# Corpus Analysis of American Society of Engineering Education Scholarship: 2000-2025

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## Abstract

As engineering education research expands in scope and scale, understanding how the field has evolved becomes essential for guiding future inquiry and practice. For new engineering educators and engineering education researchers who may be coming from a variety of discipline-based research areas, understanding the history of our field is important, yet difficult to trace, given the scope and size of the American Society of Engineering Education (ASEE) conferences. This study conducts a corpus analysis of ASEE conference papers spanning 2000–2025 to systematically map trends in research topics over the past 25 years. Using natural language processing and topic modeling techniques, we analyzed more than 40,000 ASEE papers to reveal patterns that are difficult to detect through traditional literature reviews. A corpus-level approach provides unique advantages: it enables objective, data-driven insight into how engineering education discourse has shifted over time and identifies emerging and declining themes. Data visualizations provide opportunities for readers to find trends of relevance to themselves. This analysis supports educators and researchers in benchmarking their efforts against broader trends, identifying underexplored areas, and recognizing methodological shifts within the community. Preliminary results show clustering of 25 years of ASEE scholarship into 160 topics. Exploration of these topics highlights growth in specific research and pedagogical areas and evaluation methods. Our analysis also shows the expected shifts in pedagogical and research topics following 2020, and the sharp increase in papers discussing artificial intelligence (AI) in the past 5 years. By creating a longitudinal, quantitative overview of ASEE scholarship, this study provides a history of the field for new engineering educators and may help drive innovation in our field. For the engineering education community, this analysis may inform conference programming, journal priorities, and collaborative research agendas aimed at the most pressing challenges in engineering education.

An interactive visualization of this corpus is available here: hollygolecki.com/asee-corpus.


## Introduction

As engineering education scholarship expands in scope and scale, understanding how the field has evolved becomes essential for guiding future inquiry and practice. For new engineering educators and engineering education researchers who may be coming from a variety of discipline-based research areas, understanding the history of our field is important, yet difficult to track, given the scope and size of the American Society of Engineering Education (ASEE) conferences. Thousands of engineering educators and practitioners attend and publish in the ASEE conference proceedings each year, producing a large body of scholarship. Some authors are practitioners who aim to document the outcomes of their lessons and course improvements, some transition from

other areas of engineering to education research, and others are formally trained in education research graduate programs. This study aims to answer the central research question: How have trends in engineering education scholarship changed over the past 25 years? Given the volume of papers published (over 40,000 papers over the past 25 years), it is difficult for any individual to synthesize trends and opportunities in our broad discipline. This study leverages machine learning models to present a corpus analysis of ASEE conference papers published between 2000 and 2025 to identify longitudinal trends in this body of work.

New engineering educators come from a variety of disciplines: as new educators from a technical PhD or postdoctoral program, experienced educators taking a new interest in scholarship of teaching and learning (SoTL) or engineering education research (EER) during or after careers in technical engineering disciplines, or educators from engineering education graduate programs. Engineering education graduate programs typically require that students enroll after completing a bachelor's or master's degree in a technical discipline [1]. These graduate students dedicate time to coursework in social science methods, reading engineering education scholarship under the advisement of experts in the field. Engineering faculty members who transition from graduate degrees and lengthy careers to SoTL or EER, lack this dedicated time for education and training. Additionally, the vocabulary and norms of social science based publishing are distinctly different than other engineering disciplines, and therefore, the process of orienting to the field can be particularly challenging. The National Science Foundation (NSF) has supported programs, such as Research Initiation in Engineering Formation (RIEF), to provide mentor-mentee pairs for faculty to learn EER skills [2]. Without years of dedicated graduate education or protected time through grant funding to help orient new engineering educators or new EER researchers to the discipline, it can be a daunting or unapproachable task. Our goal was to conduct this corpus analysis to provide a quantitative and digestible resource for new engineering educators and researchers as they orient to this discipline.

The exercise of determining opportunities and trends is important for the well-being of a profession. This practice has been performed through literature review, statistical analysis, and using large language models both historically and more recently. In the 1990s, Wankat independently binned papers (n=230 from 1993-1997 [3] and n=597 from 1993-2002 [4]) from the Journal of Engineering Education (JEE) into four categories. Wankat observed increases in grant funding and citations during this nascent period in engineering education. Later, others built on this early analysis by expanding the research team for increased validity and reliability, expanded the categories to six, and reported similar results to the earlier work [5]. While much of this work was focused on US scholarship, Osorio and Osorio conducted a similar study including the European Journal of Engineering Education (EJEE) (n=331 from 1998-2000) [6]. In 2011, Jesiek *et al*. performed an analysis of global trends in engineering education from 2005-2008 (n=2,173) [7]. Using bibliometric and scientometric methods, this team identified continued interest in trends such as assessment, team and design-based learning, and instructional technologies. The authors also identified increases in project-based learning and graduate outcomes. Additionally, they cited growth in research beyond undergraduate education to cooperative and continuing education, workforce development, pre-college engineering.

More recently, while some researchers have experimented with computational support to conduct such analyses, many still rely on traditional literature review to explore trends. Moye et al.

performed a multi-round Modified-Delphi method to solicit stakeholder feedback on trends and issues facing engineering and technology education reported in literature [8]. In 2021, Nadolny *et al*. performed an analysis of game based research trends at ASEE over 15 years (177 papers) [9]. In 2023, an analysis of 302 papers from Journal of Engineering Education (JEE) (n=302 from 2012-2022), reviewed for quantitative methods [10]. The study found that while most quantitative methods used in that corpus are basic statistical methods, later years showed more advanced quantitative methods (Hierarchical Linear Modeling, Structural Equation Modeling, or Random Forest Regression) that produce more nuanced analysis. A corpus analysis of papers from 12 conferences distributed in two engineering education events in Latin America and the Caribbean from 2017 to 2024 included 1690 papers. International accreditation and evaluation, online and remote laboratories, and instructional technologies were the common topics at these conferences. [11]. The largest corpus analysis in engineering education that we found looked at 39,000 papers from 1964-2023 to quantify topics, networks, and authors from a variety of journals available via Scopus [12]. The team conducted network analysis, factorial analysis, and thematic mapping to reveal growth in collaborative research, expansion in geographical participation (previously focused in the US as earlier references show), and new pedagogical approaches. The exercise of analyzing the history of engineering education is an important task for our field to undertake to understand trends, opportunities, and gaps.

A corpus-level approach to understanding engineering education scholarship provides unique advantages: it enables objective, data-driven insight into how engineering education discourse has shifted over time, identifies emerging and declining themes, and reveals connections across divisions and disciplines. This type of analysis can support educators and researchers in benchmarking their work against broader trends, identifying underexplored areas, and recognizing methodological shifts within the community. We collected the full set of ASEE proceedings from 2000-2025 and applied natural language processing techniques to model topics in the data set. Analysis reveals topics with increasing and decreasing trends. Finally, we present a case study for the New Engineering Educators (NEE) division (the division to which this paper was submitted) of topics of interest to the NEE community published over the past 25 years. By creating a longitudinal, quantitative overview of ASEE scholarship, this study provides a history of the field for new engineering educators and can help drive innovation in our field. For the engineering education community, this analysis may inform conference programming, journal priorities, and collaborative research agendas aimed at the most pressing challenges in engineering education.

## Methods

Our methods are reported in five main parts. First, we describe how the data collection and data cleaning were performed. Second, we describe the process of conducting statistics on the corpus metadata. Next, we preprocessed the data before global topic clustering across ASEE papers. We conduct and present analysis of global trends across the ASEE conference. Lastly, we present a case study of topics in the New Engineering Educators division. This paper aims to provide analysis that is relevant to both newer and longtime ASEE readership.

*Data Collection*

Papers from ASEE Annual Conferences from 2000 through 2025 are publicly available via the web links in Table 1. Each conference webpage includes a separate landing page for each paper, known to ASEE readership as ASEE PEER. These pages were parsed using the python libraries Requests and Beautifulsoup. The landing page for each paper includes bibliographic metadata: Title, Author(s), Abstract, Conference, and more. Each paper's webpage (on ASEE PEER) also includes a link to download the full text as a pdf. Full text pdfs were read and parsed using the PyMuPDF library. All metadata available for each paper, plus the full text of the pdf was then saved as a json record for each paper in each conference year 2000 through 2025. ASEE Conference papers were included in the corpus if they had a valid landing page in the PEER repository and contained at least a title and conference year metadata.

**Table 1: ASEE Annual Conference and Exposition Collections**

| Year | Conference Link | Location |
|---|---|---|
| 2025 | 2025-asee-annual-conference-exposition | Montreal |
| 2024 | 2024-asee-annual-conference-exposition | Portland |
| 2023 | 2023-asee-annual-conference-exposition | Baltimore |
| 2022 | 2022-asee-annual-conference-exposition | Minneapolis |
| 2021 | 2021-asee-virtual-annual-conference-content-access | Virtual |
| 2020 | 2020-asee-virtual-annual-conference-content-access | Virtual |
| 2019 | 2019-asee-annual-conference-exposition | Tampa |
| 2018 | 2018-asee-annual-conference-exposition | Salt Lake City |
| 2017 | 2017-asee-annual-conference-exposition | Columbus |
| 2016 | 2016-asee-annual-conference-exposition | New Orleans |
| 2015 | 2015-asee-annual-conference-exposition | Seattle |
| 2014 | 2014-asee-annual-conference-exposition | Indianapolis |
| 2013 | 2013-asee-annual-conference-exposition | Atlanta |
| 2012 | 2012-asee-annual-conference-exposition | San Antonio |
| 2011 | 2011-asee-annual-conference-exposition | Vancouver |
| 2010 | 2010-annual-conference-exposition | Louisville |
| 2009 | 2009-annual-conference-exposition | Austin |
| 2008 | 2008-annual-conference-exposition | Pittsburgh |
| 2007 | 2007-annual-conference-exposition | Honolulu |
| 2006 | 2006-annual-conference-exposition | Chicago |
| 2005 | 2005-annual-conference | Portland |
| 2004 | 2004-annual-conference | Salt Lake City |
| 2003 | 2003-annual-conference | Nashville |
| 2002 | 2002-annual-conference | Montreal |
| 2001 | 2001-annual-conference | Albuquerque |
| 2000 | 2000-annual-conference | St. Louis |

*Data Cleaning*

The collected data was then reviewed to identify potential obstacles to analysis. One challenge was the presence of different metadata fields in different landing pages. In 2000, metadata included: Title, Authors, Abstract, Conference, Location, Publication Date, Start Date, End Date, ISSN, Page Count, Page Numbers, DOI, Permanent URL, and Download Count. However, some papers in subsequent years have additional metadata including Conference Session, Tagged Division, Tagged Topic, Tagged Divisions, Tagged Topics, ISBN. In order to investigate the statistics of papers associated with divisions, the entries in the Tagged Division and Tagged Divisions metadata were mapped to the current list of ASEE divisions: Professional Interest Councils and Divisions List. It's worth noting that subtle differences in the division name data were interpreted as the same division. Differences shown below in **bold**. For example, the use of an ampersand: "Liberal Education/Engineering **&** Society Division" vs "Liberal Education/Engineering **and** Society Division", or from changes in division names such as: "Energy Conversion and Conservation Division" vs "Energy Conversion, Conservation, **and Nuclear Engineering** Division" and "**K-12 &** Pre**-**College Engineering" vs "Pre College Engineering Education Division". Additionally, some of these occurred simultaneously within the same paper such as https://peer.asee.org/24344 which lists the Tagged Divisions as: "Electrical and Computer, Minorities in Engineering, First-Year Programs, Liberal Education/Engineering **&** Society, Women in Engineering, Design in Engineering Education, Engineering Libraries, Technological and Engineering Literacy/Philosophy of Engineering, and Student" this text string is interpreted as the following nine divisions:

- Electrical and Computer Engineering Division
- Minorities in Engineering Division
- First-Year Programs Division
- Liberal Education/Engineering and Society Division
- Women in Engineering Division
- Design in Engineering Education Division
- Engineering Libraries Division
- Technological and Engineering Literacy/Philosophy of Engineering Division
- Student Division

Papers like this with multiple tagged divisions were counted in each division's total. Of the total 41,000+ papers included, more than 12,000 had no tagged division. This added to the motivation to better understand the research themes present in the corpus considered as a whole. Next, we present a brief statistical summary of this metadata.

*Metadata Statistics*

From the collected data, 41,729 papers were identified. The number of papers by conference year are shown in Figure 1. Using the download count metadata, the five most downloaded papers are

linked in Table 2. Papers with a tagged division or tagged divisions label contribute to the total number from each division shown in Figure 2. The most downloaded paper from individual divisions in Table 3, note that this table is sorted by number of downloads and only includes the top 16 papers.


**Figure 1: Papers per year; 41,729 total from 2000-2025.**

**Table 2: Top 5 most downloaded papers as of October 2025**

| Title & Hyperlink | Downloads |
|---|---|
| Aerodynamic Performance of the NACA 2412 Airfoil at Low Reynolds Number | 83,922 |
| The Social, Economic, And Political Impact Of Technology: An Historical Perspective | 75,413 |
| The Relationship Between The Tightening Torque And The Clamp Force | 51,338 |
| Calculation Of Tolerance Stacks Using Direct Position Approach In Geometric Dimensioning And Tolerancing | 44,878 |
| The Market Pull Versus Technology Push Continuum Of Engineering Education | 43,583 |

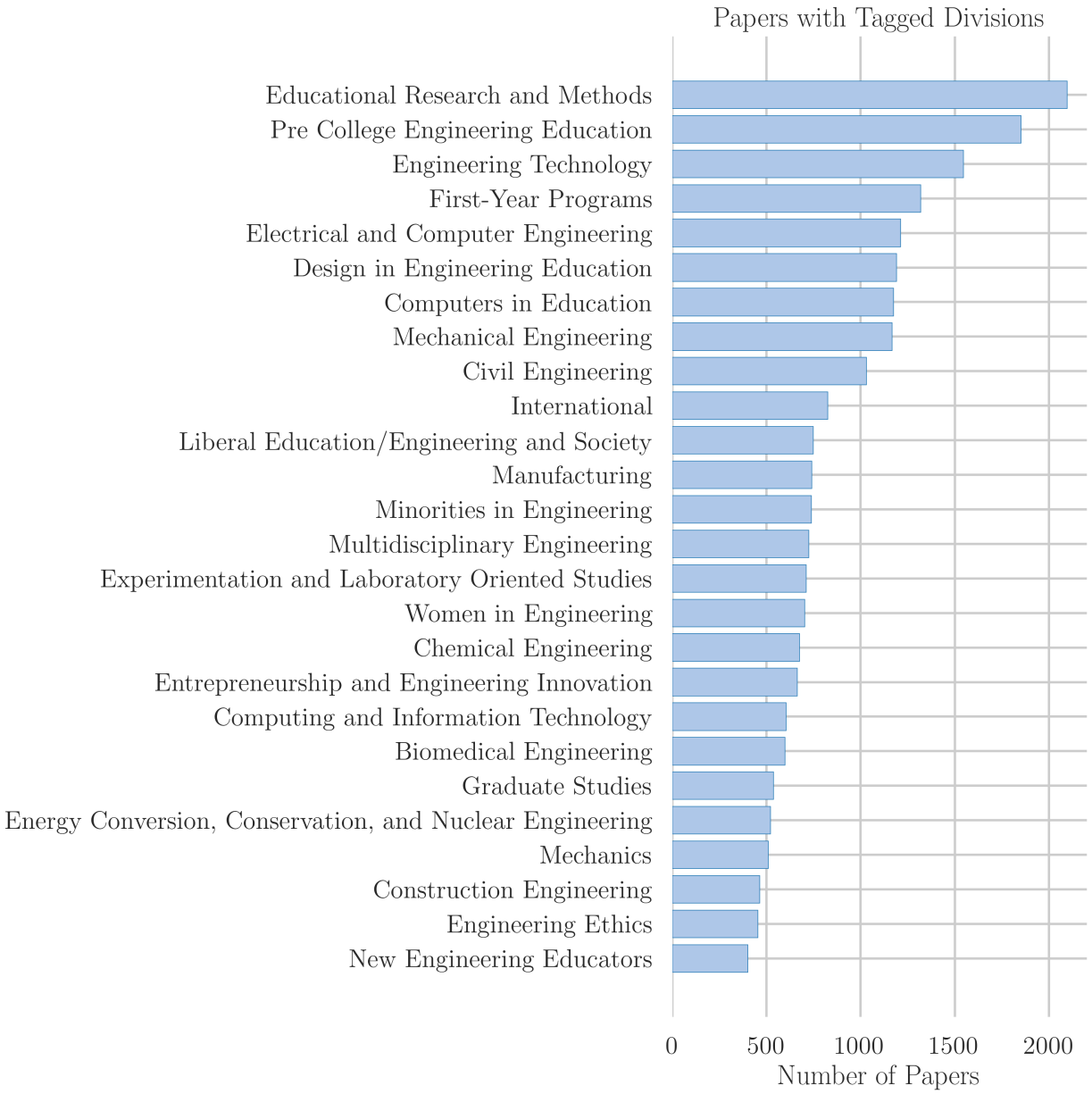


**Figure 2: Number of Papers with Tagged Divisions (12,000 papers, including most from 2022, do not have tagged divisions)**

**Table 3: Most Downloaded Paper per Division as of October 2025**

| Division | Title | Downloads |
|---|---|---|
| Engineering Technology | Calculation Of Tolerance Stacks Using Direct Position Approach In Geometric Dimensioning And Tolerancing | 44,878 |
| Student | Qualitative Coding: An Approach to Assess Inter-Rater Reliability | 40,201 |
| Materials | Selection Of Material, Shape, And Manufacturing Process For A Connecting Rod | 39,384 |
| Mechanical Engineering | A Compilation Of Examples For Using Excell In Solving Heat Transfer Problems | 31,084 |
| Mechanics | Engineering Students Understand the Elastic Neutral Axis, but What About the Plastic Neutral Axis? | 30,619 |
| Computing and Information Technology | Fun, Innovative Computer Science Activities for the Classroom and Outreach | 28,869 |
| Graduate Studies | Engineering Portfolios: Value, Use, and Examples | 28,247 |
| Instrumentation | Elevator Control System Project | 25,510 |
| Engineering Ethics | Ethics in the Classroom: The Volkswagen Diesel Scandal | 23,940 |
| Chemical Engineering | Plotting McCabe-Thiele Diagrams in Microsoft Excel for Non-Ideal Systems | 22,705 |
| Computers in Education | The Flipped Classroom: A Survey of the Research | 20,354 |
| Manufacturing | Understanding Surface Quality: Beyond Average Roughness (Ra) | 20,332 |
| Educational Research and Methods | Micro-project: A Curricular Reform in Maharashtra State, India | 19,667 |
| Engineering Physics and Physics | Graphical Analysis And Equations Of Uniformly Accelerated Motion: A Unified Approach | 18,551 |
| Design in Engineering Education | An Automated Bottle Filling And Capping Project For Freshman Engineering Students | 17,846 |
| Systems Engineering | Associate Systems Engineering Professional (Asep) Certification: A Credential Tailored For Students And Junior Engineers | 13,134 |

*Preprocessing*

The text used for analysis of topic clusters within the corpus consisted of the paper title, abstract, Conference Session, Tagged Division, and Tagged Topic. These fields were concatenated as a text string of multiple tokens, then cleaned by lowercasing, lemmatizing, removing punctuation and formatting characters as well as single character tokens. Common words without significant meaning (NLTK stopwords) as well as words that appear in more than 50% of papers and a list of domain specific stopwords were stripped from each record. These stopwords are shown in Table 4.

**Table 4: Stopwords considered in preprocessing**

| | |
|---|---|
| domain specific | american, society, engineering, education, division, research, asee, annual, conference, proceedings, session, research, poster, paper, manuscript, submission, review, peer, abstract, introduction, background, method, methods, methodology, discussion, conclusion, conclusions, present, presents, presented, describe, describes, described, discuss, discusses, explore, explores, examine, examines, investigate, investigates, propose, proposed, et, al, figure, fig, table, section, student, students, engineer, engineers, educational, course, courses, teach, teaching, learning, learn, learner, learners, study, analysis, data, results, board |
| high frequency | design, provide, use, program |

*Clustering*

Semantic representations of documents were generated using a pretrained Sentence-BERT (Bidirectional Encoder Representations from Transformers) transformer model ("all-MiniLM-L6-v2") [13]. Each paper was embedded into a fixed-length dense vector representing the contextual meaning of the document rather than bag-of-words frequency. Papers with similar core concepts have vectors that are close together in this multi-dimensional embedding space.

The 384-dimensional embeddings vector was reduced to $n$ dimensions using UMAP (Uniform Manifold Approximation and Projection) [14] to facilitate clustering. The reduced embeddings were used exclusively for clustering and not for interpretive analysis of individual dimensions. A reduction to 10 dimensions was used for determining clusters. For the purpose of visualization, the identified clusters are highlighted on a separate reduction to just 2 dimensions in Figure 3. The clustering was performed using HDBSCAN (Hierarchical Density-Based Spatial Clustering of Applications with Noise) [15], a density-based algorithm that identifies high-density clusters and explicitly labeling low-density points as noise. HDBSCAN does not require the number of clusters to be specified in advance and is well-suited for high-dimensional embedding spaces.

This figure attempts to visualize the ASEE corpus in its entirety. Each plotted point represents a single paper, the colors correspond to the cluster. One significant challenge encountered in this

work was developing succinct and meaningful labels for the clusters. The labels shown in Figure 3 were generated using an automated keyword grouping procedure that identifies salient terms within each cluster and combines them into compact, human-readable descriptors. Labels consist of grouped keywords joined by a delimiter and are intended to summarize dominant thematic concepts. The value in parenthesis at the end of each label is the size of the cluster as a percentage of the total corpus. Only the largest 20 clusters of the 160 identified are identified and labeled in this image.

Finally, a measure of cluster coherence was computed using the c_v metric implemented in Gensim [16], a widely used Python library for topic modeling and natural language processing. Values higher than 0.6 suggest a strong, well-defined theme, values below 0.3 suggest a weak, loosely-defined theme.

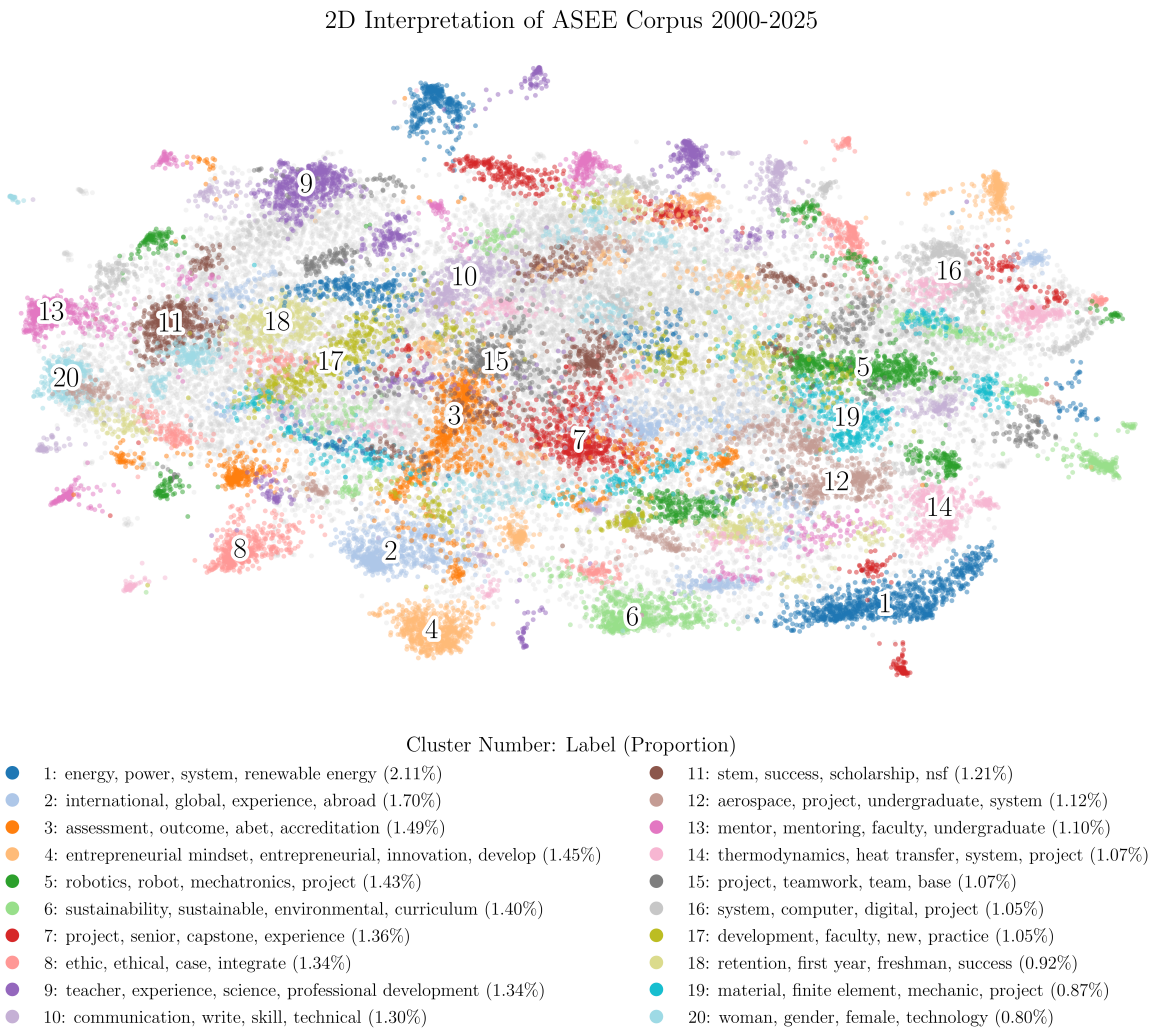


**Figure 3: Two dimensional interpretation of the ASEE corpus from 2000-2025. Each point represents one paper, colors correspond to clusters, the largest 20 of which are labeled.**

## Results

*Entire Corpus*

Once clusters were identified, temporal trends were computed by assessing the number of papers within the cluster for each year in this study. The clusters with the most significant decline and increase over this period are shown in Figures 4 and 5, respectively.

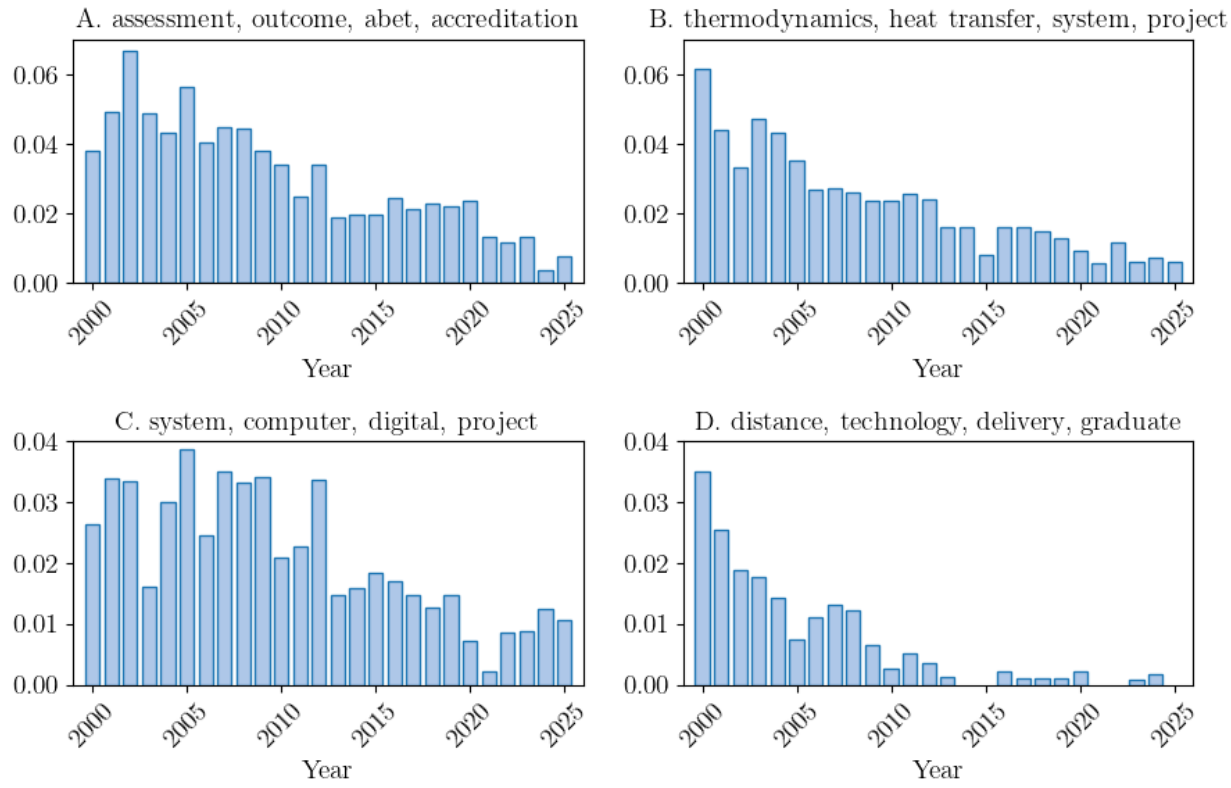


**Figure 4: Clusters with the steepest temporal decline. Y axis is the proportion of the full data set.**

Notable temporal trends in clusters are shown in Figure 6. As a way to gain confidence in our results, we compared against expected trends. Generative AI and the COVID-19 pandemic were two topics for which we expected to see trends. Generative AI and COVID-19 were both clusters in the data set. As anticipated, generative AI has quickly grown in popularity in the last few years (generative, artificial intelligence, ai, tool). Publications related to the COVID-19 pandemic sharply increase and declined after 2021 (pandemic, covid, online, impact). Additionally, we highlight noteworthy trends. Papers discussing makerspaces began increasing around 2015 (maker space, university, makerspace, makerspaces), nearly the same time as a drop off in papers discussing classroom technology (tablet pc, technology, multimedia, classroom). Papers discussing a flipped classroom peaked around 2015, then declined (flip, flipped, classroom, mechanic). Papers discussing connected devices / internet of things (IOT) became more prevalent after 2015 (internet thing, project, iot, system). Diversity, equity and inclusion was steady until

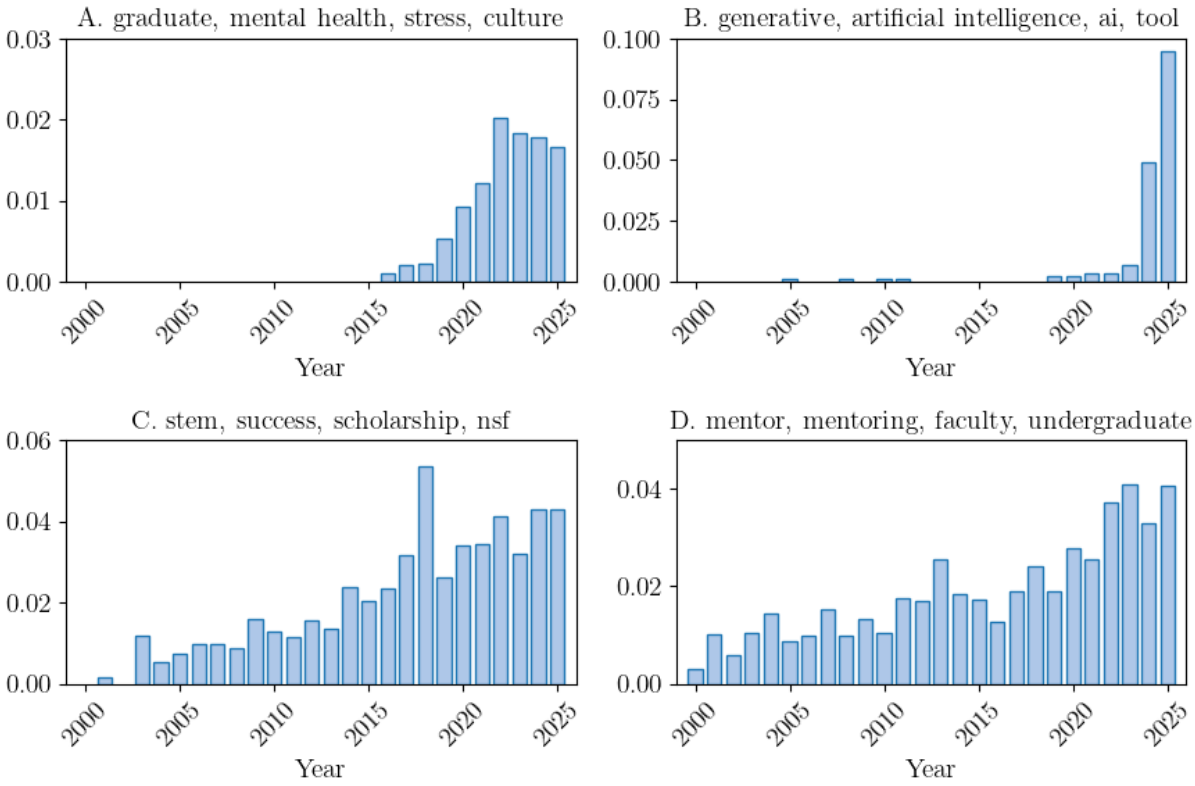


**Figure 5: Clusters with the steepest temporal incline. Y axis is the proportion of the full data set.**

2016 when it experienced significant growth (inclusion, diversity, team, perspective). Ethics was also steady until an gradual increase in the late 2010s (ethic, ethical, case, integrate). Further contextual analysis will help to explain these trends. In this paper, our goal is to present quantitative trends with the hope that the ASEE readership will take up these topic clusters and temporal data for further exploration.

Our process can further be validated by visualizing trends reported in earlier efforts to summarize the engineering education field. During our literature review, we read that Jesiek *et al.* reported on increasing numbers of articles focused on populations *other* than undergraduate education [7]. The authors cited growth in research on cooperative and continuing education, workforce development, and pre-college engineering. Our results, expanding beyond the timeline of the Jesiek study, show similar trends. The topic cluster trends in Figure 7 all demonstrate growth in papers on groups including military, community college, and children (K12).

Table 5 shows the 20 most prominent clusters in the corpus. The first column indicates the percentage of the corpus in the cluster, the second column shows the cluster coherence. Cluster labels are shown in the third column, to support cluster interpretation, we extracted cluster-specific keyword/phrases by identifying frequently occurring multi-word sequences (n-grams) within documents assigned to each cluster. These key words and phrases are included in the fourth column. The final column links to a representative paper identified by selecting the

document whose vector representation is nearest to the cluster centroid, this is used here as a qualitative exemplar for cluster interpretation.

**Table 5: Description of the 20 largest clusters**

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 46.4% | | noise, outlier | | |
| 2.1% | 0.76 | energy, power, system, renewable energy | renewable energy source, renewable energy system, renewable energy technology | Development Of A Renewable Energy Course For A Technology Program |
| 1.7% | 0.72 | international, global, experience, abroad | short term abroad, develop global competency, develop global competence | Incorporating Global Issues Into Freshman Engineering Course |
| 1.5% | 0.79 | assessment, outcome, abet, accreditation | civil body knowledge, continuous improvement process, accreditation technology abet | Promoting Consistent Assessment of Student Learning Outcomes over Multiple Courses and Multiple Instructors in Continuous Program Improvement |
| 1.4% | 0.69 | entrepreneurial mindset, entrepreneurial, innovation, develop | develop entrepreneurial mindset, connection create value, kern entrepreneurial network | Growing Entrepreneurial Mindset in Interdisciplinary Student Engineers: Experiences of a Project-Based Engineering Program |
| 1.4% | 0.75 | robotics, robot, mechatronics, project | robot operate system, middle high school, autonomous mobile robot | Developing Courseware for Robotics in Pre-engineering Education for High School Students |
| 1.4% | 0.74 | sustainability, sustainable, environmental, curriculum | life cycle assessment, sustainable development goal, one planet eop | Effects of Using Computer-Aided Drawing Programs to Implement Sustainable Engineering Design Principles on First-Year Engineering Students |
| 1.4% | 0.70 | project, senior, capstone, experience | senior capstone project, industry sponsor project, capstone senior project | Redesigning Senior Capstone Sequence with Multidisciplinary, Industry-Sponsored Projects |
| 1.3% | 0.68 | ethic, ethical, case, integrate | ethical decision making, ethical decision make, ethic across curriculum | Engineering, Ethics And Society: Program Outcomes, Assessment And Evaluation |
| 1.3% | 0.64 | teacher, experience, science, professional development | pre service teacher, high school teacher, teacher professional development | Factors That Support Teacher Shift to Engineering Design |
| 1.3% | 0.71 | communication, write, skill, technical | lab report write, ability communicate effectively, technical communication skill | Integrating Writing Into Technical Courses |
| 1.2% | 0.71 | stem, success, scholarship, nsf | national science foundation, science technology mathematics, science technology mathematics stem | Board 103: Work in Progress: NSF S-STEM Program: Recruitment, Engagement, and Retention: Energizing and Supporting Students with Diverse Backgrounds in Mechanical Engineering |
| 1.1% | 0.54 | aerospace, project, undergraduate, system | high altitude balloon, unmanned aerial vehicle, unmanned aerial system | Big Blue: A Multidisciplinary Capstone Engineering Design Project |

Continued on next page

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 1.1% | 0.71 | mentor, mentoring, faculty, undergraduate | national science foundation, new faculty member, mentor first year | Developing Inclusive Engineers: Teaching Peer-Mentors Principles of Equity and Inclusion |
| 1.1% | 0.60 | thermodynamics, heat transfer, system, project | thermodynamics fluid mechanic, second law thermodynamics, internal combustion engine | Workshop Exercises For Connecting Fundamentals To Equipment In The First Thermodynamics Course |
| 1.1% | 0.64 | project, teamwork, team, base | team member effectiveness, team base project, assessment team member | Effectiveness of Techniques to Develop and Assess the Teamwork Skills of First-year Engineering Students |
| 1.1% | 0.61 | system, computer, digital, project | hardware description language, field programmable gate, programmable gate array | An Innovative Rapid Processor Platform Design For Early Engineering Education |
| 1.0% | 0.56 | development, faculty, new, practice | new faculty member, tenure track faculty, evidence base practice | Implementing Interconnected Faculty Development Initiatives for STEM Faculty |
| 0.9% | 0.77 | retention, first year, freshman, success | co curricular activity, grade point average, first year experience | Retention And Success Of Engineering Undergraduates |
| 0.9% | 0.65 | material, finite element, mechanic, project | finite element fea, introductory material science, stress concentration factor | Linking Mechanics And Materials In Engineering Design: A New Approach |
| 0.8% | 0.70 | woman, gender, female, technology | increase number woman, woman computer science, science technology mathematics | Addressing Gender Disparities in Computing Majors and Careers: Development and Effects of a Community Support Structure |

**Table 6: Description of clusters with the steepest temporal decline in Figure 4**

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 2.8% | 0.79 | assessment, outcome, abet, accreditation | civil body knowledge, continuous improvement process, accreditation technology abet | Promoting Consistent Assessment of Student Learning Outcomes over Multiple Courses and Multiple Instructors in Continuous Program Improvement |
| 2.0% | 0.60 | thermodynamics, heat transfer, system, project | thermodynamics fluid mechanic, second law thermodynamics, internal combustion engine | Workshop Exercises For Connecting Fundamentals To Equipment In The First Thermodynamics Course |
| 2.0% | 0.61 | system, computer, digital, project | hardware description language, field programmable gate, programmable gate array | An Innovative Rapid Processor Platform Design For Early Engineering Education |
| 0.6% | 0.62 | distance, technology, delivery, graduate | old dominion university, web base distance, real time interaction | Distance Learning Delivery Of A Web Based Degree In Electrical/Electronics Engineering Technology, Which Incorporates Hands On Laboratory Experiments And Real Time Video |

**Table 7: Description of clusters with the steepest temporal incline in Figure 5**

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.5% | 0.59 | graduate, mental health, stress, culture | mental health concern, mental health challenge, graduate mental health | CAREER: Supporting Undergraduate Mental Health by Building a Culture of Wellness in Engineering |
| 0.9% | 0.80 | generative, artificial intelligence, ai, tool | artificial intelligence ai, generative artificial intelligence, large language model | Exploring Student Perceptions of Learning Experience in Fundamental Mechanics Courses Enhanced by ChatGPT |
| 2.3% | 0.71 | stem, success, scholarship, nsf | national science foundation, science technology mathematics, science technology mathematics stem | Board 103: Work in Progress: NSF S-STEM Program: Recruitment, Engagement, and Retention: Energizing and Supporting Students with Diverse Backgrounds in Mechanical Engineering |
| 2.0% | 0.71 | mentor, mentoring, faculty, undergraduate | national science foundation, new faculty member, mentor first year | Developing Inclusive Engineers: Teaching Peer-Mentors Principles of Equity and Inclusion |

**Table 8: Description of clusters with noteworthy temporal changes in Figure 6**

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.5% | 0.80 | generative, artificial intelligence, ai, tool | artificial intelligence ai, generative artificial intelligence, large language model | Exploring Student Perceptions of Learning Experience in Fundamental Mechanics Courses Enhanced by ChatGPT |
| 0.5% | 0.76 | pandemic, covid, online, impact | due covid pandemic, impact covid pandemic, face face instruction | Student Responses to Remote Teaching During the Covid-19 Pandemic: Implications for the Future of Online Learning |
| 0.2% | 0.76 | maker space, university, makerspace, makerspaces | university maker space, idea generation ability, throughout academic career | Building an Identity in the Makerspace |
| 0.2% | 0.66 | tablet pc, technology, multimedia, classroom | tablet pc classroom, tablet pc technology, faculty tablet pc | Evaluation Of Tablet Pcs For Engineering Instruction And Content Development |
| 0.4% | 0.75 | flip, flipped, classroom, mechanic | flipped classroom model, flipped classroom approach, implement flipped classroom | A Flipped Course in Modern Energy Systems: Preparation, Delivery, and Postmortem |
| 0.1% | 0.65 | internet thing, project, iot, system | internet thing iot, cyber physical system, internet thing iot technology | Internet of Things Education Project (IoTEP) |
| 0.3% | 0.62 | inclusion, diversity, team, perspective | diversity equity inclusion, equity inclusion dei, diversity equity inclusion dei | Work in Progress: Developing a Foundational Engineering Course to Improve Students' Sense of Belonging and Increase Diversity |
| 0.3% | 0.59 | graduate, mental health, stress, culture | mental health concern, mental health challenge, graduate mental health | CAREER: Supporting Undergraduate Mental Health by Building a Culture of Wellness in Engineering |

Continued on next page

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.5% | 0.58 | biomedical, curriculum, undergraduate, development | medical device industry, undergraduate biomedical curriculum, undergraduate bme curriculum | WIP: A Vertically-integrated, Project-focused Approach to Undergraduate Biomedical Engineering Education |
| 1.3% | 0.68 | ethic, ethical, case, integrate | ethical decision making, ethical decision make, ethic across curriculum | Engineering, Ethics And Society: Program Outcomes, Assessment And Evaluation |

**Table 9: Description of clusters with non-traditional students in Figure 7**

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.2% | 0.63 | pathways, military, year, veteran | veteran service member, post gi bill, veteran active duty | Military Veteran Students' Pathways in Engineering Education (Year 2) |
| 0.4% | 0.62 | success, community college, year, experience | four year institution, community college transfer, transfer four year | Successes and Difficulties Experienced by Engineering Transfer Students at a Large Public University |
| 0.2% | 0.73 | clinical immersion, biomedical, work progress, experience | unmet clinical need, clinical immersion experience, work progress clinical | Designing an Interprofessional Educational Undergraduate Clinical Experience |
| 0.2% | 0.67 | child, parent, fundamental, family | engage young child, knowledge attitude behavior, thinking young child | Engineering Childhood: Knowledge Transmission Through Parenting |

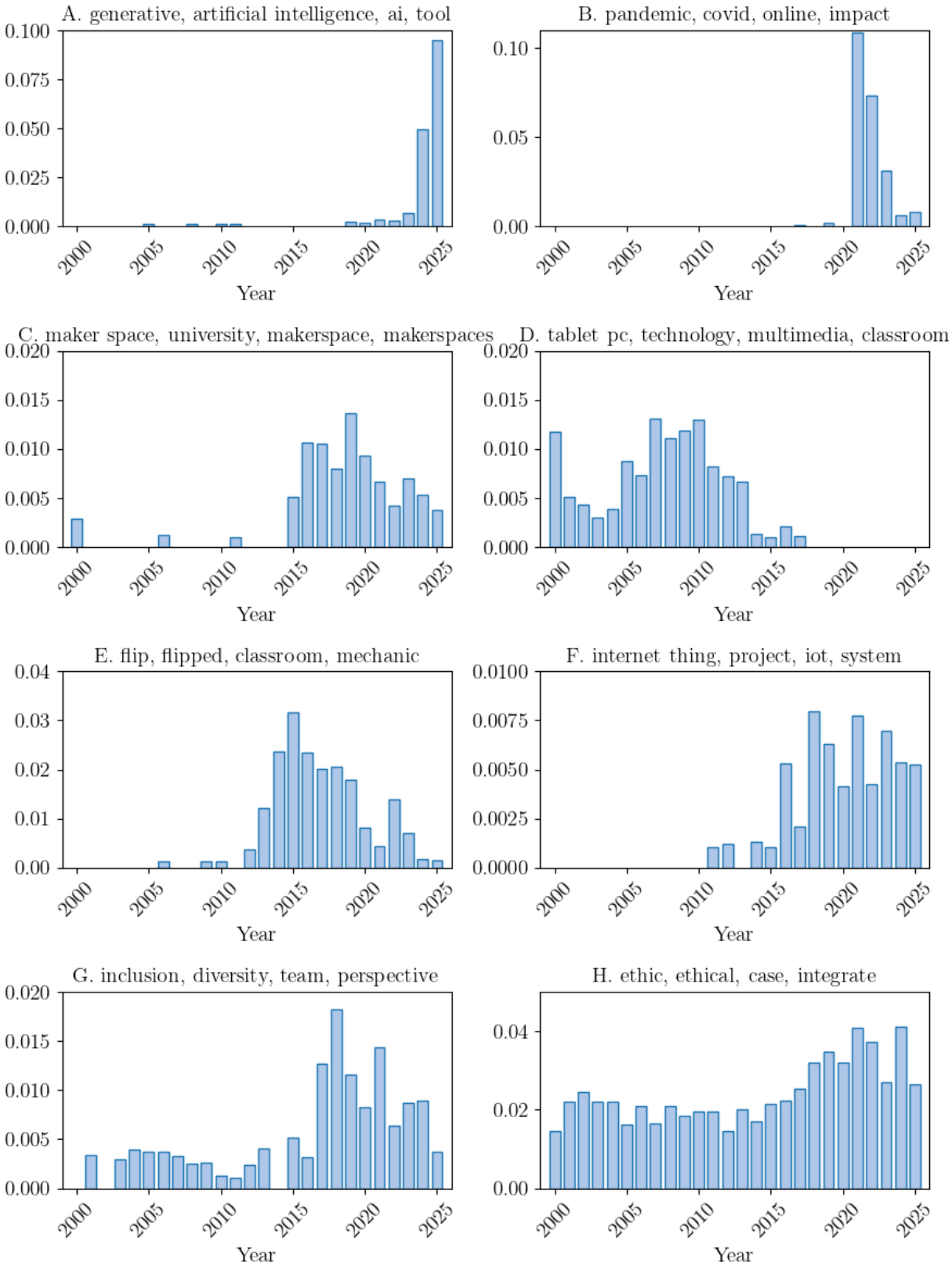


**Figure 6: Noteworthy temporal changes within selected clusters**

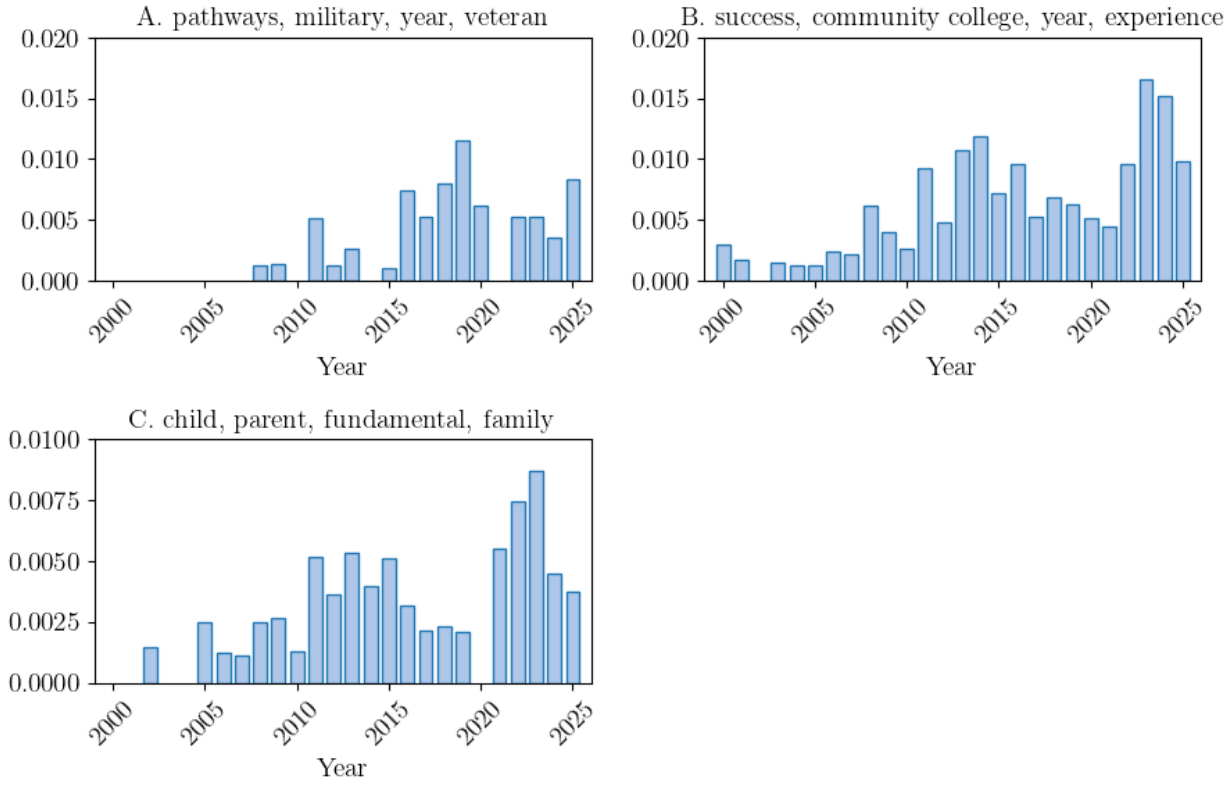


**Figure 7: Clusters of non-traditional students**

*Divisional*

As a case study for exploring ASEE divisional trends in topics, we explored the New Engineering Educators division. Table 10 shows the clusters identified in the subset of papers with a 'Tagged Division' of the New Engineering Educators. Note the UMAP settings for dimensional reduction of the embeddings were modified for a much smaller list of 386 papers from 2000-2025 in the data set. While the number of papers per cluster is insufficient to extract temporal trends, the top topic clusters in Figure 8, reveal topics, which are logical for members of this division.

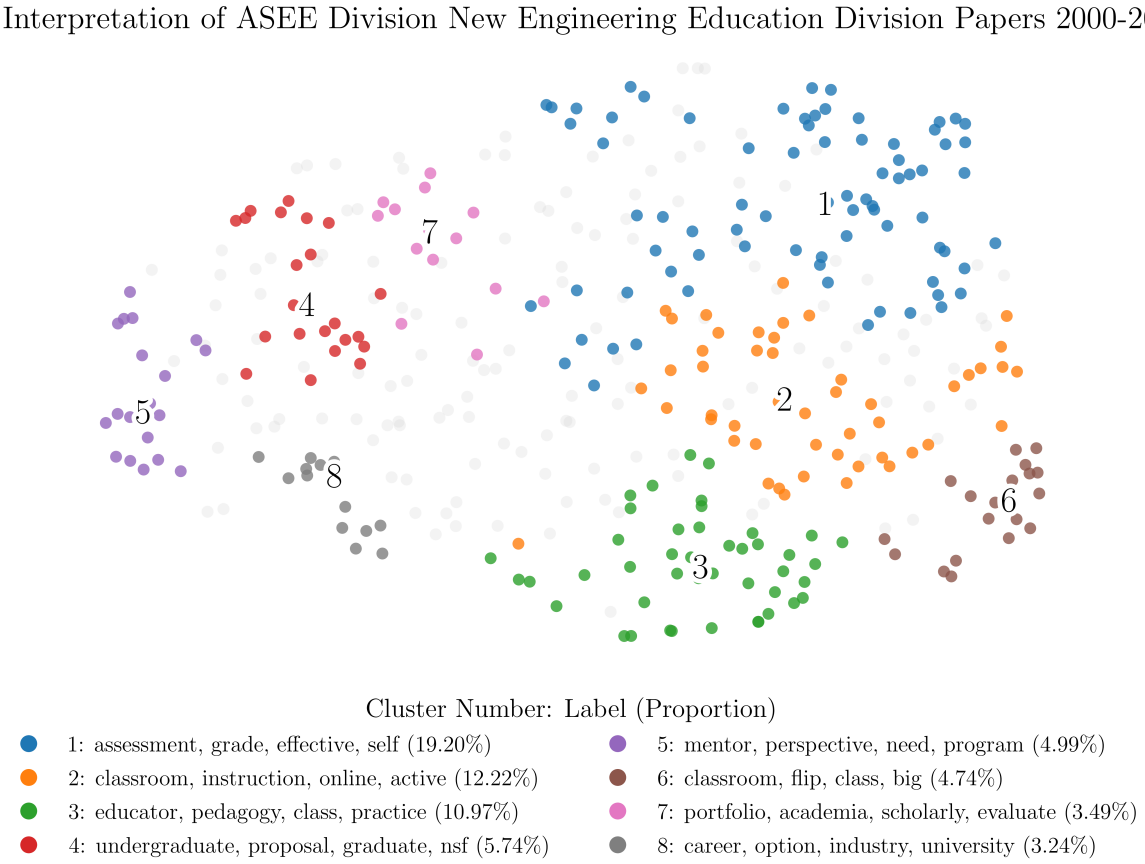


**Figure 8: Two dimensional interpretation of the papers in the New Engineering Educators Division. Each dot represents one paper, colors correspond to clusters, all of which are labeled.**

**Table 10: Description of clusters in the New Engineering Educators Division**

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 35.4% | | noise, outlier | | |
| 19.2% | 0.60 | assessment, grade, effective, self | standard base grade, standard base grading, problem solve skill | Improved Pedagogy Enabled by Assessment Using Gradescope |

Continued on next page

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 12.2% | 0.58 | classroom, instruction, online, active | think pair share, summer immersion program, semi structure interview | Using Interactive Audience Response Systems To Enrich Engineering Education |
| 11.0% | 0.59 | educator, pedagogy, class, practice | become effective teacher, national science foundation, semi structure interview | Beyond Anecdotes: How To Assess What Goes On In Your Classes |
| 5.7% | 0.71 | undergraduate, proposal, graduate, nsf | national science foundation, broad impact criterion, non tenure track | Performing Engineering Research At Non Ph.D. Granting Institutions |
| 5.0% | 0.58 | mentor, perspective, need, program | face many challenge, past seven year, national science foundation | Mentoring Programs Supporting Junior Faculty |
| 4.7% | 0.43 | classroom, flip, class, big | play significant role, real world examples, real world application | Improvements in Student Learning Experiences by Course Revitalization |
| 3.5% | 0.51 | portfolio, academia, scholarly, evaluate | full time member, first year member, across united state | Developing Metrics To Evaluate Instructional Scholarship In Engineering |
| 3.2% | 0.53 | career, option, industry, university | long term goal, write grant proposal, at the end semester | Assistant Professorhood: Your Very Own Startup Company |

Here we presented demonstration of a corpus analysis tool developed for ASEE scholarship. Now that the process has been developed and tested, further exploration into divisions, authors, institutions, topics, methods, and more are possible.

## Limitations

The semantic analysis tool developed and demonstrated here is powerful for broad analysis of an expansive body of work. However, this method is not without limitations. There is an important distinction between our corpus analysis and more traditional historical research, analysis, and literature review. This textual analysis approach is not intended to replace rigorous historical and qualitative scholarship. Both approaches seek to explore the past through examining disciplinary scholarship by identifying trends in the data to inspire further analysis and interpretation. These trends may be useful to a variety of readers who want to understand increases and decreases in topics and therefore metadata associate with those clusters. We, the authors, echo the sentiment of Odden *et al.*, [17] who state in their recent semantic analysis of *Science Education* that such analyses are not meant to automate historical or qualitative inquiry, but rather to serve as analytical tools for scanning large datasets and presenting results that can prompt new questions and further analysis.

## Conclusions

The goal of this study was to develop a method of analyzing the corpus of ASEE papers from 2000 to 2025. Semantic analysis allows us to scan a body of literature that would be nearly impossible for a human team to process. The analysis clusters ASEE papers into 160 topics (Figure 3 and Supplemental Table 11). An interactive visualization of these topics is available here: hollygolecki.com/asee-corpus. This paper details the 20 most prominent topics (Table 5)

and topics with sharpest incline (Figure 5) and decline (Figure 4). We also show noteworthy patterns (Figure 6). In this work, we aimed to present quantitative data without our own interpretation. We anticipate that this data can help new engineering educators orient themselves to topics of prominence at the ASEE conference. Additionally, we believe this data can be a tool for established researchers to contextualize their own efforts within the ASEE scholarship and plan for future analysis and exploration.

## Acknowledgments

This work made use of the Illinois Campus Cluster, a computing resource that is operated by the Illinois Campus Cluster Program (ICCP) in conjunction with the National Center for Supercomputing Applications (NCSA) and which is supported by funds from the University of Illinois Urbana-Champaign. HMG acknowledges the National Science Foundation. This material is based in part on work supported by the National Science Foundation under Grant Number NSF CAREER 2541364 .

## References

[1] J. P. Martin, D. E. Suresh, and P. A. Jensen, "Using collaborative autoethnography to investigate mentoring relationships for novice engineering education researchers," *International Journal of STEM Education*, vol. 11, no. 1, p. 13, 2024.

[2] J. P. Martin, I. Miller, K. J. Jensen, and D. E. Suresh, "A social network analysis of faculty mentees funded by the research initiation in engineering formation (rief) program," *IEEE Transactions on Education*, 2024.

[3] P. C. Wankat, "An analysis of the articles in the journal of engineering education," *Journal of Engineering Education*, vol. 88, no. 1, pp. 37–42, 1999.

[4] P. C. Wankat, "Analysis of the first ten years of the journal of engineering education," *Journal of Engineering Education*, vol. 93, no. 1, pp. 13–21, 2004.

[5] K. Whitin and S. Sheppard, "Taking stock: An analysis of the publishing record as represented by the journal of engineering education," *Journal of Engineering Education*, vol. 93, no. 1, pp. 5–12, 2004.

[6] N. L. Osorio and M. A. Osorio, "Engineering education in europe and the usa: An analysis of two journals," *Science & Technology Libraries*, vol. 23, no. 1, pp. 49–70, 2002.

[7] B. K. Jesiek, M. Borrego, K. Beddoes, M. Hurtado, P. Rajendran, and D. Sangam, "Mapping global trends in engineering education research, 2005–2008," *International Journal of Engineering Education*, vol. 27, no. 1, pp. 77–90, 2011.

[8] J. J. Moye, P. A. Reed, R. Wu-Rorrer, and D. Lecorchick, "Current and future trends and issues facing technology and engineering education in the united states," *Journal of Technology Education*, vol. 32, no. 1, 2020.

[9] L. Nadolny, M. I. Alam, M. G. Brown, and M. H. Lamm, "Game research trends at the annual asee conference: A 15-year content analysis," in *2021 ASEE Virtual Annual Conference Content Access*, 2021.

[10] A. S. Putra, J. Morphew, and L. Tan, "By the numbers: A review of quantitative research methods in journal of engineering education from 2012 to 2022," in *2023 ASEE Annual Conference & Exposition*, 2023.

[11] L. Romero, M. M. Larrondo-Petrie, J. Texier, and L. V. Cervantes, "A thematic analysis of trends in engineering education conferences congresses in latin america and the caribbean: An insight into future innovations and developments in higher education," in *2025 ASEE Annual Conference & Exposition*, 2025.

[12] S. Abdelhamid and M. Aly, "Exploring the engineering education literature: Trends, networks, and themes through bibliometric insights," in *The Learning Ideas Conference*. Springer, 2024, pp. 1–12.

[13] N. Reimers and I. Gurevych, "Sentence-bert: Sentence embeddings using siamese bert-networks," in *Proceedings of the 2019 Conference on Empirical Methods in Natural Language Processing*. Association for Computational Linguistics, 11 2019. [Online]. Available: https://arxiv.org/abs/1908.10084

[14] L. McInnes, J. Healy, N. Saul, and L. Grossberger, "Umap: Uniform manifold approximation and projection," *The Journal of Open Source Software*, vol. 3, no. 29, p. 861, 2018.

[15] L. McInnes, J. Healy, and S. Astels, "hdbscan: Hierarchical density based clustering," *The Journal of Open Source Software*, vol. 2, no. 11, p. 205, 2017.

[16] R. Řehůřek and P. Sojka, "Software Framework for Topic Modelling with Large Corpora," in *Proceedings of the LREC 2010 Workshop on New Challenges for NLP Frameworks*. Valletta, Malta: ELRA, May 2010, pp. 45–50.

[17] T. O. B. Odden, A. Marin, and J. L. Rudolph, "How has science education changed over the last 100 years? an analysis using natural language processing," *Science Education*, vol. 105, pp. 653–680, 7 2021.

## Supplemental

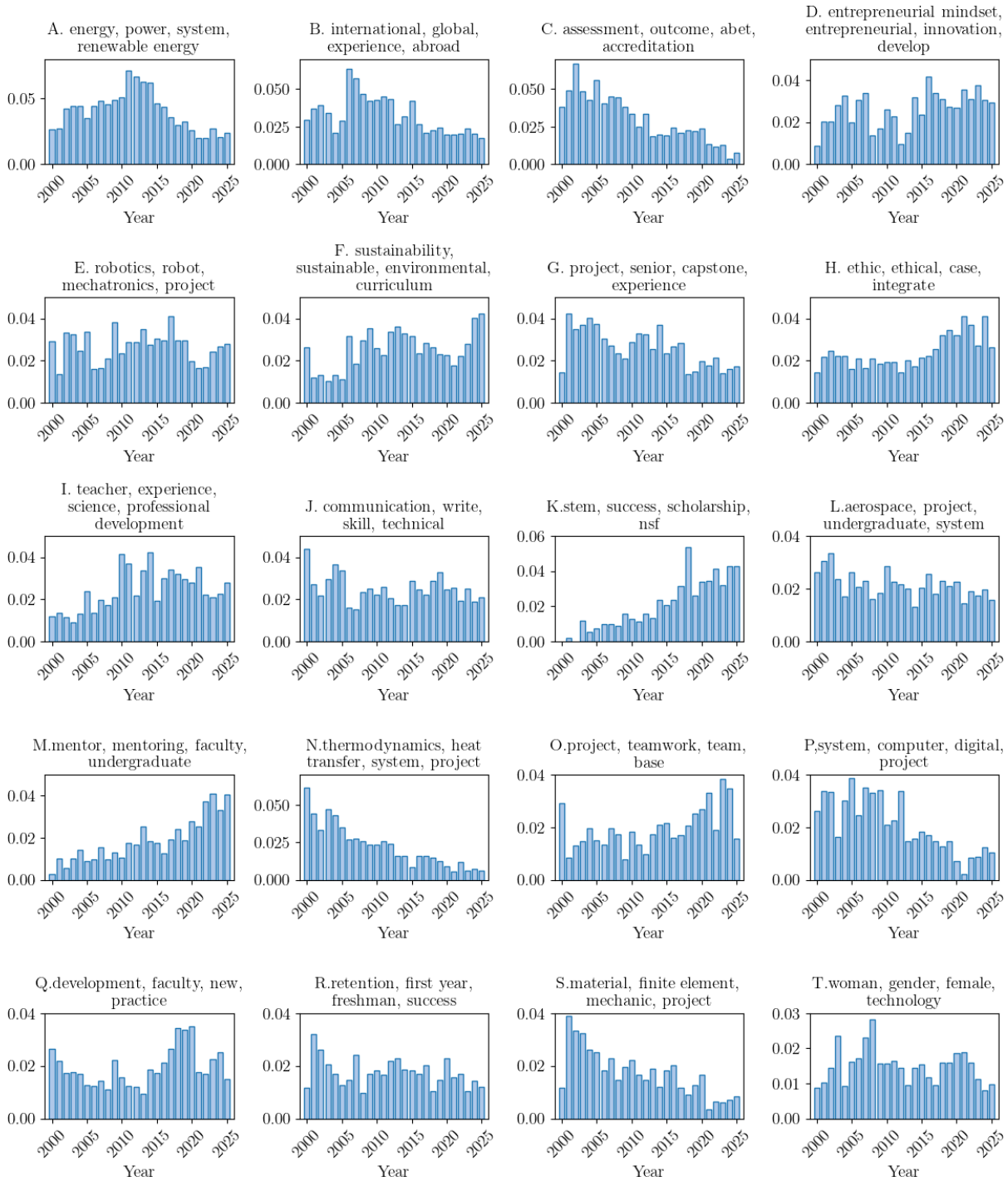


**Figure 9: Temporal changes within the top 20 clusters.**

**Table 11: Description of all clusters**

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 46.4% | | noise, outlier | | |
| 2.1% | 0.76 | energy, power, system, renewable energy | renewable energy source, renewable energy system, renewable energy technology | Development Of A Renewable Energy Course For A Technology Program |
| 1.7% | 0.72 | international, global, experience, abroad | short term abroad, develop global competency, develop global competence | Incorporating Global Issues Into Freshman Engineering Course |
| 1.5% | 0.79 | assessment, outcome, abet, accreditation | civil body knowledge, continuous improvement process, accreditation technology abet | Promoting Consistent Assessment of Student Learning Outcomes over Multiple Courses and Multiple Instructors in Continuous Program Improvement |
| 1.4% | 0.69 | entrepreneurial mindset, entrepreneurial, innovation, develop | develop entrepreneurial mindset, connection create value, kern entrepreneurial network | Growing Entrepreneurial Mindset in Interdisciplinary Student Engineers: Experiences of a Project-Based Engineering Program |
| 1.4% | 0.75 | robotics, robot, mechatronics, project | robot operate system, middle high school, autonomous mobile robot | Developing Courseware for Robotics in Pre-engineering Education for High School Students |
| 1.4% | 0.74 | sustainability, sustainable, environmental, curriculum | life cycle assessment, sustainable development goal, one planet eop | Effects of Using Computer-Aided Drawing Programs to Implement Sustainable Engineering Design Principles on First-Year Engineering Students |
| 1.4% | 0.70 | project, senior, capstone, experience | senior capstone project, industry sponsor project, capstone senior project | Redesigning Senior Capstone Sequence with Multidisciplinary, Industry-Sponsored Projects |
| 1.3% | 0.68 | ethic, ethical, case, integrate | ethical decision making, ethical decision make, ethic across curriculum | Engineering, Ethics And Society: Program Outcomes, Assessment And Evaluation |
| 1.3% | 0.64 | teacher, experience, science, professional development | pre service teacher, high school teacher, teacher professional development | Factors That Support Teacher Shift to Engineering Design |
| 1.3% | 0.71 | communication, write, skill, technical | lab report write, ability communicate effectively, technical communication skill | Integrating Writing Into Technical Courses |
| 1.2% | 0.71 | stem, success, scholarship, nsf | national science foundation, science technology mathematics, science technology mathematics stem | Board 103: Work in Progress: NSF S-STEM Program: Recruitment, Engagement, and Retention: Energizing and Supporting Students with Diverse Backgrounds in Mechanical Engineering |
| 1.1% | 0.54 | aerospace, project, undergraduate, system | high altitude balloon, unmanned aerial vehicle, unmanned aerial system | Big Blue: A Multidisciplinary Capstone Engineering Design Project |
| 1.1% | 0.71 | mentor, mentoring, faculty, undergraduate | national science foundation, new faculty member, mentor first year | Developing Inclusive Engineers: Teaching Peer-Mentors Principles of Equity and Inclusion |

Continued on next page

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 1.1% | 0.60 | thermodynamics, heat transfer, system, project | thermodynamics fluid mechanic, second law thermodynamics, internal combustion engine | Workshop Exercises For Connecting Fundamentals To Equipment In The First Thermodynamics Course |
| 1.1% | 0.64 | project, teamwork, team, base | team member effectiveness, team base project, assessment team member | Effectiveness of Techniques to Develop and Assess the Teamwork Skills of First-year Engineering Students |
| 1.1% | 0.61 | system, computer, digital, project | hardware description language, field programmable gate, programmable gate array | An Innovative Rapid Processor Platform Design For Early Engineering Education |
| 1.0% | 0.56 | development, faculty, new, practice | new faculty member, tenure track faculty, evidence base practice | Implementing Interconnected Faculty Development Initiatives for STEM Faculty |
| 0.9% | 0.77 | retention, first year, freshman, success | co curricular activity, grade point average, first year experience | Retention And Success Of Engineering Undergraduates |
| 0.9% | 0.65 | material, finite element, mechanic, project | finite element fea, introductory material science, stress concentration factor | Linking Mechanics And Materials In Engineering Design: A New Approach |
| 0.8% | 0.70 | woman, gender, female, technology | increase number woman, woman computer science, science technology mathematics | Addressing Gender Disparities in Computing Majors and Careers: Development and Effects of a Community Support Structure |
| 0.8% | 0.76 | library, information literacy, faculty, librarian | information literacy instruction, information literacy skill, integrate information literacy | Integrating Information Literacy in Engineering: Librarians/Faculty |
| 0.7% | 0.64 | construction, project, management, structural | information model bim, building information model, build information model | Introducing Building Information Modeling Course into a Newly Developed Construction Program with Various Student Backgrounds |
| 0.6% | 0.60 | development, leader, develop, skill | develop leadership skill, leadership identity development, development leadership skill | Developing Students' Engineering Leadership Identity: Development and Results of a Pilot Effort with First Year Students |
| 0.6% | 0.75 | security, cybersecurity, cyber, curriculum | cyber physical system, computer science cybersecurity, cyber defense competition | Design and Development of Cybersecurity Concentration Courses and Laboratory Experiences for Undergraduate Students |
| 0.5% | 0.58 | biomedical, curriculum, undergraduate, development | medical device industry, undergraduate biomedical curriculum, undergraduate bme curriculum | WIP: A Vertically-integrated, Project-focused Approach to Undergraduate Biomedical Engineering Education |
| 0.5% | 0.59 | nanotechnology, undergraduate, curriculum, development | national science foundation, atomic force microscopy, atomic force microscope | NanoExposed! – An Introduction to Nanotechnology |
| 0.5% | 0.76 | pandemic, covid, online, impact | due covid pandemic, impact covid pandemic, face face instruction | Student Responses to Remote Teaching During the Covid-19 Pandemic: Implications for the Future of Online Learning |
| 0.5% | 0.84 | virtual, reality, augment, augmented | virtual reality vr, augmented reality ar, immersive virtual reality | Virtual Reality: A Learning Tool for Promoting Learners' Engagement in Engineering Technology |

Continued on next page

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.5% | 0.80 | generative, artificial intelligence, ai, tool | artificial intelligence ai, generative artificial intelligence, large language model | Exploring Student Perceptions of Learning Experience in Fundamental Mechanics Courses Enhanced by ChatGPT |
| 0.5% | 0.61 | visualization, skill, ability, improve | spatial visualization skill, spatial visualization test, purdue spatial visualization | An Analysis of First-Year Engineering Majors' Spatial Skill |
| 0.5% | 0.79 | creative, creativity, innovation, thinking | creative problem solve, creative self efficacy, ill structure problem | I'm Not the Creative Type: Barriers to Student Creativity within Engineering Innovation Projects |
| 0.4% | 0.71 | printing, manufacturing, additive manufacturing, project | deposition model fdm, additive manufacturing technology, rapid prototyping rp | Additive Manufacturing in Manufacturing Education: A New Course Development and Implementation |
| 0.4% | 0.75 | flip, flipped, classroom, mechanic | flipped classroom model, flipped classroom approach, implement flipped classroom | A Flipped Course in Modern Energy Systems: Preparation, Delivery, and Postmortem |
| 0.4% | 0.70 | system, digital, communication, signal | digital signal processing, signal processing dsp, digital signal processing dsp | Integration Of A Dsp Hardware Based Laboratory Into An Introductory Signals And Systems Course |
| 0.4% | 0.77 | virtual, lab, experiment, laboratory | interactive virtual laboratory, virtual cvd laboratory, thermo fluid laboratory | Enhancement Of Student Learning In Experimental Design Using Virtual Laboratories |
| 0.4% | 0.77 | concept inventory, problem, static, problem solve | problem solve process, static concept inventory, problem solve skill | WIP: Common Errors in Learning Strength of Materials Concepts as a Foundation to an Interactive Web-based Problem-solving Assessment Interface |
| 0.4% | 0.53 | base, technology, approach, system | first year find, integration core science, dynamic system find | Students To Engineering Practice |
| 0.4% | 0.65 | curriculum, chemistry, freshman, chemical | material energy balance, unit operation laboratory, chemical summer school | First Impressions: Engaging First-Year Undergraduates in Chemical Engineering Design |
| 0.4% | 0.72 | manufacturing, manufacture, technology, workforce | university wisconsin stout, national science foundation, center next generation | Assessing The Competencies In The Manufacturing Engineering Technology Programs |
| 0.4% | 0.62 | success, community college, year, experience | four year institution, community college transfer, transfer four year | Successes and Difficulties Experienced by Engineering Transfer Students at a Large Public University |
| 0.3% | 0.60 | undergraduate, measure, first year, impact | self efficacy belief, measure self efficacy, self efficacy self | Enhancing Engineering Self-Efficacy in Community College Students Through Workshop Implementation |
| 0.3% | 0.59 | water, environmental, project, development | water resource management, water distribution system, storm water runoff | Integrating Engineering, Innovation, and Research at All Levels: An Educational Model for Water Reuse Design |
| 0.3% | 0.63 | disability, project, experience, disabled | deaf hard hear, autism spectrum disorder, disability act ada | HuskyADAPT: A Project-based Accessible Design Course (Experience) |
| 0.3% | 0.64 | technological, literacy, technology, non | technological literacy philosophy, develop technological literacy, standard technological literacy | Applications of Reflective Thinking Exercises in Both Technological Literacy and Standard Engineering Courses |

Continued on next page

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.3% | 0.76 | fluid mechanic, fluid, undergraduate, cfd | computational fluid dynamic, fluid dynamic cfd, computational fluid dynamic cfd | Combining Simulation and Experiment to Determine Fluid Forces in the Fluid Mechanics Laboratory |
| 0.3% | 0.57 | electric, electrical, base, concept | electric circuit concept, op amp circuit, analog integrate circuit | Concept Inventory Assessment Instruments for Circuits Courses |
| 0.3% | 0.62 | distance, technology, delivery, graduate | old dominion university, web base distance, real time interaction | Distance Learning Delivery Of A Web Based Degree In Electrical/Electronics Engineering Technology, Which Incorporates Hands On Laboratory Experiments And Real Time Video |
| 0.3% | 0.62 | inclusion, diversity, team, perspective | diversity equity inclusion, equity inclusion dei, diversity equity inclusion dei | Work in Progress: Developing a Foundational Engineering Course to Improve Students' Sense of Belonging and Increase Diversity |
| 0.3% | 0.80 | mathematics, calculus, mathematical, math | process object schema, schema apos theory, process object schema apos | Integrating Applications In The Technion Calculus Course: A Supplementary Instruction Experiment |
| 0.3% | 0.70 | vibration, dynamic, mechanical, experiment | single degree freedom, partial differential equation, degree freedom system | Innovative Experimental Practices In Vibration Mechanics |
| 0.3% | 0.78 | grade, mastery, grading, exam | standard base grading, standard base grade, base grade system | Effect of Mastery-graded Exams on Student Outcomes in Statics and Mechanics of Solids Course |
| 0.3% | 0.57 | process, safety, construction, chemical | occupational safety health, chemical process safety, safety health administration | Work in Progress: Content Validation of an Engineering Process Safety Decision-making Instrument (EPSRI) |
| 0.3% | 0.59 | graduate, mental health, stress, culture | mental health concern, mental health challenge, graduate mental health | CAREER: Supporting Undergraduate Mental Health by Building a Culture of Wellness in Engineering |
| 0.3% | 0.64 | remote, distance, base, experiment | remote laboratory experiment, remotely accessible laboratory, remote access laboratory | Execution of Remote Laboratory with Learning Management System |
| 0.3% | 0.74 | calculus, mathematics, success, math | wright state model, college algebra trigonometry, wright state university | Implementing an Engineering Applications of Mathematics Course at the University of Arkansas and Assessing Retention Impact |
| 0.3% | 0.81 | stem, middle school, girl, female | middle school girl, high school girl, science technology mathematics | Building the Pipeline: STEM Summer Camps and the Path to Gender Equality in Engineering |
| 0.3% | 0.55 | economy, economics, simulation, base | time value money, social security benefit, internal rate return | Integrating Innovative Pedagogies into Engineering Economics Courses |
| 0.3% | 0.74 | cad, solid modeling, model, graphic | computer aid cad, geometric dimensioning tolerancing, dimensioning tolerancing gd | Development Of A Multimedia Based Interactive Environment For 3 D Solid Modeling Tutorials |
| 0.2% | 0.59 | service, community, project, impact | community service project, project community service, faculty community partner | Service Learning Integrated Into Existing Core Courses Throughout A College Of Engineering |

Continued on next page

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.2% | 0.67 | partnership, university, collaboration, academia | university industry partnership, college industry partnership, university industry collaboration | Building Sustainable Industry Partnerships That Engage Faculty and Prepare Job-Ready Students |
| 0.2% | 0.63 | motivation, undergraduate, first year, attitude | self determination theory, achievement goal orientation, motivated strategy questionnaire | Longitudinal Study of Changes in Student Motivation and Attitudes in Engineering |
| 0.2% | 0.73 | underwater, project, naval, ocean | autonomous underwater vehicle, remotely operated vehicle, underwater vehicle auv | Impact Of The Nnrne Program On Ocean Engineering Education |
| 0.2% | 0.60 | technology, graduate, degree, development | master degree technology, computer information technology, master science technology | Meeting Industry Needs for Professional and Technical Skills With New Graduate Degrees |
| 0.2% | 0.66 | tablet pc, technology, multimedia, classroom | tablet pc classroom, tablet pc technology, faculty tablet pc | Evaluation Of Tablet Pcs For Engineering Instruction And Content Development |
| 0.2% | 0.52 | stem, interest, evaluation, effect | camp high school, middle high school, summer camp high school | Board 153: An Immersive Summer Camp Designed for Underrepresented Populations and Its Effectiveness on Increasing Pre-College Awareness and Broadening Participation in Engineering (Evaluation) |
| 0.2% | 0.87 | programmable logic, controller, control, plc | programmable logic controller, logic controller plc, programmable logic controller plc | Programmable Controllers: An Affordable Necessity |
| 0.2% | 0.61 | university, development, technology, science | nuclear power plant, university texas austin, nuclear regulatory commission | Project-based Learning Program for Nuclear Workforce Development Phase II: Implementation |
| 0.2% | 0.85 | public policy, infrastructure, disaster, katrina | public policy issue, emergency management technology, post disaster reconstruction | Board 323: Integrating Servingness in a Mini-Capstone Project: Resilient and Sustainable Emergency Housing Design |
| 0.2% | 0.76 | maker space, university, makerspace, makerspaces | university maker space, idea generation ability, throughout academic career | Building an Identity in the Makerspace |
| 0.2% | 0.66 | career, professional, graduate, development | early career professional, school work transition, career development theory | Understanding Engineering Students' Professional Pathways: A Longitudinal Mixed-Methods Study |
| 0.2% | 0.58 | mechanical, process, curriculum, integrate | new civil curriculum, accreditation technology abet, four year curriculum | Design Across The Curriculum: An Evaluation Of Design Instruction in a New Mechanical Engineering Program. |
| 0.2% | 0.68 | female, woman, career, faculty | female faculty member, woman stem faculty, woman faculty member | What Women Want: Female Friendly Faculty Recruitment |
| 0.2% | 0.63 | process, chemical, laboratory, experiment | unit operation laboratory, experiment undergraduate curriculum, process dynamic control | Integrating Best Practice Pedagogy With Computer Aided Modeling And Simulation To Improve Undergraduate Chemical Engineering Education |

Continued on next page

| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.2% | 0.78 | metacognitive, metacognition, skill, problem solve | self regulate srl, problem solve activity, metacognitive knowledge task | Board # 28 : Beginning to Understand Student Indicators of Metacognition |
| 0.2% | 0.66 | mem, curriculum, laboratory, semiconductor | micro electro mechanical, electro mechanical system, micro electro mechanical system | Design Of A Microelectronic Manufacturing Laboratory |
| 0.2% | 0.59 | online, screencasts, enhance, material | work example problem, cal poly pomona, www learncheme com | Participation in Structures Classes via Student Made Videos |
| 0.2% | 0.73 | clinical immersion, biomedical, work progress, experience | unmet clinical need, clinical immersion experience, work progress clinical | Designing an Interprofessional Educational Undergraduate Clinical Experience |
| 0.2% | 0.67 | black, experience, woman, work progress | critical race theory, racial ethnic identity, predominantly white institution | An Investigation of Black Students' Experiences in Engineering Teamwork |
| 0.2% | 0.72 | system, laboratory, control, controller | feedback control system, proportional integral derivative, integral derivative pid | Modeling, Simulation, And Control Of A Real System |
| 0.2% | 0.61 | lecture, active, classroom, large | personal response system, traditional lecture format, web base courseware | A Comparison And Evaluation Of Personal Response Systems In Introductory Computer Programming |
| 0.2% | 0.52 | tool, active, undergraduate, project | software verification validation, open source software, undergraduate software test | The Software Enterprise: Facilitating The Industry Preparedness Of Software Engineers |
| 0.2% | 0.62 | summer, campus, success, year | improve math placement, incoming first year, high school college | Evaluation Of A Summer Bridge Program On Engineering Students' Persistence And Success |
| 0.2% | 0.57 | transportation, competition, civil, work | state department transportation, core concept outcome, steel bridge competition | Redesigning The Transportation Course To Incorporate Team Oriented, Project Based Field Assignments |
| 0.2% | 0.79 | programming, language, computer, python | computer algebra system, high level language, capture common misconception | Using Pre Built Program Templates To Teach Numerical Methods |
| 0.2% | 0.63 | pathways, military, year, veteran | veteran service member, post gi bill, veteran active duty | Military Veteran Students' Pathways in Engineering Education (Year 2) |
| 0.2% | 0.63 | change, community practice, culture, collaboration | national science foundation, community practice cop, revolutionize department red | Mobilizing Resources in a Community of Practice: How Academic Change Agents Work Toward Equity in their Change Projects |
| 0.2% | 0.61 | laboratory, network, computer, technology | local area network, cisco network academy, electrical computer technology | Using Network Analyzers For Enhancement Of Computer Networks Teaching |
| 0.2% | 0.56 | experience, graduate, impact, institution | successful undergraduate experience, experience undergraduates reu, experience undergraduate reu | Assessing Students' Learning Outcomes During Summer Undergraduate Research Experiences |

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| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.2% | 0.65 | academic integrity, plagiarism, perception, academic | perception academic integrity, academic integrity among, academic integrity professional | Perception of Academic Integrity among Students and Faculty: A Comparison of the Ethical Gray Area |
| 0.2% | 0.67 | child, parent, fundamental, family | engage young child, knowledge attitude behavior, thinking young child | Engineering Childhood: Knowledge Transmission Through Parenting |
| 0.2% | 0.65 | introductory, programming, matlab, first | graphical user interface, linear algebra concept, solve problem matlab | Board 134: MATLAB Integration in Sophomore Mathematical Analysis Course |
| 0.2% | 0.56 | mechanic, grade, online, performance | online homework system, material energy balance, grade homework assignment | Developing Problem-Solving Skills in Dynamics: Implementation of Structured Homework Assignments |
| 0.2% | 0.67 | skill, first year, thinking, assessment | critical thinking skill, develop critical thinking, assessment critical thinking | Developing A Rubric To Assess Critical Thinking In Assignments With An Open Ended Component |
| 0.2% | 0.52 | development, empathic, service, formation | end user context, interpersonal reactivity index, role empathy play | Where Empathy is Needed in Engineering Formation |
| 0.2% | 0.63 | technology, project, vehicle, automotive | western washington university, human power vehicle, formula sae car | Experimental Vehicles Program Creates Lasting Partnerships with the National and International Industries |
| 0.2% | 0.58 | technology, project, microwave, computer | electromagnetic field wave, electromagnetic compatibility emc, electric magnetic field | Teaching Applied Electromagnetics To Engineering Technology Students |
| 0.2% | 0.62 | innovation, technology, leadership, development | faculty reward system, national collaborative task force, national collaborative task | Enabling A Strong U.S. Engineering Workforce For Leadership Of Technology Development And Innovation In Industry: Setting A New Vision For Integrative Professional Graduate Education In Engineering Practice |
| 0.2% | 0.60 | interactive, open, online, book | material energy balance, textbook material energy balance, textbook material energy | Evaluating the Effectiveness of an Open-Source Textbook in a Large, Middle-Year Engineering Mechanics Course |
| 0.2% | 0.75 | electrical, laboratory, lab, circuit | oscilloscope function generator, need take account, integrated lecture lab | Lab-in-a-Box: Online Instruction and Multimedia Materials to Support Independent Experimentation on Concepts from Circuits |
| 0.1% | 0.61 | map, mapping, concept, undergraduate | create concept map, develop concept map, concept map tool | The Impact of Cognitive Style on Concept Mapping: Visualizing Variations in the Structure of Ideas |
| 0.1% | 0.59 | experience, graduate, undergraduate, outcome | internship co op, internship experience internship, rich source assessment | Professional Internships: A Requirement For Graduation |
| 0.1% | 0.65 | internet thing, project, iot, system | internet thing iot, cyber physical system, internet thing iot technology | Internet of Things Education Project (IoTEP) |

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| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.1% | 0.60 | manufacturing, simulation, principle, system | lean manufacturing principle, lean six sigma, lean manufacturing concept | The Value Of Inquiry In Teaching Lean Process Design |
| 0.1% | 0.48 | electronic, assessment, base, professional | web base portfolio, electronic portfolio portfolio, portfolio assessment tool | Enhancing Design Learning By Implementing Electronic Portfolios |
| 0.1% | 0.50 | base, video, engagement, serious | game aid pedagogy, non digital game, game base gbl | Serious Games to Improve Student Learning in Engineering Classes |
| 0.1% | 0.64 | instructor, first year, classroom, work | first year instructor, instructor summer workshop, two hour class | Board 139: Investing in Instructors: Creating Intelligent Feedback Loops in Large Foundational Courses for Undergraduate Engineering |
| 0.1% | 0.64 | system, hydrogen, undergraduate, pem | hydrogen fuel cell, pem fuel cell, fuel cell technology | A Fuel Cell Systems Course For Undergraduate Engineering Students |
| 0.1% | 0.54 | laboratory, soil, undergraduate, classroom | undergraduate soil mechanic, soil mechanic class, synchronous video conferencing | Geotechnical Site Characterization in a Box: Bringing the Full Site Characterization Experience to the Classroom |
| 0.1% | 0.57 | social, environmental, curriculum, system | social justice issue, integrate social justice, social environmental justice | Social Justice Curriculum in Thermal Systems and Mechanical Systems Design: What Motivates Students to Engage? |
| 0.1% | 0.70 | stem, lgbtq, queer, experience | lesbian gay bisexual, gay bisexual transgender, lesbian gay bisexual transgender | Board 50: LGBTQ+ Advocacy in STEM: Impact Stories from Community of Practice |
| 0.1% | 0.65 | outreach, stem, school, impact | science technology mathematics, nsf itest project, science technology mathematics stem | Identifying High Impact Activities in Stimulating STEM Interests among High School Students (Evaluation) |
| 0.1% | 0.68 | sociotechnical, thinking, social, technical | social technical dimension, integrate social technical, socio technical divide | Building Sociotechnical Competencies through an Integration of Engineering Ethics and Science, Technology and Society Studies: A Reflection on Instructional Practices |
| 0.1% | 0.78 | neurodivergent, neurodiversity, college, adhd | attention deficit hyperactivity, deficit hyperactivity disorder, attention deficit hyperactivity disorder | WIP: Examining the Experiences of Neurodivergent Learners in STEM Fields in Their Transition to and Engagement with Online Learning |
| 0.1% | 0.61 | biotechnology, environmental, curriculum, development | molecular biology environmental, three core area, continue rapid growth | Development Of A Bioengineering Concentration In The Department Of Chemical Engineering At Prairie View A&M University: Outcomes And Lessons Learned |
| 0.1% | 0.50 | formation, year, fundamental, thinking | computational thinking ct, computational thinking skill, computational thinking formation | Inspiring Computational Thinking in Young Children's Engineering Design Activities (Fundamental) |
| 0.1% | 0.64 | gamification, static, engagement, gamified | game like element, many different way, non game context | Gamification in Computer Science Education: a Systematic Literature Review |

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| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.1% | 0.63 | reflective, reflection, work, progress | reflection reflection activity, pedagogical tool develop, experience industrial project | Integrating Reflection into Engineering Education |
| 0.1% | 0.68 | electric, vehicle, hybrid, development | hybrid electric vehicle, internal combustion engine, electric drive vehicle | Applications Of Computer Based Power Electronics To Electric Vehicle Technology, An Interdisciplinary Senior Course. |
| 0.1% | 0.60 | identity, graduate, experience, doctoral | attrition rate doctoral, base prior experience, rise doctoral institute | Board 18: Engineering Doctoral Students' Motivations and Identities: Understandings and Implications |
| 0.1% | 0.68 | hispanic, identity, development, latina | hispanic serve institution, community cultural wealth, hispanic serving institution | Illuminating the Pathways of Latine and Hispanic PhDs into Engineering Teaching-Focused Faculty Positions |
| 0.1% | 0.94 | optic, photonics, optical, fiber | fiber optic communication, optical communication network, optical fiber communication | Optical Design Tools For Photonics Engineering Education |
| 0.1% | 0.57 | undergraduate, development, adult, professional | support identity development, professional identity development, professional identity formation | Should Professional Engineering Identity be the only Identity Considered when Developing Programs? |
| 0.1% | 0.83 | innovation, innovativeness, innovative, innovator | innovative non innovative, way experience innovation, stage innovation process | Integrating Innovation Curriculum: Measuring Student Innovation to Assess Course and Program Effectiveness |
| 0.1% | 0.70 | processing, natural language, work progress, model | natural language processing, large language model, language processing nlp | Future-Ready Students: Validating the Use of Natural Language Processing to Analyze Student Reflections on a Remote Learning Group Project |
| 0.1% | 0.62 | technology, music, stem, steam | heavy metal music, technological socio cultural, music technology smt | Music Technology as an Introduction to STEM |
| 0.1% | 0.65 | art, case, liberal, college | humanity social science, integration liberal art, liberal art college | An Integrative Education in Engineering and the Liberal Arts: An Institutional Case Study |
| 0.1% | 0.76 | qualitative, belief, epistemological, epistemic | large qualitative set, improve overall quality, various quantitative qualitative | Examining Epistemological Views of Engineering among First-Year Engineering Students |
| 0.1% | 0.51 | define, software, undergraduate, laboratory | software define radio, define radio sdr, software define radio sdr | On Developing a Software Defined Radio Laboratory Course for Undergraduate Wireless Engineering Curriculum |
| 0.1% | 0.65 | state, cooperative, gulf, arab | arab gulf state, united arab emirates, arab gulf region | On Engineering Education Reform In The Arab States: A Path Forward |
| 0.1% | 0.54 | project, lean, technology, improvement | lean six sigma, six sigma project, six sigma tool | Teaching Six Sigma In A Course Project |
| 0.1% | 0.64 | development, graduate, professional, skill | obtain high quality, non technical skill, graduate technology degree | Preparing Engineering Students for Work in the 21st Century |
| 0.1% | 0.62 | processing, image, computer, undergraduate | image processing toolbox, digital image processing, convolutional neural network | Optimized Signal/Image Feature Recognition For Machine Learning |

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| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.1% | 0.66 | plant, system, agriculture, smart | real time monitoring, university maryland eastern shore, university maryland eastern | Site Specific Farming, Environmental Concerns, And Associated Advanced Technologies, Provide A Platform For Active Learning And Research At A Land Grant University |
| 0.1% | 0.55 | graduate, experience, science, project | science team science, find common ground, center instructional practice | Assessing Student Perspectives Of Interdisciplinary Collaboration |
| 0.1% | 0.63 | assess, rubric, outcome, project | sustain continuous improvement, high stake assessment, assessment direct measure | Use Of Rubrics For Assessment Of A Senior Project Design Course |
| 0.1% | 0.75 | stem, school, middle, high | science fair project, mathematics science content, national science foundation | Evaluating A Comprehensive Middle School Outreach Program—The Results |
| 0.1% | 0.49 | capture, biomedical, project, system | scenario base problem, modeling simulation system, leverage power java | Developing an AI/ML activity for a BME physiology course |
| 0.1% | 0.83 | biodiesel, production, biomass, sustainable | waste vegetable oil, issue relate energy, energy material good | Motivating Student Learning Using Biofuel-based Activities |
| 0.1% | 0.56 | experience, classroom, year, first | mobile hand experiment, hand activity develop, discovery critical thinking | Hands On Experiences In The First Year Engineering Classroom |
| 0.1% | 0.59 | technology, base, web, enhance | web enhance instruction, world wide web, nuclear health physic | Developing A Multi Author Web Site To Support Large Acl Engineering Classes |
| 0.1% | 0.58 | network, collaboration, interaction, relationship | social network sna, social medium platform, analyze social medium | The Effect of a Collaborative Environment on Engineering Students' Social Networks |
| 0.1% | 0.62 | mechanic, project, mechanical, material | dynamic system project, technology large scale, undergraduate mechanical curriculum | Engineering Design Applications in the Introduction to Mechanical Engineering Curriculum |
| 0.1% | 0.58 | project, global, humanitarian, practice | sustainable development goal, prepare become leader, colorado school mine | Developing Humanitarian Engineering Perspectives Among Underrepresented Scholars Through Engagement with the Sustainable Development Goals in Global Contexts |
| 0.1% | 0.57 | management, new, industry, develop | university new mexico, associated general contractor, demand construction manager | Involving Industry Partners In Construction Engineering And Management Capstone Courses |
| 0.1% | 0.55 | system, technology, base, project | radio frequency identification, frequency identification rfid, radio frequency identification rfid | Application Of Rfid Technology In A Senior Design Course |
| 0.1% | 0.58 | service, international, project, world | chapter without border, without border ewb, international development work | Application of Sustainable Solutions in International Service-Learning Engineering Projects |
| 0.1% | 0.62 | project, computer, network, sensor | wireless sensor network, wireless sensor network wsn, sensor network wsn | Designing A Continuous Monitoring And Tracking System Based On A Wireless Sensor Network |

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| Prop. | Coh. | Label | Keywords/Phrases | Central paper |
|---|---|---|---|---|
| 0.1% | 0.70 | agile, project, software, scrum | agile software development, agile project management, mechatronics capstone project | Working Towards the Student Scrum: Developing Agile Android Applications |
| 0.1% | 0.55 | development, application, base, technology | mobile application development, mobile studio pedagogy, improve project outcome | Work-in-Progress: Using Modern Mobile Technologies in STEM Education |
| 0.1% | 0.75 | university, civil, afghanistan, herat | military academy afghanistan, national military academy afghanistan, national military academy | Lessons From Efforts To Develop And Implement A Modern Educational Program In Afghanistan |
| 0.1% | 0.63 | dynamic, body, work, static | free body diagram, rigid body dynamic, rigid body kinematics | Enriching Statics Instruction With Physical Objects |
| 0.1% | 0.58 | integrate, curriculum, technology, improve | advanced manufacturing technology, specific manufacturing process, georgia southern university | A Pedagogical Framework and Course Module for Building Awareness and Know-How Related to the Digital Thread and Smart Manufacturing Using STEP AP242 |
| 0.1% | 0.62 | school, high, stem, progress | underrepresented stem field, science technology mathematics, stem science technology | Board 10: Work in Progress: Design of a Full-Time Summer Research Program for High School Students |
| 0.1% | 0.65 | patent, intellectual property, law, undergraduate | patent trademark office, intellectual property ip, intellectual property law | Student Patents On Inter University Projects |
| 0.1% | 0.51 | complexity, transfer, change, curriculum | first time college, overall structure curriculum, multiple institution database | Curricular Integration Of Computational Tools By Evolutionary Steps |
| 0.1% | 0.61 | project, airfoil, wind tunnel, test | boundary layer separation, wind tunnel test, wind tunnel facility | A Simple Educational Wind Tunnel Setup For Visualization Of Duct Flow Streamlines And Nozzle/Diffuser Boundary Layer Separation |
| 0.1% | 0.65 | face, online, classroom, blend | online face face, traditional face face, face face class | A Comparison between Mixed-Mode and Face-to-Face Instructional Delivery Approaches for Engineering Analysis: Statics. |
| 0.1% | 0.65 | excel, spreadsheet, application, material | visual basic application, basic application vba, visual basic application vba | Integrating MS Excel in Engineering Technology Curriculum |
| 0.1% | 0.59 | doctoral, ph, industry, perspective | job search process, technology leadership innovation, washington dc national | Student Perspectives on Developing More Relevant Ph.D. Programs in STEM Disciplines through Professional Skills Training |
| 0.1% | 0.63 | development, leadership, graduate, skill | graduate assistant gtas, leadership graduate assistant, experience graduate assistant | The Impact of a Graduate Teaching and Leadership Course on Engineering Graduate Teaching Assistants' Learning of Pedagogy |