

Academic conference posters: A systematic review

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Abstract

Introduction: Many faculty, postgraduate trainees, and students present posters to disseminate their research and engage in professional development. While reputable journals have formal guidance and rigor to their manuscript publication process, posters can vary more in quality. Both add value to the literature, but it is less clear what literature exists on the content and value of scholarly posters. We aimed to review the literature on academic-style posters.

Methods: We systematically searched 10 education, psychology, and health-sciences databases to identify journal articles describing academic-style posters. Titles and abstracts were screened with articles sorted into categories. One author initially sorted, and another author reviewed/confirmed how each article was sorted. In this mixed-methods systematic review, categories were then examined either using qualitative thematic-analysis or quantitative content-analysis, wherein two authors independently reviewed each included article.

Results: Our search yielded 3570 articles. The 439 remaining after title/abstract screening represented a range of professions/disciplines, mostly from health-professions. We inductively sorted articles into five categories: Poster Guidance, Poster Quality Rubrics, Posters within education, Technology Integration with Posters, and Posters as Supportive Aids. An overarching theme of posters as Science-based Visual Communication was observed across all five categories and integrated to enhance the overall description of posters (i.e., complementary).

Conclusion: Visual Communication and Scientific Rigor were vital to poster quality, assessment rubrics had little psychometric evidence, and posters used in education settings appeared numerous and a promising pedagogical aid. These insights can be used to further improve assessment of posters and ultimately professional development of students/trainees/faculty.

Keywords: mixed methods systematic review, systematic review, review, academic posters, scientific posters, research posters, posters

Introduction

Reputable journals have formal guidance and rigor to their manuscript publication process; however, heterogeneity in quality of posters at professional conferences has been reported across multiple professions/disciplines.¹⁻⁶ Both journal articles and posters can and should add value. Full-length journal articles provide a medium to record research findings and to build on other investigators' findings towards a generalized knowledge of an entire research community; this can take a while to develop.

Meanwhile, academic-style posters, as a core component of many academic and professional conferences, can allow timely dissemination of current research (with some in-progress) and facilitate professional development of poster authors.^{1,2,6} Networking with like-interested colleagues at professional conferences can be another benefit of posters.⁶ Regardless of reason, posters need to be of sufficient quality to communicate effectively to colleagues.

To improve the quality of posters at professional conferences, at least a few notable strategies have been explored. One strategy has been for various academic disciplines to provide guidance through publishing articles from experienced academicians on how to create posters.^{3,4,7,8} Expectations of posters as a visual presentation medium has been an important central message among many. A second strategy that is more involved has been to create a rubric to quantify and guide poster quality.^{2-5,9} While no single rubric has gained wide-spread adoption, the concept of a rubric to quantify poster quality and help identify aspects of posters that help improve quality seems helpful to reducing heterogeneity in poster quality. A third strategy has been to re-imagine the poster. That is, to change posters from a traditional format of introduction, methods, results, conclusion (like a journal

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research article) to a contemporary format with more emphasis on quality visuals, fewer words, and a clear summary statement.^{10,11} These strategies are not mutually exclusive and have been combined in some disciplines.

It is much less clear what literature exists on the content and value of scholarly posters. While prior literature should be examined before deciding on next steps to further improve poster quality, we could not find any formal review articles (systematic, narrative, scoping, or any other type) of posters from an initial literature search. While some other poster articles had a brief “review of literature” incorporating a single or few disciplines, no article had reviewed the entire literature. Herein, investigators were initially focused on the first strategy noted above (i.e., poster guidance articles), but we also sought to identify the second strategy in the literature (i.e., scoring rubric articles). Therefore, we used an innovative approach with a broad systematic search and aimed to integrate the various single-discipline recommendations in the literature into an integrated interdisciplinary overview of scholarly posters. Additionally, we aimed to review and characterize all the various scoring rubrics in the literature that assessed the quality of presented posters. Furthermore, we expected articles other than poster guidance or poster-quality rubrics because of our broad systematic search and so aimed to quickly summarize the other categories of poster articles that were retrieved.

Methods

Among the numerous review typologies,¹² this review followed the description for a “mixed-methods” review. More recently, a systematic search has enhanced this typography resulting in a “mixed-methods systematic review” (MMSR).¹³

Literature Search

Our systematic literature search used the PRISMA-S checklist criteria in reporting.¹⁴ Ten databases, namely MEDLINE (OVID), Embase (Embase.com), Web of Science Core Collection (Clarivate), CINAHL Plus, Health Source Nursing/Academic, Education Resource Information Center (ERIC), Education Research Complete, Education Full Text, and APA PsycINFO, and Psychology & Behavioral Science Collection (all EBSCOhost), were systematically searched. The search strategy was developed using truncated keywords, phrases, subject headings and proximity searching and translated to each database platform. All searches were performed on October 18th, 2023. No language limits were used initially, but results were filtered by publication-type and English-language title words to pre-screen and avoid reports of clinical studies presented as conference posters. Pre-2000 (older) items were excluded in post-processing. All results were exported to EndNote 21 (EndNote 21, Clarivate, Philadelphia, PA) citation management software¹⁵ and duplicates were removed by successive iterations of EndNote's duplicate detection algorithms and manual inspection. The search strategy is

available in Appendix A, and more detailed citation file in .RIS format is available by request from authors.

Articles were inductively-sorted by title and abstract (by WLS, and checked by MJP) into Poster Guidance for poster creation, Poster Quality Rubrics, Posters within Education, Technology Integration with Posters, and Posters as Supportive Tools categories. Knowing that we were going to need to review entire articles, some articles had English-language titles with and without English-language abstracts, and so we further narrowed to English-language articles at this point. A PRISMA flow diagram summarizes this in Figure 1.

In this MMSR, qualitative and quantitative methods were combined using a pragmatic mixed-methods approach.¹⁶ Namely, the qualitative method of thematic analysis was used for Poster Guidance, Technology Integration with Posters, and Posters as Supportive Tools categories, while the quantitative method of content analysis was used for Poster Quality Rubrics and Posters within Education.¹⁷ The mixed-methods study design was multistage with qualitative and quantitative methods combined after analysis to give a more complex description;¹⁸ that is, the stages would be complementary.^{17,18} Of note, the Poster Guidance and Poster Quality Rubrics categories were the main meta-research¹⁹ attention of this study and so were more extensively analyzed.

Poster Guidance

Articles were included in this category if they focused on expert recommendations and/or study findings for creating high-quality posters. To integrate the numerous profession/disciplinary perspectives, thematic analysis²⁰ was used. The qualitative portions of this review followed Creswell's guidance to use more than one validation strategy.^{21,22} Thus, for “investigator triangulation,” two reviewers (MJP & DDA or MJP & CG) independently evaluated each categorized article and qualitatively-coded them for notable ideas/concepts. For the validation strategy of “rich, thick description,” investigators reported inductive codes and code descriptions, as well as an organizational map illustrating how codes evolved into themes and the overarching theme. This “rich, thick description” was further augmented as other categories of articles added to Poster Guidance with further descriptions building to a thicker, richer, overall description of posters for this entire MMSR.

Poster Quality Rubrics

To illustrate variation in poster quality, multiple researchers have quantified the quality of posters presented at their disciplinary conferences. Articles were included in this category if they focused on evaluating poster quality using a scoring rubric. Two reviewers (MJP & CG) independently evaluated each article categorized as Poster Quality Rubrics and quantitatively-coded each article for reported rubric characteristics of publication year, profession/discipline, rubric

type (e.g., analytic, holistic), rating scale used, poster criteria evaluated, whether instrument was created by those authors or from the literature (with some rubrics modified), scoring validity evidence reported (including reliability).

Posters within Education

Articles were included in this category if they were in an educational setting and focused on posters developed by learners. Two reviewers (MJP & DDA) independently evaluated each of these articles and quantitatively classified each for: discipline, whether describing a course or broader program, as well as whether it was used for summative course grading or as a formative, descriptive communication medium.

Technology Integration with Posters

Articles were included in this category if they focused on integrating technology with posters, including individual e-posters and entire virtual poster sessions. Two investigators (MJP & CG) independently evaluated each of these articles and qualitatively-coded them for notable concepts followed by inductively identifying themes. While some technologies were dated at the time of our review, those articles were included within this review and evaluated for purpose of those technologies.

Posters as Supportive Tools

Articles that remained unsorted after inclusion into one of the aforementioned categories were initially categorized as “other.” Two investigators (MJP & CG) independently reviewed each article in this category and qualitatively-coded them for their main idea/concept. Themes were inductively generated using the same approach as the technology category. Once reviewed, this category was re-labelled as Posters as Supportive Tools.

Results

The literature search yielded 3570 records, and 439 remained after screening titles and abstracts. Three-hundred ninety-six (396) studies were included in this systematic review. Citations of included studies are listed in Appendix B.

Poster Guidance

Eighty-four (84) articles were identified that focused on guidance with how to develop quality posters for presentation at professional conferences. Professions/disciplines represented in this sub-collection were medicine (n = 28, 33%), nursing (n = 28, 33%), pharmacy (n = 8, 10%), physical sciences (n = 6, 7%), applied sciences (n = 5, 6%), social sciences (n = 5, 6%), and other healthcare professions (n = 4, 5%).

Twelve (12) unique codes were uncovered; these were “attention-catching,” “visual-format,” “less is more,” “minimize text,” “IMRaD ordering” (Introduction, Methods, Results, and Discussion), “key message,” “text font/size,”

“networking,” “continuous professional development,” “references needed,” “pre-print feedback,” and “graphic specific.” Table 1 lists each code and a description for that code. Most of these articles were opinion-based recommendations derived from a senior author in a single-profession/discipline and appeared related to their past experiences with poster presentations. Table 1 also reports the frequencies of those codes as discussed by those various guidance article authors.

Table 1. Codes, Description, and Frequency within 84 Poster Guidance Articles

Code	Code Description	Frequency (%)
Attention Catching	Posters first need to attract the attention of viewers, to be able to convey their message. Keep in mind that an individual poster is surrounded by many other posters, and so needs to stand out to attract viewers.	76 (91)
Visual Format	Humans can process visuals MUCH quicker than reading text. Thus, posters should mostly rely on visuals to quickly present information. If a poster is a wall of text with little to attract the eye, it may only be visited by few (if any) potential viewers.	73 (87)
Less is More	Posters are inherently limited in their available presentation space. It is important to only include pertinent information to convey one key message (i.e., one story)	72 (86)
Minimize Text	Posters should NOT rely on large amounts of text like journal articles, but should instead use minimal text to supplement important visual information.	67 (80)
IMRaD Ordering	Reporting in science is ordered as Introduction, Methods, Results, and Discussion (Conclusion). Fellow scientists expect this order when reporting research.	65 (77)

Code	Code Description	Frequency (%)
Key Message	Highlighting the important take-away note to quickly facilitate viewer learning and help viewers know what to take away.	59 (70)
Text Font/Size	The poster text needs to be easily readable. Larger text is helpful and high-contrast color choice can help as well to improve readability.	52 (62)
Networking	Beyond presenting a poster, poster-sessions provide an opportunity for like-interested colleagues to interact and develop relationships with one another (e.g., possible future collaborators).	42 (50)
References Needed	Science builds on science. Posters, like manuscripts, should have references to show this. Limited poster space should mean selective references, though a QR-code can link to more references or resources.	35 (42)
Pre-Print Feedback	It is important to have peers and colleagues help review and revise a poster before it is printed. It may also be helpful to have reviewers from outside one's discipline to assess general comprehension.	24 (29)
Graphic Specifics	Graphics can help convey information more quickly and easily than text. Descriptions of graphic details such as "use figures instead of tables" or "few graphics directly-related to key-message are better than many graphics."	23 (27)
Continuous Professional Development	Beyond conveying information, poster creation and poster sessions can help facilitate researchers' professional development. Students and early career stage professionals may benefit even more from posters.	15 (18)

Over the 84 articles, saturation quickly transpired during inductive coding. While "Visual Format" to posters was almost unanimously discussed, fewer articles guided their readers to other concepts that we identified in this review. Of note, only one article had all 12 concepts (from the 12 codes in Table 1) in its text, while four other articles included most (11/12) concepts. Presumably, the different authors' guidance included their profession's/discipline's culture in what was written and not written; these somewhat differed among the various guidance articles. For instance, the vast majority of "References Needed" came from medicine, physical sciences, and applied sciences, while none came from nursing. Interestingly, some nursing articles focused fervently on visual communication and even recommended to avoid citing references on posters, fearing that reference specifics might clutter poster aesthetics. And so while there was consensus on "Visual Communication," some professions/disciplines provided some more nuance.

These 12 codes were then organized into three related themes of "*Visual First- Impressions Count*," "*Communication is Key*," and "*Grounded in Science*." Afterwards and to summarize this entire category, these three themes were distilled into an overarching theme of "*Science-based Visual Communication*." Figure 2 shows our organization of codes, themes, and overarching theme.

Twenty-five (25) articles were sorted into this category. After further review, 13 articles were not scoring poster-quality per se, with nine articles that used their rubric in a classroom-setting only (and not professional conference) and four other articles that had investigated quality of reporting for underlying research methods that had been used. These 13 articles were excluded from further analysis. The 12 remaining articles provided specific rubric descriptions for quality of academic conference posters.

Published rubrics for poster-quality were exclusively from the fields of medicine (n = 10, 83%) and nursing (n = 2, 17%); none were from pharmacy. Of the 12 rubrics identified, the majority were analytic (n = 10, 83%) compared to holistic (n = 2, 17%). A majority (n = 10, 83%) of rubrics used a rating-scale between 2-5 points, while two rubrics (17%) used 50-point rating-scales. The number of criteria differed among rubrics, ranging from one to 24 criteria, with ten criteria as most frequent (27%). Individual criteria in each rubric are displayed in Table 2. These criteria aligned with the themes identified among Poster Guidance articles of "*Visual First- Impressions Count*," "*Communication is Key*," and "*Grounded in Science*."

Table 2. Criteria Identified within 12 Academic-style Poster Quality Rubrics

Criteria	Frequency (%)
Text/ Formatting	9 (75)
Title	9 (75)
Poster Layout	8 (67)
Images/Figures	7 (58)
Key Points	6 (50)
Viewable from Short Distance	6 (50)
Originality	5 (42)
Objectives	5 (42)
Authors Listed on Poster	5 (42)
Sources Utilized	4 (33)
Results	3 (25)
Handout Provided	3 (25)
Succinct Methods	2 (17)
Logical Color Scheme	2 (17)
Poster Size	2 (17)
Conclusions	2 (17)
Study Design	1 (8)
Authors Present at Poster	1 (8)

Notably, psychometric evidence for any poster quality rubric was sparse, as only three studies (25%) reported *any* scoring-validation evidence such as a reliability coefficient. Only one study used a previously-published rubric without modification, though reported no scoring-validation evidence. Three other rubric reports used a previously published rubric that authors had modified, though only one of those reported scoring-validation evidence. Most rubrics (n = 8, 67%) had been developed by its authors, though only two of those modified instruments reported any scoring-validation evidence.

Posters within Education

Two-hundred and thirty-five (235) articles were in this category. These came from 44 professions/disciplines, with

biology (n = 33, 14%), medicine (n = 25, 11%), nursing (n = 25, 11%), chemistry (n = 22, 9%), pharmacy (n = 21, 9%), and science education (n = 16, 7%) having the highest representation. These reports of students creating posters spanned educational settings from secondary/high-school through professional and graduate schooling, though most described undergraduate experiences. Most articles (n = 178, 75%) described posters in coursework, wherein many of those (n = 112, 63%) reported that the posters were used in students' course grading. Meanwhile, 25% of articles (n = 59) described using posters to summarize students' entire program of study. Of note, all these 235 reports were retrospective observational studies; although these were numerous and described a variety of educational settings. Of note, while all described "successful" use of posters, there was no common objective outcome reported that could be combined and summarized, nor could different procedural elements (e.g., requiring other students to provide peer-assessment during a poster presentation session) be analyzed.

Technology Integration with Posters

Thirty-five (35) articles were in this category, and two major themes were identified. The first major theme captured how technology was incorporated with the poster and had three codes related to the flow of technology with the poster. When technology was used to display the poster (from technology to poster), this was coded as "virtual poster session," with nineteen (54%) articles included. When the poster was used to present technology (from poster to technology) this was coded as "interactive poster," with seven (20%) articles included. If technology flowed on both sides of the poster (technology to poster to technology) this was coded as "poster sandwich," with four (11%) articles included.

Five articles (14%) described the second major theme of "virtual conference." As distinct from the "virtual poster session" code above, technology in these articles focused on the entire conference. This would have further complexity such as multiple, sequential sessions among other entire conference logistics.

Posters as Supportive Tools

Seventeen (17) articles were within this category. The common theme for this category was exploring how posters could be useful tools for a number of reasons. These reasons described five codes: "improving research communication" in eight articles (47%), "using posters as a strategy to transfer knowledge" in three articles (17%), "improving research quality" in two articles (12%), "poster use as a publication for patent law" in two articles (12%), and "understanding how people interact with posters" in two articles (12%).

Overall Integration and Complementarity

As noted previously, this mixed-methods review had complementary categories. The main overarching theme from

the Poster Guidance category of “*Science-based Visual Communication*” was identified across the other four categories of this review as well. That is, various poster-quality rubrics had multiple items to examine different aspects of “*Science-based Visual Communication*”; reported education settings were mainly science-oriented; technology was most often used to enhance visual communication and/or scientific rigor; posters were helpful tools to support science activities. Thus, all five categories appeared to complement each other and blended into a more rich, thicker description of different aspects of this broader topic of academic-style posters.

Discussion

Having systematically-searched “posters” over the last couple decades, our broad integration of journal articles from many professions/disciplines summarizing the literature for developing academic-style posters should generalize to a wider audience from numerous professions/disciplines.

Poster Guidance

Poster Guidance articles came from many professions/disciplines though had somewhat similar guidance on how to prepare and present posters. That is, while most individual Poster Guidance articles were voiced from an expert in one discipline, our aggregating enabled saturation of collective, broader themes that showed some similar expectations across disciplines. One noteworthy difference was that some science-centered professions/disciplines discussed *scientific rigor* towards reproducibility of science, while other professions seemed focused on only *visual impression* (sometimes even recommending excluding references on posters and/or excluding other methods-related elements of scientific rigor).²³ That said, it should be acknowledged that different professions/disciplines may use posters somewhat differently. For example, one cross-discipline study of posters from three disparate disciplines demonstrated that posters in physics were different from posters in clinical psychology or law.²⁴

Moreover, our Poster Guidance codes and themes recognized the unique presentation format of posters to convey information to their audiences. While journal manuscripts can usually cover more breadth and depth of a topic, including granular details to help support and explain their information, this is a text-heavy medium. Journal manuscripts are read over an extended period; however, posters are not journal manuscripts. Instead, posters require succinct brevity, with necessities of swiftly attracting viewers and then quickly conveying its key message. Of note, each poster should have only one idea/story, but a written manuscript has space for an extended and more complex weaving together of multiple ideas/storylines. As such, multiple posters can together become a single manuscript if the multiple ideas from each separate poster can be woven together (like this manuscript has done).^{25,26} Keep in mind that a poster is displayed in a

“sea” of other posters and needs to shine through to their potential audiences; viewers have limited time and will only interact with a small number of posters. For instance, multiple authors discussed a “10-10 Rule” in that a poster has 10 seconds to swiftly attract a potential viewer from 10 feet away.^{10,27-29}

The codes we identified in this review (as in Table 1) can be used as a “quality checklist” for future presenters. For example, “Does my poster have few graphics that are focused on my topic?” Authors could then use the codes during poster revisions, and this checklist process could continue until all codes have been adequately addressed. Noting that posters are a form of communication meant to initiate professional conversations and interactions, their quality can affect the quantity of professional interactions initiated. High-quality posters are also vital as a professional development activity as poster quality can facilitate communication and collaboration opportunities.

Further, it would be remiss to not discuss students. Formative professional development of students is an essential part of academic curricula, where pharmacy includes professional development as a required curriculum outcome.^{30,31} We suspect other professions/disciplines have similar requirements. While a sub-set of Poster Guidance articles discussed soon-to-graduate nurse-practitioner students and recently-graduated nurse-practitioners, we did not find articles targeted explicitly to trainees within pharmacy.³²⁻³⁵ Posters can be a helpful professional identity formation activity and one that seems to have often been employed with pharmacy trainees (e.g., graduate students in the pharmaceutical sciences, postgraduate residents in pharmacy practice).³⁶ In fact, our experiences suggest that posters seem to be part of a “signature pedagogy” for pharmacy academia.³⁷ As former graduate students and residents, we have taken advantage of this helpful professional development activity and we have continued to as faculty. Please note that this initial student professional development discussion dovetails with articles categorized as Posters within Education discussion below.

Poster Quality Rubrics

The focus of reviewed rubrics was largely on visual communication. The vast majority of reviewed rubrics were analytic rubrics, while a few were holistic rubrics, and none were mixed-approach rubrics.³⁸ Among analytic rubrics, individual criteria (in Table 2), appeared to align with our overarching theme of *Science-based Visual Communication*, though some seemingly did so better than others. That is, some analytic rubric criteria examined methods and/or study design elements. Recalling that one vital purpose of posters is timely presentation of a recent project based in science, it seems important to note study design and other methods. As new scientific knowledge and procedures build on prior

scientific knowledge, it seems prudent for future rubrics to continue to evaluate visualization and communication components but also evaluate posters as tools to advance science (i.e., scientific rigor).⁶

Another prominent issue that arose during this review of rubrics was a lack of score-validation evidence (including reliability evidence) for various rubrics' scores. Very few studies reported any of these foundational components. Measuring validity and reliability can start the process of improving rubric quality, but high-quality measurement instruments should be used. Wise consumers of research should seek poster-quality rubrics that have sound score-validation evidence disseminated in the literature.

Additionally, it was interesting that most poster-quality rubrics were authored by medicine, with nursing providing the rest. In this MMSR, it was surprising that no poster-quality rubrics were developed in pharmacy, despite pharmacy academia's affinity for them as pedagogical tools. Please keep in mind that our intent was not trying to uncover a single "best" type of poster for all professions/disciplines together. That said, we found that published guidance and rubrics from multiple professions/disciplines described very similar expectations, and thus higher- versus lower-quality posters appeared similar for the various professions/disciplines. And so, it seems important from our findings that future poster authors, regardless of profession/discipline, revise their poster(s) towards higher-quality.

Posters within Education

From review of this category, investigators found that posters could serve as pedagogical tools for students in many education settings, in a broad range of age-groups (high-school, undergraduate, graduate) and in a wide variety of professions/disciplines. Moreover, educators implemented poster projects in formal classroom settings, as part of a greater program, or in smaller workshop-like environments to bolster student learning outcomes. Beyond their direct learning, some students also had the opportunity to take their created posters to professional/disciplinary conferences and further educate those students about professional interactions, networking, and helping to acclimatize them to the professional fields they were involved in. As noted in Poster Guidance discussion above, the concept of posters as tools for professional identity formation is noteworthy. Notably, articles in this Posters within Education category frequently described how students could use their posters to help bridge the gap between student and professional.

Many articles discussed how educators had used poster projects as graded assessments of students' knowledge and skills. These efficient projects could serve dual purposes of being a means to solidify student ability in a course/workshop/program topic and as an assessment tool.

While most authors discussed posters as summative assessments, some authors described poster projects as purely formative assessments where they could help students at each step ensuring their comprehension and ability to perform. Thus, posters appear to be one versatile learning tool for teachers/professors to implement, whether supporting/documenting students' growth, and/or used for helping to assess students' knowledge/ability. Within diverse educational settings, student poster projects have bolstered course content or entire program outcomes and helped facilitate students' initial professional development (i.e., professional identity formation).

Technology Integration with Posters

Themes in this category focused on technology and how technology had been incorporated with posters. While some specific technologies had changed since they were reported in the literature, those articles still fit into the same themes we identified. From studies in this category, technology could facilitate a variety of different ways to present posters outside or as a supplement to a traditional poster presentation. Early technology innovations in poster design started with the use of video screens embedded in posters and virtual universes.^{39,40} These strategies eventually led to incorporation of QR-codes to improve poster visualization and offload content.⁴¹ Because smartphones are nearly ubiquitous at current, QR-codes can be a helpful way to de-clutter some specifics from a poster and to offload those to a linked virtual space. However, QR-codes on poster presentations remain in a transitional state where some presenters and viewers appreciate them, while some other viewers do not. As a caution, it seems important that viewers need *not* follow any QR-code link to get the key-message or other important content from the poster.

The largest technology shift investigators found was the rapid adoption and publication of experiences of virtual posters during the 2019-2021 COVID-19 pandemic, with benefits described such as reaching a larger audience, decreasing costs of traveling to meetings, and increasing diversity of presenters.⁴² However, many of these ascribed benefits had been reported as early as 2016, and so COVID observations simply confirmed previous findings.⁴³ Overall, technology has allowed communication of scientific results from posters in a variety of audio and visual formats. As technology continues to evolve, it is likely incorporation of technology into posters will change in a technical sense without a change in the purpose of technology being used to augment scientific communication.

Posters as Supportive Tools

Though the reason for the tool varied widely from improving research communication to counting as a publication in patent law, this category described posters as being supportive tools. It was interesting to observe the varied uses where posters have been employed as a tool in accomplishing a task or

process. Posters are a tool that can be applied to many different uses, disciplines, and processes. While the most common use of posters has been research communication, posters have also been used as a tool in evaluating how people interact with posters as a vehicle for transferring knowledge. Similar to other tools, the question remains whether it will improve the process in terms of quality and/or in terms of time. Future studies could explore these questions. Overall, posters are valuable tools that can be used to improve research communication

Recommendations

Following from this MMSR, we have several insights and recommendations. First, we did not uncover any prior review articles, and so this is a pioneering and innovative “state of the art” systematic review. Second, the use of posters as a visual communication format was emphasized in almost all guidance. While this may seem obvious to some, experienced academicians have all seen posters that are walls of text. Thus, we recommend that poster authors pay very close attention to posters as visual communication, regardless of their intended audience. Third and after noting visual communication, some disciplines also focused on scientific rigor; we agree. We recommend that authors provide some references on their poster. Fourth, we recommend making use of QR-code technology to link to further methods details or additional references as a support tool for interested poster viewers (and not just use the QR-code for a poster-copy). Fifth, reviewed rubrics had little psychometric evidence, and reliability was the main evidence reported when it was. We recommend rubrics be used that have sound psychometric evidence. Additionally, we find it important to state there was no “gold standard” rubric or guideline on how to develop a poster. Future work should aim to streamline poster guidance and rubrics. Sixth, numerous descriptions of posters were published detailing use in an education setting. We recommend that other educators consider using this very promising pedagogical tool. Last, while posters are a common professional development activity, formal instruction and direction have been limited. We recommend (and hope) that professional organizations (such as the American Association of Colleges of Pharmacy) might help bolster this (currently) limited instruction and direction.

Limitations

A first limitation of this review was that it examined only peer-reviewed journal articles; no books were reviewed, and no grey-literature were uncovered in this search. Second, a few articles made “negative” suggestions (that is, indicated *not* to include some materials or concepts); those suggestions were not included in our analysis, as this study focused on explicit, positive recommendations. Third, this literature search was filtered and limited to articles that had English-language titles and abstracts. Some articles from alternate sources may have been left out. However, investigators had quickly found

saturation within the reviewed articles, and the articles were quite repetitive despite coming from a variety of professions/disciplines.

Next Steps

Two notable innovations are being explored as next steps. First is to revise a recent mixed-approach rubric informed by findings from this systematic review, especially for scientific rigor.² Second is to facilitate developing an education initiative for future poster presenters on what makes a higher-quality poster. While this approach has been described for a single-institution’s medical residency, envisioning it with adaptation to an organization-level seems beneficial (such as with a professional organization like the American Association of Colleges of Pharmacy).⁹

Conclusion

This systematic review integrated common themes from multiple profession/disciplinary perspectives on poster creation into an overarching theme of *Science-based Visual Communication*. Further, this review identified few poster quality rubrics in the literature. While these rubric criteria did focus on aspects of this review’s overarching theme, most were without psychometric evidence reported from their use. Moreover, numerous reports from many academic professions/disciplines described broad use of posters within education settings, and for poster’s potential to bridge students’ professional identify formation into career-long professional development. Through the multiple categories of this current systematic review, posters appeared to be a helpful activity. Following with our findings (Attention Catching, Less is More, Minimize Text, Key Message); the internet term “TL;DR” or “too long; didn’t read” can serve as a good reminder for posters. The TL;DR of posters is to make your point *quick*, show its *importance*, and do it in a *quality* presentation to promote *professional development* opportunities.

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Figure 1. PRISMA Flow Diagram for Systematic Review of Academic-style Posters

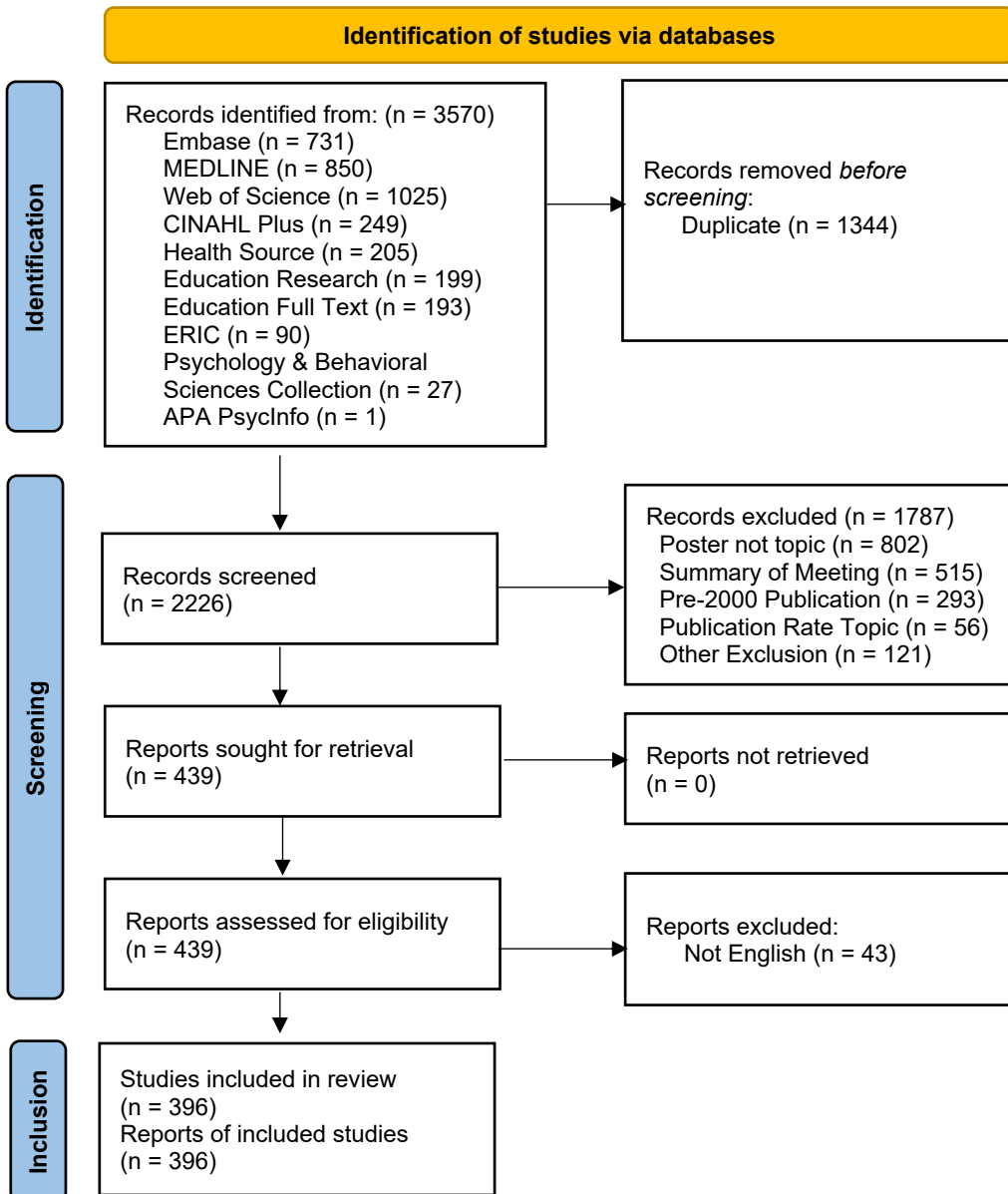
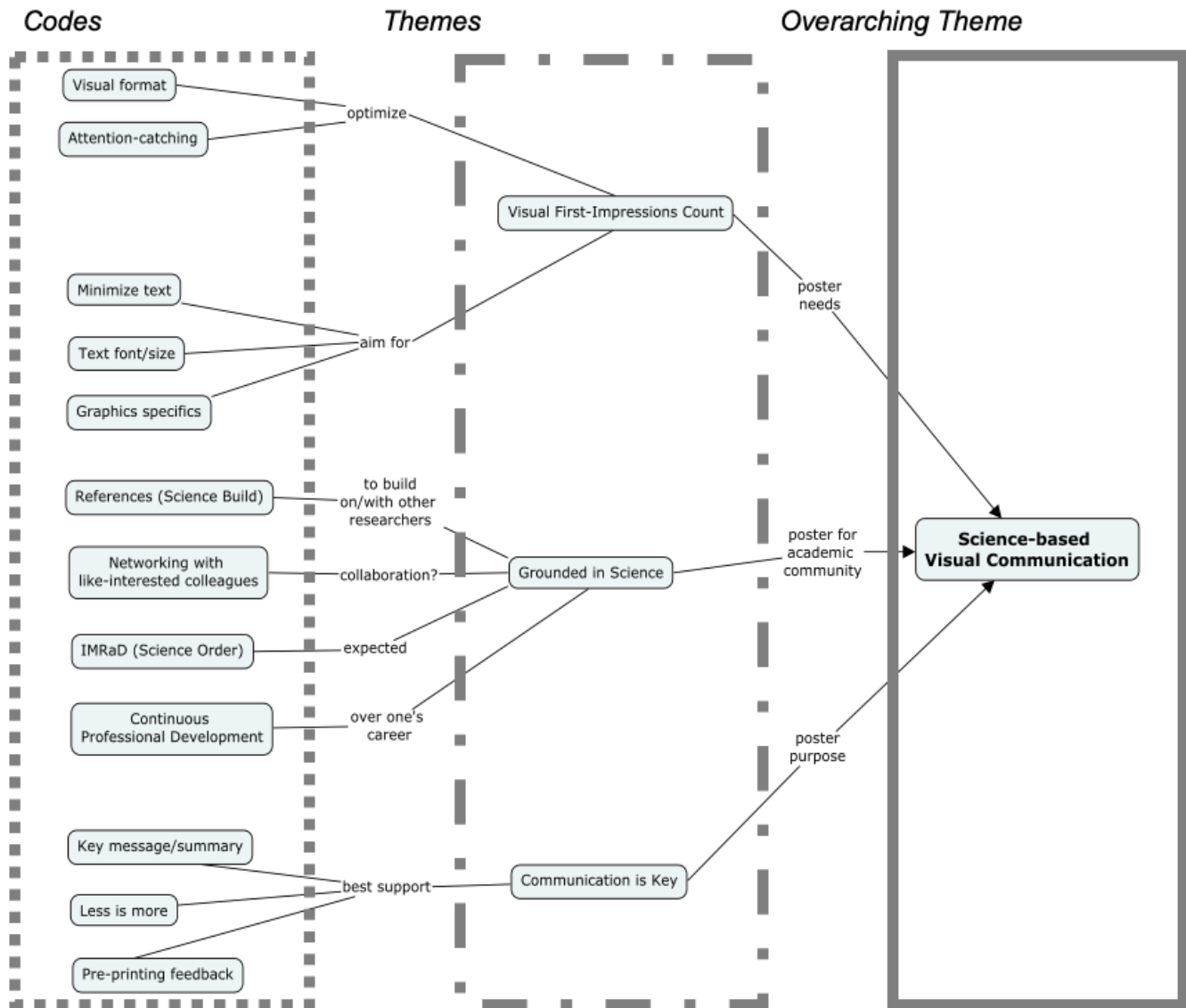


Figure 2. Coding Organization, Themes, and Overarching Theme for Poster Guidance Articles



Note: IMRaD = Introduction, Methods, Results, and Discussion