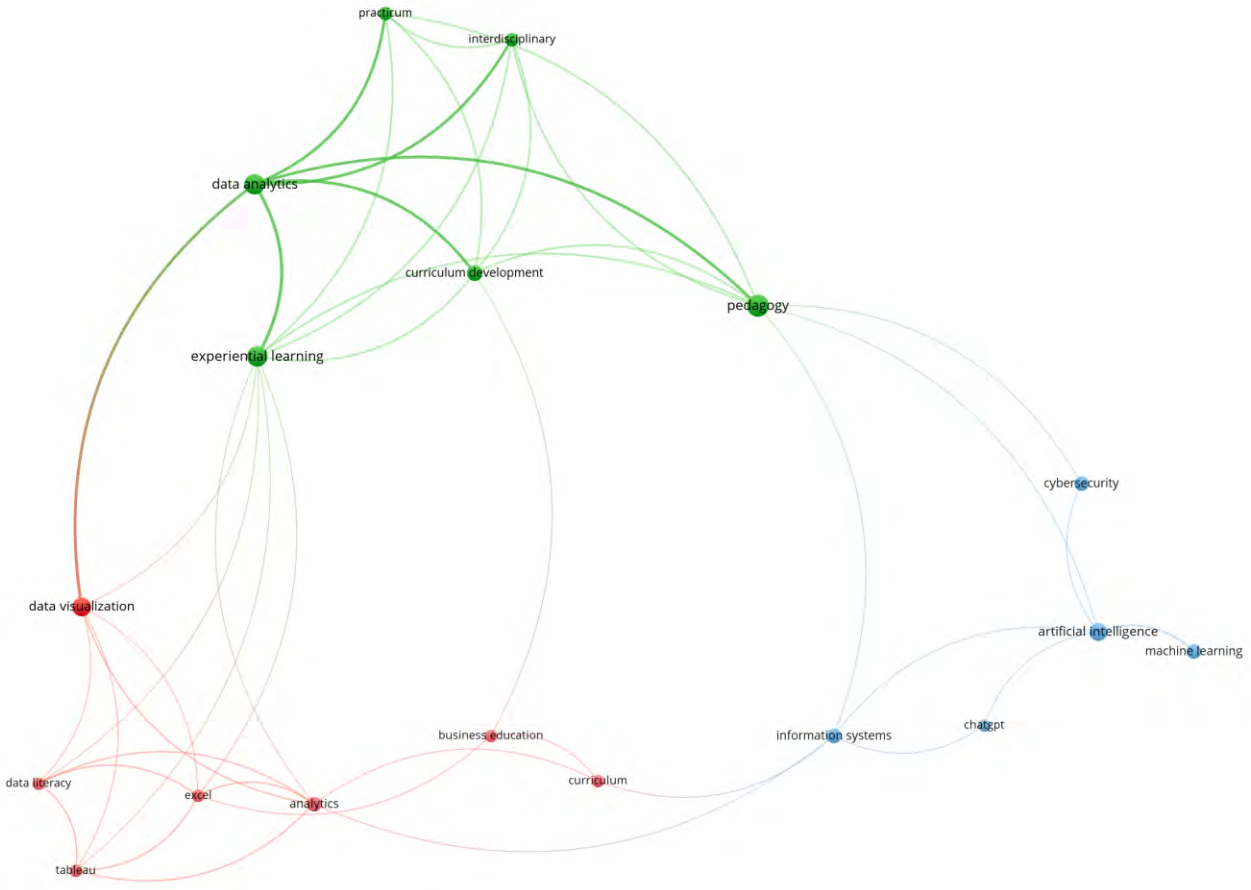


Figure 5: 2023-2024 Term Map

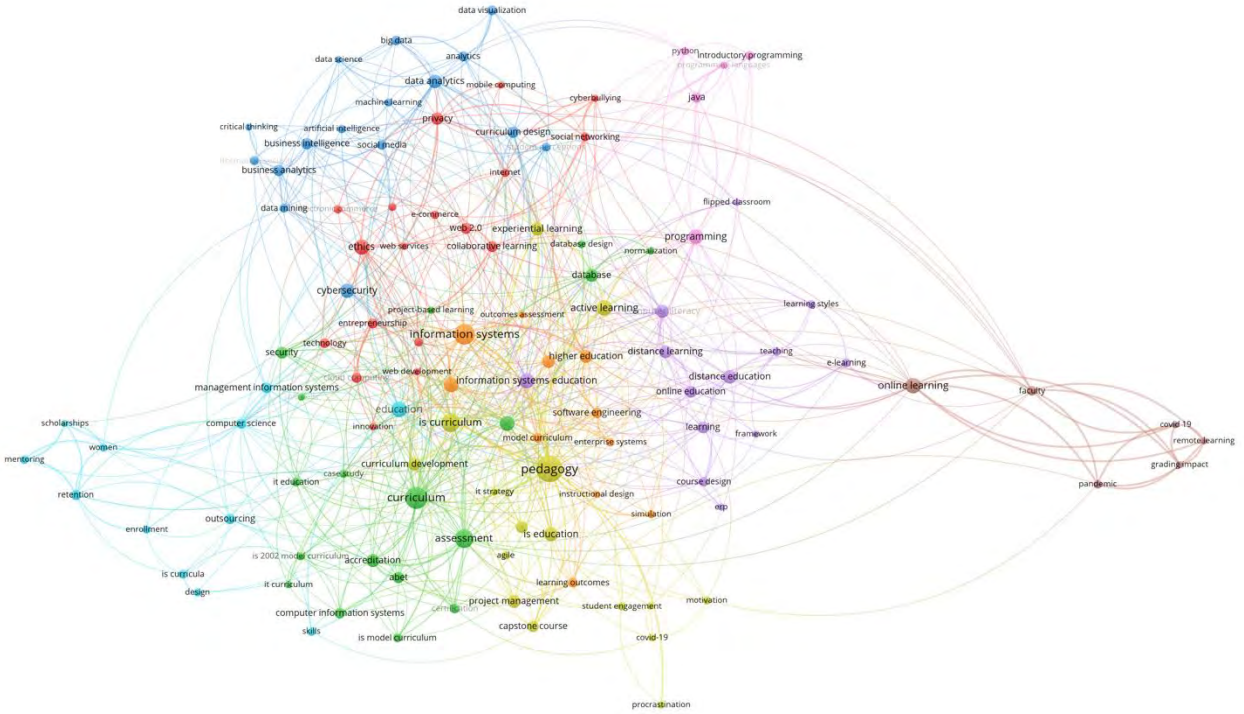


Figure 6: Full Network Term Map

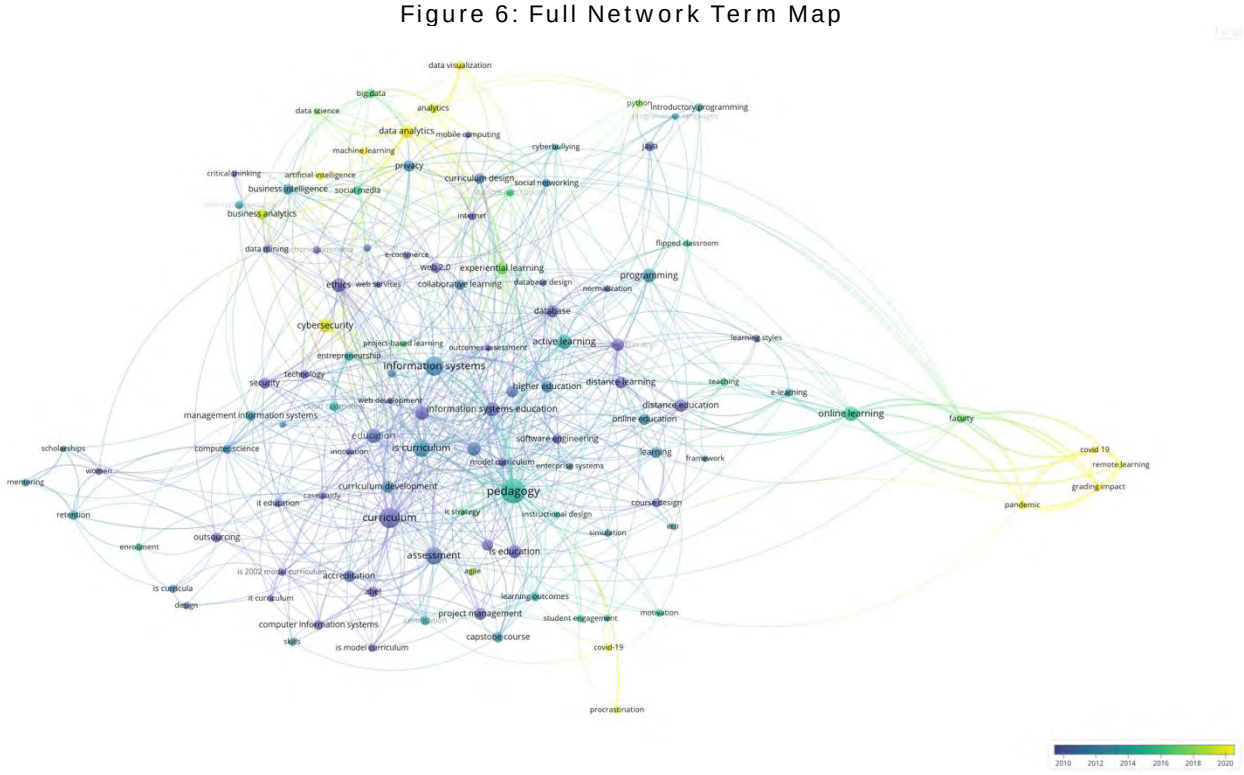


Figure 7: Full Network Time Overlay