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*Sense-making, sensemaking and sense making*
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# Sense-making, sensemaking and sense making—A systematic review and meta-synthesis of literature in information science and education: An Annual Review of Information Science and Technology (ARIST) paper

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**Abstract**

Sense-making, sensemaking, and sense making are terms used in different disciplines. Similarities of usage seem unclear. (1) to examine the concepts used in different approaches to sense-making/sensemaking/sense making; (2) to identify, classify and synthesize recent studies relevant to information science, as well as similar group on sensemaking in education research; (3) to reflect on future directions for sense-making/sensemaking methodology in information science. The objectives were to retrieve, examine, classify and perform meta-synthesis on sense-making/sensemaking studies in both information science and education research. The review used systematic review principles, with selection criteria for case studies for examination in both information science and education sets. The final meta-synthesis used a meta-ethnographic approach, together with findings of recent overviews on organizational sensemaking, and other information science reviews. Qualitative sense-making studies in information science often used Dervin's SMM (sense-making methodology) and studies in organizations and education frequently used Weick's organizational sensemaking. Different mixed methods approaches were identified. Sense-making is actively used in research and practice in information science and knowledge management. Using a coherent sense-making methodology helps and dialogic principles are useful in planning, data collection and analysis. Individual and collective sense-making are important to information science.

## 1 | INTRODUCTION

Sense-making/sensemaking/sense making are "terms commonly understood as the processes through which people interpret and give meaning to their experiences … The terms originally focused on the five senses but have expanded in meaning to cover physical, emotional, spiritual and intuitional responses posited as involved in human sense-makings of their worlds, both internal and external" (Urquhart et al., 2020).

This review explores some of the concepts used in different approaches to sense-making/sensemaking/sense making to examine similarities and differences, why and how approaches diverge and may later seem to merge, or

even disappear. The work presented here is based partly on observations that emerged during the initial preparation, and later updating of a contribution to the Oxford Bibliographies in Communication on sense-making/sensemaking (Urquhart et al., 2020). The main disciplines using the terms were identified as human–computer interaction (HCI), cognitive systems engineering, knowledge management, communication studies, and library and information studies. The main corresponding research approaches were Dan Russell's sensemaking in HCI, Gary Klein's sensemaking in cognitive systems engineering, David Snowden's organizational sense-making in knowledge management, Karl Weick's sensemaking in organizational communication and Brenda Dervin's sense-making methodology (SMM) in user studies, human information behavior. The spelling variations of sense-making/sensemaking we use are deliberate as different disciplines tend to use the same spelling variant.

The five main research approaches are rooted in different "ways of thinking and practice," that influence the priorities placed on different research questions, and the methodologies used (Dervin & Naumer, 2009). Research interests of the protagonists of the different sense-making/sensemaking approaches have changed over time and this is reflected in the level of research activity observed (Urquhart et al., 2020), as well as some of the responses to critiques of the different approaches, and some of the apparent overlap between different sense-making approaches. For example, Snowden's perspective on Dervin's sense-making focuses on how to make decisions in organizations that work in complex settings—"naturalizing sense-making." Snowden's Cynefin Framework has five domains (simple/known, complicated/knowable, complex, chaotic, disordered). Each domain has different cause and effect relationships, demanding different responses from management. The Framework helps decision makers to make sense of problems, think about strategies to cope with various types of challenges, and obtain some shared understandings (Kurtz & Snowden, 2003).

Dervin's sense-making methodology (SMM) is best represented by a central metaphor that focuses on six dimensions of sense-making and unmaking as human agents seek to bridge gaps communicatively. The metaphor's dimensions are: (a) situations—time–space anchored moments where agents experience barriers, constraints, and so on; (b) gaps—the questions, confusions, and muddles agents confront during these moments; (c) bridges—the sense-makings/unmakings by which agents move over gaps (e.g., thoughts/ideas, cognitions, attitudes, feelings, memories); (d) outcomes/uses—the consequences to be sought or avoided via gap-bridging (helps, hindrances, effects, and so on); (e) verbings—the micro-level communicative energizings or actings by

which agents move through time–space, which could be internal or external, trans-situational or situational, habitual or innovative, cognitive, emotional, spiritual, or physical; and (f) contexts—the ideological structures, communities, and knowledge systems that both constrain and enable sense-making practices (Schaefer & Dervin, 2009). The emphasis is on process, bridging the gaps, using "helps" or dealing with hindrances, moving through time–space. Dervin's sense-making methodology was influenced by discussions with Richard F. Carter, and the writings of many philosophers, principally Bourdieu, Foucault, Gadamer and Habermas. Gross (2023) suggests that sense-making's philosophical origins may be traced to the Greek philosophers and later, Hegel.

Weick's organizational sensemaking has developed from earlier ideas about dealing with equivocality and uncertainty as an inevitable part of work in organizations. Weick (1995) takes a definite social constructionist stance, defining sensemaking as "a central activity in the construction of both the organization and the environment it confronts" (p. 69) and defines sensemaking as "placement of items into frameworks, comprehending, redressing surprise, constructing meaning, interacting in pursuit of mutual understanding, and patterning" (p. 6). In Weick (2001), "sensemaking seems to follow roughly a sequence in which people concerned with identity in the social context of other actors engage ongoing events from which they extract cues and make plausible sense retrospectively while enacting more or less order into those ongoing events" (p. 462), and these arguments are extended in Weick et al. (2005). Sandberg and Tsoukas (2015) suggest that the limitations concern the (mainly) retrospective viewpoint, vague definitions of process, sense, and lack of focus on the wider situation in which sensemaking occurs. Maitlis and Christianson (2014) reviewed research on sensemaking in many different organizations, examining how events became triggers for sensemaking, how people create meaning among themselves, and how action and sensemaking relate to each other. They further distinguish sensemaking, sensebreaking and sense-giving. The problems with organizational sensemaking research are often unconscious assumptions about who should legitimize plausibility (Thurlow & Helms Mills, 2015), and the influence of power in sensemaking (Schildt et al., 2020). Researchers in management science usually use Weick's ideas on organizational sensemaking, but, unlike SMM, there is little guidance on methodology in Weick's own research.

Russell's sensemaking in human–computer interaction (HCI) research (Russell et al., 1993) considered efficiency of searching, and later the team's research took slightly different directions. Pirolli and Card (2005) studied processes in intelligence analysis, identifying two major sensemaking loops (foraging and sensemaking).

Klein's sensemaking in cognitive systems engineering is similar to the HCI approach to sensemaking in the emphasis on cognitive processes, but Klein places more emphasis on the socio-technical environment, and has developed research methods for studying naturalistic decision-making. Sensemaking as a process is described in the data/frame model (Klein et al., 2006a, 2006b) where the frame determines what counts as data, and, equally, the data shape the frame. Klein et al. (2007) considers the sensemaking cycle and Sieck et al. (2007) discuss in a report the six key sensemaking activities (elaborating, questioning, comparing, preserving, reframing, and seeking), as well as several methods for cognitive task analysis, critical decision method and sensemaking interviews. It is not surprising that Klein's work on sensemaking for the US Army has some similarities with Endsley's model of situation awareness for advanced systems that require decision making and control (e.g., in warfare) (Endsley, 1995). The model considers perception, comprehension, and projection as three levels of situation awareness, and links goals and mental models that then enable the development or selection of plans and scripts for directing actions. Human factors researchers are the main audience for the model. Klein has defended differences in his perspective (Klein, 2015) and Endsley discusses those differences and describes later development of situation awareness (Endsley, 2015a, 2015b) in a special issue of the *Journal of Cognitive Engineering and Decision Making*, on situation awareness, development and critiques. The debate from several authors in the special issue illustrates some of the problems in sense-making/sensemaking research as the same terms mean different things, with different implications, depending on the disciplinary background of the researcher, and reader.

Other perspectives identified in Urquhart et al. (2020) were participatory sensemaking/social cognition and the use of collaborative sensemaking tools. Participatory sensemaking seems to derive from the enactive approach to social cognition. The core ideas of the enactive approach are autonomy, sensemaking, embodiment, emergence, and experience (Froese & Di Paolo, 2011) and the development of the ideas are debated by cognitive scientists and philosophers. For our purposes, the emphasis on social, joined and joint understanding by participants, and the process of embodied interaction, seem important for some of the sense-making/sensemaking literature. For empirical research, de Jaegher (2021) discusses how an understanding of enactive cognition and participatory sensemaking might help interactions with neurodiverse individuals. Cunliffe and Coupland (2012) extended organizational sensemaking to include embodied narrative sensemaking. Collaborative sensemaking tools are varied in their design and application. They may support different explicit representations, sharing of representations, information sharing, interaction and exchange.

Our experience in reviewing the literature suggested that sometimes researchers from management science using aspects of "organizational sensemaking" (in the sense understood by Weick), in fact used empirical research methods that were sympathetic to sense-making methodology (SMM). For example, the SMM communication-as-procedure framework (reflecting, dialogically, on self-relating-to-self, self-relating-to-others, and self-relating-to-society) (Naumer et al., 2008) seemed highly relevant to the personal learning in an autoethnographic research study in a healthcare organization (Urquhart & Lam, 2021).

More recently, browsing revealed a large group of studies in educational research on sense-making/sense-making/sense making. There have been earlier educational sense-making/sensemaking studies, but this large group was unexpected. We expected the education research group to provide some new perspectives, given the interest in supporting learning management systems and the links between sensemaking and learning (Zhang & Soergel, 2014, 2016, 2020) as well as improved searching systems for student learning (Rieh et al., 2016).

The main aims of the review were: (1) to examine the concepts used in different approaches to sense-making/sensemaking/sense making; (2) to identify, classify and synthesize recent studies relevant to information science, as well as similar group on sense-making in education research; (3) to reflect on future directions for sense-making/sensemaking methodology in information science. The objectives were to retrieve, examine, classify, and perform meta-synthesis on sense-making/sensemaking studies in both information science and education research. The final meta-synthesis used a meta-ethnographic approach, together with findings of recent overviews on organizational sensemaking, and other information science reviews.

The approach to the review combines elements of a systematic review and meta-synthesis but there are some differences, as Section 2 explains. The process of doing systematic reviews developed in the health sector, as a transparent and credible process for assessing the general effectiveness of an intervention, to help clinical decision making and decisions about the funding. There are many definitions of a systematic review but the main elements generally concern:

- Providing an overview of primary research on a particular research question.
- Identifying, appraising, and synthesizing all the high-quality research evidence on a research question.
- Emphasis on use of a strict methodology, so that the processes the authors use are transparent, rigorous, and replicable. There should be steps for formulating the research question, searching for research studies,

assessing the quality of the studies, summarizing the evidence, and interpreting the findings.

Undertaking a systematic review is a time-consuming process, and more "rapid reviews" have appeared. Generally, "a rapid review is a type of knowledge synthesis in which components of the systematic review process are simplified or omitted to produce information in a short period of time" (Khangura et al., 2012), and for this reason we did a rapid review of the education research.

Unlike many systematic reviews, we did not do rigorous quality appraisal on the credibility of the research outcomes in the studies identified. Our quality appraisal was different as the research question was not whether a particular intervention worked or not. Our knowledge synthesis examined how a research methodology that included sense-making/sensemaking/sense making worked and how the methodology should be applied. We did quality appraisal to find studies that discussed the methodology used, with evidence of the use of sense-making/sensemaking in the data presented in the results. We selected a range of those studies, or groups of studies, as "case studies." The final meta-synthesis on methodology for sense-making/sensemaking incorporated relevant findings from information science and related disciplines. We emphasize that our understanding of methodology as applied to sense-making/sensemaking is not limited to the methods to be used in inquiry, but methodology as governing what should be investigated, how to frame the research problem, how to make the inquiry legitimate (Dervin, 2003), and how to evaluate design and implementation of information systems (Urquhart, 2018).

## 2 | METHODS

### 2.1 | Finding and screening the literature: Rapid review of the education research

To find recent primary research we searched Web of Science Core Collection. More searching and analysis of the results with Web of Science tools indicated that 2017 was the first year when more literature on the topic suddenly appeared in the education field, and that was then our start date.

As we were focused on the use of the concept described as sense-making, our search string for Web of Science Core Collection was simple: sense-making OR sensemaking OR "sense making" (Topic) and "Qualitative Research" OR "Qualitative Analysis" (Search within all fields) and Education OR Educational (Search within all fields) and 2022 OR 2021 OR 2020 OR 2019 OR 2018 OR 2017 (Publication Years). For the meta-synthesis we wanted to find credible qualitative research that illustrated how the authors

approached sense-making (traditionally or using new approaches to "making sense").

A follow-up search was done to retrieve educational research studies on sensemaking that were cited in many of the studies retrieved in the first search, as found in preliminary classification and description of the studies (Table 1). This provided the essential background understanding of how sense-making/sensemaking was

**TABLE 1** Classification of information science research retrieved.

| Aspect of research | Number of studies out of the total of 97 publications |
| --- | --- |
| Brenda Dervin's sense-making methodology (SMM) (cited/applied) | 51 (e.g., Bronstein, 2020; Lekic et al., 2020; Oduntan & Ruthven, 2017; Sirikul & Dorner, 2016) |
| Karl Weick's sensemaking in organizational communication/Maitlis & Christianson review (cited/applied) | 27 (e.g., Lichtner & Westbrook, 2019; Madsen & Schmeltz, 2022) |
| David Snowden's organizational sense-making in knowledge management or complex systems sensemaking | 3 (e.g., Cuevas Shaw, 2021) |
| Gary Klein's sensemaking in cognitive systems engineering (cited/applied) | 9 (e.g., Doppler Haider et al., 2019; Zhang & Soergel, 2016) |
| Dan Russell's sensemaking in HCI (also Pirolli & Card) (cited/applied) | 6 (e.g., Dennerlein et al., 2020; Waldner et al., 2021) |
| Learning (including collaborative learning situations, learning management systems, information visualization for sense-making, informal workplace learning) | 13 |
| Health and social care | 13 |
| Knowledge management and dealing with complexity | 8 |
| Social media/general media | 8 |
| Crisis communication, emergency response | 7 |
| Organizational change | 5 |
| Migration, refugees | 5 |
| No previous sensemaking theoretical framework mentioned | 5 |
| No full text available | 3 |

understood in education research, and why it mattered. Our main questions were whether education "sense-making" was rooted in organizational sensemaking or not, whether there were distinct differences, and how this research might overlap with information science research.

We must stress that our rapid review for the education research had limitations:

- Most systematic reviews search a variety of databases. We only chose one, Web of Science, and filtered the output by "education research" as categorized by Web of Science.
- We did not have a team doing the screening for included and excluded studies in educational research. One person (CU) did the screening and shared the details of the screening with other members of the team.
- Most systematic reviews assess studies for risk of bias. This was not a concern for us, as we were not assessing "what works" but "how does the method work." Our literature search specifically set out to find qualitative research.

For the educational research group, the first stage of screening was the classification into two main groups (educational—mainly policy, implementation of reforms and science sense making) and health (patient education/self-management), tabulating details of the main topic, prior sense-making/sensemaking approaches cited (if any), or other approaches to sense making and/or additional research methods used, together with authors' conclusions about sense-making/sensemaking (Appendix A, Tables A1 and A2). Where possible, the full text of the study was used for this, but we have included some details from the abstract if the full text was not available. Appendix A therefore provides available details from the 86 items retrieved.

## 2.2 | Finding and screening the literature: Updating for the information science studies

The update search (2016-end February 2023) was conducted on three main databases/collections: LIS collection (incorporating Library and Information Science Abstracts), LISTA, and Web of Science Core Collection (using filters for Information Science, Library Science). The main search query was "sense-making OR sensemaking OR 'sense making'." Another search with the main search query, and the topic "knowledge management," for the same time period, provided a few more relevant items. Our focus was on methodology, which meant that some purely theoretical articles were

excluded. We included studies, and reviews that covered both theoretical principles and discussions of methodology. We had already retrieved information on some relevant doctoral research studies, and had the material in sense-making.org to act as a basis for the relevant literature on Dervin's Sense-Making Methodology (SMM). In addition, the previous review work (Urquhart et al., 2020) had identified key literature for organizational sensemaking, knowledge management, some emerging topics of interest, and reviews.

## 2.3 | Choosing an appropriate approach to meta-synthesis

We were interested in relationships between ways researchers approached sense making, their definitions, and how the methodology worked for them. There are many approaches to meta-synthesis (Barnett-Page & Thomas, 2009). A qualitative meta-synthesis follows an intentional approach to finding and selecting research studies (usually qualitative, but can be a mix of quantitative and qualitative research). The emphasis is usually on how the intervention works (or why the intervention is not always successful). For us, meta-ethnography was more appropriate as we were more interested in methodological inquiry than how and whether findings fitted together. Meta-ethnography uses "case studies," selected research studies. It was important that possible new interpretations were rooted in well conducted research, as our focus was "doing sense-making." The meta-ethnographic approach was based on Doyle's enhancement (Doyle, 2003) of the original Noblit and Hare approach to meta-ethnography (Noblit & Hare, 1988). Doyle (2003) selected case studies primarily for the "opportunity to learn," with boundary conditions for case requirements including consideration of stance in the text (reviewer/author), and trustworthiness of the case study. Our analysis template had sections for identified gaps, research questions, research framework, research design, sample, methods, analysis, findings (with emphasis on sensemaking methodology), personal reflections by the reviewer, methodology implications.

## 2.4 | Initial stage of meta-synthesis

For the education set, the case studies were selected from the 62 "included studies," primarily on the basis that there was sufficient qualitative data in the published paper for verification that the qualitative approach was sound (boundary condition). This advantageously produced a diverse range of 14 studies (indicated by a double

asterisk in Appendix A). Two co-authors (BC, LL) were asked to choose one or two of the case studies, reflect on a list of questions and complete the template. The three co-authors dealing with the case studies have different interests in sense-making/sensemaking, and thus the reflections present a mix of research, academic and practitioner perspectives.

For the information science group, there was no need to classify into main groups, although there was a range of sense-making/sensemaking applications, with different sub-disciplinary interests. Appendix B provides brief details of the topics, the sense-making/sensemaking approaches that influenced the research design and analysis, and some notes on the methodology, for the 97 publications in the final set (not necessarily separate studies as some publications were related to each other). We took a similar approach to the selection of case studies as we did for the education research group, focusing on well conducted studies, and ensuring inclusion of a range of aspects (healthcare, knowledge management, learning management systems, social media, application of different sense-making frameworks).

## 2.5 | Second stage of meta-synthesis

The next stage of the meta-synthesis of the case studies in both the education and information sets involved examination of the interpretations across the case studies (taking each set separately at first) (Section 4). We examined how and why sense-making/sensemaking was applied, appraising the methodology and methods, analysis and how the purpose of the research related to outcomes, and produced tables of observations, with summary tables for each set (information science and education).

## 2.6 | Third stage of meta-synthesis

A meta-ethnography provides a final line of argument synthesis that brings the findings of different studies together in a way that is credible, enlightening, and transferable. Our focus, on the methodologies used in studies, means that our synthesis metaphor is a journey—think about the starting point (stance of the researcher, aims), what you need to take for your sense-making/sensemaking journey, what you could explore and compare, and how to take guidance from travel companions (theorists). The last stage of our meta-synthesis was to compare across both summary tables to extract important themes, and to use the journey metaphor to integrate lessons from the case studies, plus some other previous research and reviews.

# 3 | RESULTS

## 3.1 | Overview of documents retrieved in information science and communication research

Dervin's sense-making methodology was the most frequently cited, although the extent to which SMM was applied varied (Table 2 and Appendix B). Weick and an influential review on organizational sensemaking by Maitlis and Christianson (2014) were frequently cited, usually for research with organizations. As in the education research cohort, several studies appeared to use the term sense-making or sensemaking without reference to any theoretical framework.

The situation of the research varied, but education (formal and informal) was prominent, fortuitously confirming our suspicions that the education research cohort on sensemaking could be important to this review. We found earlier (Urquhart et al., 2020) little recent academic research on cognitive approaches to sensemaking (attributed to Dan Russell's move to working for Google (Russell, 2019)) and a shift in Gary Klein's focus of research. However, it seems that previous research on "sensemaking as searching" can help the design of search systems for searching as learning (Rieh et al., 2016). The data/frame model (Klein et al., 2006a, 2006b) plays a prominent role in the Zhang and Soergel (2014, 2020) integrated model of sensemaking—as do ideas on information foraging and sensemaking loops (Pirolli & Card, 2005), exploratory search (Qu & Furnas, 2008) and earlier influences (Russell et al., 1993). Information visualization was another area of study within "learning systems"—in formal education as well as areas such as intelligence analysis. Doppler Haider et al. (2019) used Klein's data/frame model (Klein et al., 2006a, 2006b) and Waldner et al. (2021) used a HCI approach based on Russell et al. (1993), Pirolli and Card (2005). Bowers & Krumm (2021) developed a theory of action for data use in education based on previous research on models of data use. Rieh et al. (2016) suggested that there were gaps between subfields of student web searching by students, design of information literacy programs and search system development within learning. More emphasis on "searching as a learning process" may be required.

The frequency of health, social care and "life experience" settings for individual sense-making and organizational sensemaking was accompanied by use of different approaches such as autoethnography, Interpretative Phenomenological Analysis, and Everyday Life Information Seeking (Savolainen, 1995). A group of studies examined the experiences of migration, being a refugee, or returning from working abroad.

**TABLE 2** Classification of educational research retrieved.

| Name of framework | Education ($n = 71$) | Health/patient education and self-management ($n = 15$) | Total ($n = 86$) |
|---|---|---|---|
| Weick (and variants) | 17 | 4 | 21 |
| Dervin (SMM) | 2 | 2 | 4 |
| Science sense-making and conceptual learning | 6 | 0 | 6 |
| Interpretative phenomenological analysis (IPA) | 2 | 5 | 7 |
| Education research writing on sensemaking (influenced by Weick?) | 12 (of these 5 did not also cite Weick) | 0 | 12 |
| Use of metaphor | 3 | 0 | 3 |
| Narrative (narrative inquiry, narrative performance theory, narrative writing) | 4 | 0 | 4 |
| Autoethnography | 3 | 0 | 3 |
| Chronic disease management/body–mind (various authors) | 1 | 3 | 4 |
| Some stress on dialogue/dual process/identity and role tensions/exploring difference | 8 | 4 | 12 |
| Coherence (Honig & Hatch) | 2 | 0 | 2 |
| No previous sensemaking theoretical framework mentioned | 12 (with one systematic review including studies that mention sense-making of learning analytic dashboards) | 2 | 14 |
| No full text available | 10 | 1 | 11 |

The organizational sensemaking group covered communications practices in contentious areas, working across community networks, crisis communications, organizational change. The shared theme was that of individuals making sense of troublesome situations, dealing with ambiguity, uncertainty.

## 3.2 | Overview of the documents retrieved in education research and related reviews of organizational sensemaking

Most of the studies retrieved were in the general education area ($n = 71$), with a small sub-group of six concerned with sense-making in science. The remainder ($n = 15$) were more concerned with the patient or health professional experience, mostly dealing with self-management of chronic disease. Interpretative phenomenological analysis (IPA) was an approach used in a third of the health group to "make sense" of the patient experience (Table 2). Finding a small group of autoethnography studies was not surprising (Urquhart & Lam, 2021).

No sensemaking theoretical framework was apparent in 14/86 items retrieved. The term sense making appeared without any reference to previous literature on the topic, or as "common sense." Some of these studies examined sense making of learner analytic dashboards, including one systematic review. This type of sensemaking seemed to relate to the cognitive approaches to sensemaking, such as the human computer interaction (HCI) approach to sensemaking, which is categorized in the Oxford Bibliography (Urquhart et al., 2020) as associated with searching, exploratory search, information visualization and contextual sensemaking.

Most of the education research approaches to sensemaking had been influenced by organizational sensemaking (Weick). One recent review (Cristofaro, 2022) followed a systematic review process, and two other overview studies that have taken different perspectives on sensemaking. The latter two examine power in sensemaking processes (Schildt et al., 2020) and differentiation of types of sensemaking using a phenomenological perspective (Sandberg & Tsoukas, 2020). Cristofaro (2022) attempts to update the Weick sensemaking model as

explained in Weick et al. (2005), to examine how new approaches have survived—a Darwinian co-evolutionary approach that should explain better what is important now in organizational sensemaking. Four new properties are identified: context dependent (material or social), driven by affective states stimulated by body experiences, power directed, and emotionally and cognitively contagious. Two properties are updated, as retrospection is now seen as future-oriented retrospection, and extraction of new cues is considered as extraction and update of cues. These changes parallel the increasing interest in embodiment in information science. Similarly, the emphasis on emotion and contagion echoes some research on the reasons for the success of misinformation and conspiracy theories. For our purposes in information science, Cristofaro emphasizes the collective sensemaking that occurs in organizational sensemaking, noting the important role of middle managers in mediating sense-making processes.

The one theme uniting most of the education research studies cited frequently in the cohort retrieved was the need for research strategies sympathetic to the educational setting. The main education sensemakers cited included Spillane et al. (2002) who noted the dialectic of requiring change (policymaking) but allowing for local autonomy, stressing the importance of situated cognition. Coburn (2001) attempted to bridge institutional theory (Scott, 1995) and sensemaking theory (Weick, 1995). Coburn viewed sensemaking as collective (rooted in social interaction and negotiation) and social (because deeply situated in teachers' embedded contexts). Organizational sensemaking often uses the term group sensemaking but Coburn's use of the term collective makes the important distinction that teachers were not necessarily united in the implementation of a particular policy, and sensemaking was shaped by school leaders (Coburn, 2005). Coburn (2006) used frame analysis (e.g., Benford & Snow, 2000; Snow et al., 1986) together with sense-making to understand how the teachers' sensemaking with their social networks could be shaped iteratively and influenced by school leaders. Ketelaar et al. (2012) examined differences in ownership, sense-making and agency, suggesting that these three concepts were related in different ways to teachers' identities, using the Luttenberg et al. (2009) typology of sense-making. März & Kelchtermans (2013, p. 4) examined the individual and collective processes of sense-making: "sense-making is generally defined as an (inter)active and dynamic process by which individuals and groups make meaning from the environments in which they operate, which in turn orients their actions."

In science sense-making, use of the terms sense-making and sensemaking was very varied, sometimes without clear relationship to previous education research on sensemaking. Many of the science and mathematics studies concerned the Next Generation Science Standards (http://www.nextgenscience.org). Some researchers referred to McNeill's simplified grouping of the Next Generation Science Standards of science practices into three main sets of practices: Investigating, Sensemaking and Critiquing practices (McNeill et al., 2015). In other studies, the theoretical justification was more mixed. From our perspective, there may be links with between spatial sensemaking (Ramey et al., 2017) and participatory sensemaking and social cognition, as participatory sensemaking is part of the enactive approach with its five core ideas of autonomy, sensemaking, embodiment, emergence and experience (Froese & di Paolo, 2011) and based on Varela's perspective on cognitive science (Varela et al., 1991). Two studies (Finch et al., 2020; Marckwordt et al., 2022) cited and used the framework developed by Odden and Russ (2019) for science sensemaking as a process of knowledge integration.

## 3.3 | Recent systematic reviews, overviews, integrative approaches in information science sense-making

In information science, the recent focus has been on integrating models of information seeking behavior (e.g., Liu, 2017). Urquhart (2011) in an examination of suitable meta-synthesis methods for research on information behavior, noted the range of inquiry paradigms used in existing reviews, and recommended that theoretical assumptions need to be made apparent when integrating findings from different research paradigms. Agarwal (2022) discussed how to develop a unified approach to modeling information behavior, with care taken to examine differences between models, rather than trying to iron out the differences—"unity in diversity" as Agarwal defined the approach. Agarwal (2022) included sensemaking (SMM), but the unified model inevitably reflects the other models included, and looks, superficially, more like an information seeking process model. For most information systems designers, and most information services, a process model makes more sense to their view of the world, as the information seeking takes place over a relatively short timescale. However, sense-making is messier, involving situation entry origins, situation movement states, reactions to situation (emotions, attitudes) (e.g., Dervin, Reinhard, Song, & Reed, 2006)—and may occur over a longer time period than is generally studied for information system design.

Rieh et al. (2016) reviewed research on aspects of sensemaking in "searching as learning," and developed a

model of comprehensive search for critical and creative learning, that emphasizes the higher levels of Bloom's taxonomy of learning objectives in analyzing, synthesizing, integrating and creating information. Search systems could support the required sense-making activities through more attention to different representations, annotations for reflection, maps and diagrams to encourage organization and structuring in different views. Marchionini (2019) reviewed searching for information, sensemaking and learning to develop a theoretical framework that links those concepts.

Turner et al. (2023), in a different approach to a literature review on sense-making/sensemaking, used topic modeling (unsupervised machine learning) and content analysis, using 60 articles from a Web of Science search for text analysis, alongside the literature review on sense-making/sensemaking in the Oxford Bibliography (Urquhart et al., 2020). The final multifaceted sensemaking theory has nine stages of sensemaking: sensing, meaning-making, sensegiving, becoming, agency, counterfactuals, future-scoping, movement, and impact. The authors map these to existing sense-making/sensemaking frameworks. Dervin's "verbings" appears the easiest match, but the associations are not direct. Sensing is related to *be aware*, meaning-making to *interpret*, (or *experience* or *comprehend*) sensegiving to *ascribe meaning to*, becoming to *experience*, agency to *feel*, counterfactuals to *understand*, future-scoping to *grasp*, movement to *comprehend* and/or *meaning making* (with aspects of moving through time/space). Impact has no direct association with Dervin's verbings, but does relate to the desirable optimistic outcome of sense-making—or Snowden's emphasis on where potential changes can occur (more stories like these, fewer like these).

A bibliometric analysis (Chang & Li, 2020) of the influence of Dervin's SMM, based on citations to the Dervin (1983) publication indicated that authors most frequently cited Dervin (1983) in "related work" (literature review or introduction). The SMM concepts of gaps was cited most, followed closely by situations, then uses. Almost three quarters of the citing articles were in journals classified as Library and Information Science journals. Over half the citing articles were concerned with information behavior, perhaps demonstrating the turn to the user and their situation. Kelly (2021) discussed an interview with Brenda Dervin in which Dervin reflected on her personal journey as a researcher, working on the development of SMM, across the information science and communication domains. Savolainen (1993) discussed the contribution of sense-making to study of information seeking and use, prior to the development of the Everyday Life Information Seeking (ELIS) model that attempts to provide a framework for non-work

information seeking (Savolainen, 1995) taking account of how personal priorities for organizing life, and also taking account of factors that may affect that mastery of getting things done. Several studies in Appendix B (Li & Todd, 2016, and the case studies Oduntan, 2018, and Olsson, 2016) cite both Dervin's SMM and ELIS as influences on research design. Sense-making was also mentioned as a contributory theory to studies on "information practice" in a review (Zhong et al., 2023).

Mesgari and Okoli (2019) reviewed the organizational sensemaking literature that concerned use, adoption, attitudes, and practice with technology, and sensemaking around technology. They proposed an ecological approach to studying organization-technology sensemaking, which should explain the adoption of information technology through the relationship between the user, information technology artifact, and action—what people do to make sense of the information technology, and how the affordances develop.

## 3.4 | Making sense of individual experience, and narrative approaches

The literature searches in both the education and information science fields revealed a group of studies that used related approaches to sense-making/sensemaking and used terms such as "making sense." These included Interpretative Phenomenological Analysis and autoethnography. Another, varied group, used the term "narrative" in their sense-making/sensemaking research, and we noted mentions of "dialogical" and "dialectical."

One strategy, frequently used in health research studies on patient experience, was interpretative phenomenological analysis (IPA). VanScoy and Evenstad (2015) reviewed the applications of the IPA approach in library and information science qualitative research, and situated it within previous phenomenological approaches used in library and information science. VanScoy and Evenstad discussed how to apply the procedures in their own research on reference and information service librarians, and the stress and burnout experienced by information and computer technology professionals. The advantages of the IPA approach include the provision of clear procedures, although VanScoy and Evenstad suggested that existing qualitative data analysis software, designed more for grounded theory, may not help the multi-stage analysis required. Further examples of the use of IPA include VanScoy and Bright (2017) on librarians of color in reference services, Zontek and Lipianin-Zontek (2021) on knowledge management and transfer in diverse voluntary groups, Rimkeit and Claridge (2017) on reading classic fiction in book groups for

people with dementia and Valentine et al. (2020) on young people's experience of a social media intervention for first episode psychosis. In more organizational settings, IPA was used by Urban (2021) on individuals' experience with virtual documents in a 3D storytelling world, by Ahmed and Naveed (2019) on academic information behavior of visually impaired students, and by Jackson (2018) on the experience of ethics review board chairs with changing approaches to research data governance. Other studies have taken a mixed approach, for example, combining grounded theory and IPA (Chen et al., 2020), participatory action research and IPA (Mat Saat et al., 2018) studied Malay children's experiences of parental cancer). Gorichanaz (2015, 2017, 2019) has developed an approach called auto-hermeneutics, examining relationships with IPA and autoethnography along the way. Hyatt (2017) described related research on athletic endurance. Sbaffi and Hargreaves (2022) examined how informal caregivers of people with dementia approached information seeking and developed trust in some sources over others. They used IPA in the analysis and developed a model of information trust formation that draws on Dervin's sense-making framework (Dervin, 2015) as interviewees frequently mentioned trying to make sense of information, related to their context.

Autoethnography has many definitions, but as Fourie (2021, p. 4) notes, the key characteristics are the use of personal experience, writer as both researcher and research participant, critical reflections, and self-evaluation. The edited collection by Fourie (2021) examined different types of autoethnography, some of the challenges in doing an autoethnographic study, and some examples in library and information science. Another edited collection (Herrmann, 2017) took an organizational perspective, and focused on questions of power and identity in working lives. Other examples of autoethnographic research in information science include studies of librarians working as faculty developers and information literacy instructors (Bordonaro, 2020; Fister, 2017; Morrison, 2017; Terry-Bowles & Sobel, 2022), and working in academia as a person of color (Cooke, 2019; Gibson, 2019).

The research studies that claimed use of "narrative" methods were a diverse group. One was chosen as an education case study (De Luca Picione et al., 2022) for the meta-ethnographic synthesis. Beyond the education field, there are studies that discuss "narrative sense-making"—one example in library and information science is a study of how older people justified their rejection of computers, and how they positioned themselves in relation to societal expectations of computer use (Weaver et al., 2010). Andersen et al. (2020) used an approach to narrative sense-making that stresses the "stories told,

and lives lived" to examine narrative sense-making and prospective social action (for change), introducing a special issue on the topic. Within health services research, there is an approach entitled communicated narrative sense-making that is based on the theories of Koenig Kellas (2018). Charvat et al. (2021) used this approach to understand the role of social support for pregnant women during the COVID-19 pandemic, and the type of narrative tone in the stories the women told. Computational text analysis has made the analysis of large amounts of text much easier, and Guenduez and Mettler (2023) used structural topic modeling with qualitative narrative analysis to understand the "stories" that governments were presenting about their policies for artificial intelligence. Another narrative analysis (chosen as an information science case study) examined how changes occurred in the sensemaking of the purpose of internal social media in a public sector organization (Madsen & Schmeltz, 2022).

Another aspect of "experience" is human information experience understood in terms of UX, user experience research and its relationships to human information interaction research (O'Brien, 2011). O'Brien articulated the connections, including sense-making. Fu et al. (2023) used SMM and O'Brien's ideas about "user experience."

## 4 | META-SYNTHESIS

### 4.1 | Case studies selected for information science research and sense-making

We selected the following 19 case studies for further examination

- Group of three studies authored or co-authored by Jenny Bronstein: (1) Bronstein (2020) on using different frameworks to study integration of migrant workers; (2) Genuis and Bronstein (2017) regaining "normality" in health crisis situations, (3) Naveh and Bronstein (2019) on sense-making in virtual health communities for diabetic pregnant women.
- Cuevas Shaw (2021) on scholarly publishing reactions to the COVID-19 pandemic and organizational sense-making, taking a complex adaptive systems perspective and using discourse analysis of documents.
- Davies (2020) on university communications practice and internal sense-making by staff of an external marketing campaign.
- Dennerlein et al. (2020) on co-designing tools for work-based learning by professionals in the health sector.

- Doppler Haider et al. (2019) on the sensemaking by intelligence analysts of various types of information visualizations showing temporal development of criminal social networks.
- Ferrara (2017) on the information practice of volunteer guides at an art museum, taking a sense-making perspective on how they integrated information preparing them for exhibitions, and using discourse analysis to critically examine the volunteers' perceptions.
- Greyson (2018) on information behavior in health and sense-making's relationships to information triangulation.
- Koh et al. (2019) on Maker learning and information behavior in a technology-oriented high school class.
- Lekic et al. (2020) on information behavior of top managers in a French telecommunications company.
- Lichtner and Westbrook (2019) on collective mindfulness and sensemaking during a health IT implementation.
- Madsen and Schmeltz (2022) on sensemaking of changes of purpose of internal social media in a public sector organization.
- Mirbabaie et al. (2022) on rumor correction in social media crisis communication, the spread of rumors, how sense-breaking may work, and the differences between connective and collective action.
- Oduntan and Ruthven (2017) on the information gaps in refugee integration.
- Olsson (2016) on the embodied information practices of field archeologists.
- Sirikul and Dorner (2016) on Thai immigrants' information-seeking behavior during settlement.
- Stieglitz et al. (2018) on sense-making in social media during extreme events.
- Tao and Tombros (2017) on collaborative sensemaking in collaborative information seeking.

The selection (Appendix C, Table C1) covered different types of sense-making/sensemaking (Dervin's SMM), use of the Zhang and Soergel (2014) model of sensemaking that uses Klein's data/frame ideas, organizational sensemaking (Weick), collaborative sensemaking (Paul & Morris), information foraging and sensemaking loops (Pirolli & Card, co-researchers with Russell), and complex adaptive systems frameworks, often for organizational settings where there is uncertainty.

The situation of research included many types of organizations (educational, technological, high reliability, public sector, scholarly publishing, health sector). The topics, questions, and research strategies varied.

## 4.2 | Approach to meta-synthesis of information science research on sense-making/sensemaking

Some key concepts and themes from each study were identified. We were interested in the stance and stated purpose of each study, the research framework, and some of the researchers' observations on the sense-making/sensemaking studied. We were interested in studying a wide variety of research designs, and the use of different research frameworks. Where appropriate, the authors' own words or those of influential authors for the design of the research were included in the case study analyses (Appendix C, Table C1).

The main themes that emerged from the table of observations (Appendix C, Table C2) were:

- Various research stances (design science, for development of analysis tools or learning tools, systems (complex adaptive systems) approaches for understanding and responding to complexity, and sense-making for a purpose, often to understand a problematic situation for individuals trying to overcome difficulties and to plan support services (often information services) accordingly (such as the studies on migrants). Some research was formally funded by organizations as consultancy type research, other research was funded by national or international funding agencies, but many of the information science case studies did not give details about funding or other support.
- Huge variety in the contribution of sense-making methodology to research design, methods, and analysis. Like the education research case studies, several used theoretical models or concepts that were relevant to the situation under study (e.g., a framework relevant to integration of migrants as well as [typically] one or more aspects of Dervin's SMM).
- Similarly, there were many variations on SMM use, although the most frequent was use of the situation-gaps-uses/helps framework. Less frequently used aspects were the notion of information resistance, the importance of situational relevance, and participants playing an active role in co-construction of findings (Dervin's view of the actor as an expert in their field).
- Variety of dialogic processes (e.g., drawing out and recognizing contradictory views, identification of situational constraints, sensemaking that is wary of early commitment to a decision).
- Use of multiple methods, and verification processes, triangulation of findings.
- Analysis of social media to examine communication processes, sense-breaking—big data analysis.

- Using SMM or organizational sensemaking principles for analyzing existing datasets.
- Examining how learning and information behavior relate to each other during maker learning in schools—using SMM as process oriented and people centered research methodology.
- Communication and discourse analysis associated with sense-making/sensemaking, looking at purposes of communication, or discourse analysis of policy statements, or how interviewees framed their reflections.
- Frameworks for inter-subjective sensemaking on social media—do the affordances of social media allow for expanded individual sensemaking—can we relate this to the social enaction theories that may also influence embodied sensemaking?
- Collective sensemaking, collective mindfulness—differences of opinion among researchers (depending on their research stance) on what constitutes collective sensemaking. Contrasting collective action with connective action (analysis of behavior types on social media). Making sense together with others for a purpose—collaborative sensemaking.
- Relevance of Zhang and Soergel (2014) model of sense-making to study of learning situations, learning tools—where the data/frame model of Klein et al. (2006a, 2006b) seems very relevant. Collaborative sensemaking models may include iterations of activities, structuring, sharing, synthesizing—structure and data loops.

## 4.3 | Case studies chosen in education research and sense-making

We selected the following seven case studies for further analysis:

- Chu (2022) on the individual sensemaking of university and district stakeholders in a teacher residency program where there seemed to be a lack of collaboration among bodies responsible for implementation of teacher residency.
- De Luca Picione et al. (2022) on the sensemaking process of academic inclusion (using an "upside down" world narrative methodology).
- Hillmann et al. (2018) on the role of scenario planning in educating future managers on resilience capabilities such as anticipation and sensemaking (qualitative research using video-based analysis comparing two student groups).
- Hodge and Stosich (2022) on accountability, alignment, and coherence: how educators made sense of

complex policy environments in the era of Common Core State Standards, and related assessments, curriculum, and teacher evaluation.
- Lambert et al. (2019) on the experiences of renal dieticians dealing with patients with end stage kidney disease, using sense-making.
- Marckwordt et al. (2022) on teacher enactment of the crosscutting concepts in Next Generation Science Standards in classrooms.
- Manuti et al. (2021) on metaphors (Lakoff & Johnson, 2003) as sensemaking tools to understand organizational change management.

The full case study analyses are presented in Appendix D, Table D1.

## 4.4 | Approach to meta-synthesis of education research sense-making

The same approach to analysis of the case studies for information science was used for this group (Appendix D, Table D2).

In summary, the main themes (in bold) that emerge from the education case studies were:

- **Approaches informed by several theorists**—sense-making/sensemaking plus complementary research strategies.
- **Implications for research on sense-making in some settings**—will take time and possibly several qualitative methods to examine thoroughly what is going on.
- **Some multi-method approaches**—using interviews, plus observations, plus document analysis, often for case study analysis.
- **Concerns whether published papers had sufficient details** to judge whether the methodology was applied as advised, or whether the methodology had sufficient theoretical grounding. Appraisal of methodologies difficult, not enough information.
- **Timescale, temporal factors**—sense-making is iterative, ongoing, may be interrupted by the arrival of new information.
- **Using findings to inform policymaking**, on implementation of reforms, or practice guidance, or inclusion/diversity policies.
- **Sense-making in complexity**—conflicting policy guidance, different push and pull factors, trying to find an approach that gives a sense of direction, coherence.
- **Personal sensemaking**—voicing uncertainties and confusions for the individual, when personal and professional beliefs challenged.

- Collective sensemaking—discussions among colleagues (internal to the school) and external (professional associations).
- Ongoing sense-making—need for people to make sense of seemingly contradictory information, to accept ambiguity and the unknown, to use past experience and knowledge, perhaps with some ideas about possible futures, to find a way forward.
- Use of conceptual metaphors—sometimes useful but need to be handled with care, and awareness of their limits (over-interpretation, and simplistic generalization).

## 4.5 | Comparing and contrasting education and information science research observations

One of the main selection criteria for the case studies, whether for the education or for the information science group was the detail provided on the methodology. Even so, some of the case studies lacked some details, a problem probably associated with journal word limits. For doctoral students, studying relevant doctoral dissertations available on databases such as Open Dissertation (Ebsco) will provide more relevant details than journal articles alone. Many earlier sensemaking studies were funded by defense or high reliability organizations (for crisis management) and the full reports (e.g., Sieck et al., 2007) provide far more methodological advice than the journal articles (Klein et al., 2006a, 2006b). The website sense-making.org contains methodological advice on SMM (papers by Brenda Dervin, colleagues, and doctoral students). The Cynefin website (thecynefin.co) contains a wealth of material on working with complexity, sense-making in many different work and cultural environments.

In both education and information science research, many studies used several theoretical approaches to help frame the research question. In the discussion in Section 5, we discuss the use of different theoretical frameworks. There are clearly many different research methods that are used to study sense-making/sensemaking. The education research set mostly used an approach based on organizational sensemaking, but with some distinctive differences from the management literature. In the information science set, the approaches were often shaped by the intended outcomes of the research, and a wide variety of methods used. Developing software tools demanded a design science approach, whereas policy evaluation or formulation was associated with retrospective qualitative research by independent observers. Longitudinal analysis over a period exceeding 12 months was

far more common in education research as policy change implementation was complicated and lengthy. Some examples of secondary analysis of existing datasets, or existing research studies were evident in the information science set.

The tables of observations (Appendix C, Tables C2 and Appendix D, Table D2) were further organized to provide a line of argument synthesis about "doing sense-making." The metaphor of a journey seemed a good fit to the concepts and concerns that stood out in the analysis: assessing feasibility, guidance and constraints; choosing appropriate routes to meet aims; exploring SMM in depth; looking ahead—difficult policymaking, new approaches; language problems for collective sensemaking; support tools for sense-making.

## 5 | DISCUSSION

## 5.1 | Sense-making/sensemaking methodology as a journey

The following sections provide the final stage of meta-synthesis, the line of argument for sense-making/sensemaking methodology for information science. We used the observations from both the education and the information science sets in a process of dialogue, querying within and across both sets, plus the further literature research and reflections to reach the line of argument. This is not a "one size fits all" approach. We should expect that research plans, that are sympathetic to the setting and participants, will vary from one study to another. Several of the case studies mentioned use of other theorists, to inform the planning of the research strategy on sense-making, or the use of other theorists to inform the analysis.

### 5.1.1 | Assessing feasibility, guidance, and constraints

As indicated earlier, "doing sense-making" is a journey. Many of the case studies considered several theoretical approaches to inform the research strategy. Bronstein (2020) used a model of integration (Ager & Strang, 2008), critiquing this with ideas from Gibson and Martin (2019) on information marginalization and Dervin's notion of resistance (Dervin, 1992) and Dervin (1999, p. 742) "assumes that articulation of one's lived experience including its struggles and resistances as well as alignments with given order is in itself a Sense-Making journey." These three theoretical perspectives were different, the Ager and Strang (2008) choice justified from a review

of theories around migration and settlement, and the other two frameworks (Dervin, 1992; Gibson & Martin, 2019) illuminated and explained why those working with migrant communities have to work to overcome distrust among their migrant clients.

Dennerlein et al. (2020) used the information foraging and sensemaking loops (Pirolli & Card, 2005) to help design software tools for informal learning, influenced by Eraut's research on theories of informal learning (Eraut, 2004) and his differentiation between reactive and deliberate learning. That differentiation helped to decide which of the possible affordances were likely to be appropriated in the workplace. Occasionally the theory of choice does not work very well and has to be revised with more categories. Doppler Haider et al. (2019) had earlier used Klein's work on data/frame sensemaking, but the extended model (Klein, 2013) that postulates three ways of obtaining insights, did not fit all the ways intelligence analysts made sense of information visualizations of the temporal development of social networks.

Work on sensemaking in social media uses several different theories as bases for the research framework. Stieglitz et al. (2018) used a framework of inter-subjective sensemaking, citing social enaction theorists (De Jaegher & Di Paolo, 2008; Fuchs & De Jaegher, 2009) as well as Suthers (2006) on trajectories of participation, the notion that patterns of participation over larger spans of times and collections of actors could be used by others to build inter-subjective sense-making. Mirbabaie et al. (2022), studying rumor correction on social media, used ideas about user archetypes that develop in sustaining and amplifying information on social media (Vaast et al., 2017) as well as a theory of connective action (Bennett & Segerberg, 2013), Maddock's typology of user behavior in questioning and correction (Maddock et al., 2015) and Giuliani (2016) on sensemaking, sensemaking and sensebreaking.

Schildt et al. (2020) review power and sensemaking in organizations, contrasting episodic and systemic power, conscious and less conscious assumption of power. Examination of power and possible unconscious bias is important when planning research strategies for sensemaking studies. In organizations, senior managers and policymakers may view their role as "sense-giving," but the review by Cristofaro (2022) of organizational sensemaking points out the pivotal role of middle managers in assisting sensemaking by staff. This was evident among the education research studies, with the critical role of head teachers in mediating how top-down policies might be implemented in schools.

Power may be unquestioned by those wielding it. Oxborrow (2020) used SMM but experienced problems in using SMM to examine the experience of non-Mãori librarians in learning about, or engaging with Mãori knowledge. Oxborrow suggested that as SMM is rooted in a Western culture, it is more suited to situations, perhaps such as described by Oduntan and Ruthven (2019, 2020), where the focus is on encouraging someone from the non-dominant culture to fit into the dominant culture. Asking someone from the dominant culture about their interactions with a non-dominant culture is difficult when there is no perceived need to know about that culture. Individuals may have information gaps of which they are entirely unaware. Oxborrow considered artificial gaps (knowledge gaps encountered through formal study, in this case about Mãori culture), anticipated gaps (learning about Mãori culture on a just-in-case basis), and avoided gaps (where an individual decides not to address their information or knowledge gap). Oxborrow used additional methods, including focus groups with Mãori librarians (to discuss their experiences with non-Mãori colleagues) to understand how these gaps emerged.

In another doctoral research study, Ford (2020) used SMM to focus on a holistic understanding of information use among public health practitioners. The researcher used semi-structured interviews and vignettes, and grounded theory to produce a substantive theory of information use. Suitably designed vignettes, (Finch, 1987) can provide complementary qualitative data about the likely strategies of information seeking and use, and can be combined with semi-structured interviews (O'Neill & Urquhart, 2011; Rowley & Urquhart, 2007; Urquhart, 1998). Vignettes are often helpful when participants may be reticent about the acceptability of their own views or attitudes toward policies (Leering et al., 2022; Urquhart, 1999).

Among the information science case studies, Davies (2020) examined internal sense-making about an external marketing campaign, using informal organizational ethnography with SMM to guide interviews and analysis, to encourage staff to voice contradictory, diverging views, to show awareness that the context was changing, and for interviewees to accept that agreement with the campaign was not necessary. In a different perspective on exploring difference, Doppler Haider et al. (2019) found in think-aloud sessions that intelligence analysts looked principally for connections, trends, and some also used story-telling (filling out a frame). However, they did also compare, tried to eliminate and verify, as well as noting contradictions.

Most of the information science case studies that used discourse analysis techniques were concerned about the purpose of the communication, what was actually stated, and whether those uttering or presenting the statement meant what they said, and how they presented the statement for communication with others. For example,

sentiment analysis on the basis of keywords is common in social media analysis, but Abbas et al. (2018) tried to go beyond the keyword approach and identify conversation threads. Cuevas Shaw (2021) analyzed policy statements by scholarly publishers, Ferrara (2017) asked why the volunteer guides chose to phrase their reflections in the way they did, and Olsson (2016) examined the truth claims of archeologists as they made sense of findings in field archeology.

In summary, some of the concerns about dealing with the context and power (implicit and explicit) were evident in many sense-making studies. Dervin's SMM has developed over decades and has a core concept of power (as constraining or facilitating sense-making), and focus on process ("verbs" instead of "nouns") (Naumer et al., 2008). Perhaps the use of so many of those complementary theoretical frameworks, or research techniques suggest that "verbing" also applies to consideration of the context. Researchers need to understand how the culture, or community is enacted, how expected behavior develops and norms change.

## 5.1.2 | Using appropriate routes to meet the aims

The prominent difference between research on information behavior in library and information research and the education research group was the use of observation of education professionals communicating, both with students, and with each other. Teachers, as several of the studies noted, are accustomed to observation as part of teacher evaluation and that probably makes the teaching observation "acceptable," with a defined time limit of a class time of about an hour. For other professionals more negotiation might be required, but observation helps, as one case study found, to identify instances when professionals thought they were complying with reforms—but were not. Observation reveals what is not mentioned as well as what is, and how the conversation proceeds. Discussion of a particular class session provides a focus for the interviews (before and after) to help teachers discuss particular uncertainties and confusions about changes, for example, to curriculum or assessment. Even if formal observation is not possible, site visits can provide useful background information, and collecting documentation by the organization and for the organization, is helpful (as noted in several of the case studies). Sense-making is ongoing and several of the case studies examining reforms took place over a period of 12 months or more, allowing time to observe some of the iterations, alterations, and adjustments.

Several of the sense-making and organizational sense-making studies took care to use complementary research methods to provide triangulation of their findings. In the education research group, for example, Chu (2022) identified the various stakeholders involved in a teacher residency program. The main research approach was interviews with the stakeholders, over a 2-year period covering the pilot project and implementation of the program. The interviews were complemented by extensive observation of relevant events, classroom related activities, and documentation (including policy messages). Analysis identified what was happening—and what was not happening, through a process of constant comparative analysis. The study shared interview transcripts with interviewees. A panel of subject experts served as auditors. Marckwordt et al. (2022) examined how educators made sense of complex education policy changes. After the researchers completed a classroom observation, they wrote up analytic memos. Prior to the classroom observation and after the observation teachers were asked about their attitudes toward the Next Generation Science Standards, with further interviews on the Cross Cutting Concepts at mid-year and end of year periods. Hodge and Stosich (2022) examined how educators made sense of multiple policy changes. They used two case study sites, similar in one respect but different in another. The methods included semi-structured interviews, classroom observation, plus observation of teacher meetings and professional development sessions, and a public hearing.

In a slightly different perspective on triangulation, Greyson (2018) concluded from a study of young parents' information practices that triangulation was in fact part of information practice for these young parents in a socially marginalized community. Information triangulation was evident in iterative information seeking, assessment and sense-making. Greyson describes processes of stepwise escalation as the young parents checked information from multiple sources, taking into account the authority of the source but maintaining their own agency.

The design-based research group within the information science group used various types of observation. Doppler Haider et al. (2019) used think-aloud sessions for intelligence analysts to explain their sense-making of various information visualizations. Dennerlein et al. (2020) used co-design scenarios and low fidelity prototypes to examine which affordances were taken up for informal learning in primary care. The patterns of collaborative sensemaking (task and information) were studied through use of screen recordings (Camtasia) of each participant, chat transcripts, as well as questionnaires and interviews (Tao & Tombros, 2017).

The research on social media used various types of quantitative analysis, understandably, given the vast quantity of data to analyze, but Mirbabaie et al. (2022) used quantitative techniques to identify the rumor subsets, and then did qualitative content analysis on those subsets. Abbas et al. (2018) tried to develop an automated text analysis for identifying conversation threads, using various approaches. Stieglitz et al. (2018) used sentiment analysis and also used social network analysis.

In summary, the choice of methods used in most of the case studies reflected the research questions and concerns about triangulation. The education research group observed teachers directly, and use of ethnographic methods helped to understand sense-making over time.

### 5.1.3 | Exploring SMM in depth

Many library and information science studies that use SMM, in whole or part, use interviews. Koh et al. (2019) used individual interviews (SMM informed—examining inspirations, actions, emotions, challenges, helps and learning), process mapping and maker process surveys, for a study of maker learning in high schools. In the latter study SMM was selected for its emphasis on being a process oriented and people-oriented methodology. Very often the emphasis is on situation-gaps-bridges/helps as a working framework for research design. However, the approach actually implemented may vary according to which version (publication, or workshop) about SMM has informed the research design.

For example, Oduntan and Ruthven (2017) discuss the justification for using sense-making methodology (SMM), explaining the focus on movement, change, and forces facilitating or constraining this movement (Dervin, 2003). The approach (Dervin et al., 2003) was well suited to a doctoral research study of the information behavior of asylum seekers and refugees. The authors describe development of an information needs matrix to help policymakers and service providers to this group, but the authors stress the importance of a situational approach (such as SMM) to deeper understanding of information needs and sources (Oduntan & Ruthven, 2020). As Naumer et al. (2008, p. 2) emphasize "Communication must be studied and practiced communicatively with the realization that research is itself communication practice. Effective communication requires focusing on the 6Hs—head, heart, hand, habit, hegemony, and habitus. Intersecting with others requires dialogic approaches and dialogue requires disciplined communication techniques that are reflected in interview questions and techniques." As there are often pressures on information service providers or system designers to justify running costs, it is easy for some evaluations to focus on the sources, and "relevances" of the sense-making metaphor (Mr Squiggly diagram, Naumer et al. (2008, p. 2) at the expense of greater understanding of the sense-making/sense un-making processes, gaps (confusions and muddles), bridges (ideas, attitudes, emotions, memories) and outcomes (helps, hurts, impacts). There is detailed advice on SMM interviewing, advocating a focus on "being able to elicit and hear what people really want, think, need, feel, experience, struggle with" (Dervin, Reinhard, Song, & Reed, 2006) that provides practical advice on enacting interviews using SMM principles (Urquhart & Lam, 2021).

One study in the science sense-making group described an intervention to help a student with autism deal with assessment requirements requiring participation in small group discussion (Lambert et al., 2020). For encouraging reflection in some situations, the advised approach for explicitation interviewing suggests sitting alongside, not opposite, the interviewee (Urquhart et al., 2003). This coincides with advice on talking with many neurodiverse individuals. This is another reason, perhaps, to be empathetic and creative with the combination of techniques used to study sense-making. Sense-making interviewing methods have also been used in knowledge management research to surface tacit knowledge of experts (Linderman et al., 2011) and assessment of the collective impact of city development initiatives (Linderman, 2016). In service planning, Carlin and Whittaker (2018) used Dervin's SMM as a framework for designing library interventions for autistic students.

Two of the information science case studies used SMM principles in the analysis, but not the interviewing methods. Naveh and Bronstein (2019) examined how virtual health communities might help pregnant diabetic women, using a hybrid approach of inductive and deductive coding. Genuis and Bronstein (2017) re-analyzed existing studies, one that examined information behavior of women around the menopause (and which did not use SMM interviewing methods) and the other study that analyzed text comments in a virtual health forum for people with Obsessive Compulsive Disorder (OCD), with emphasis on how people with a chronic condition come to terms with a new normal, and the sense-making processes involved. The research on the virtual health communities might be viewed as an examination of the effectiveness of dialogue among the participants, and whether sense-making among participants was effective. Another approach that uses sense-making principles in the study of communication in public spheres is the communication-as-procedure framework developed by Schaefer and Dervin (2001, 2009). This was based partly on communicative action and structuration theories, using

verbings to describe both situation-defining strategies and communicating tactics. The final coding template was based on research on online student discussion groups on controversial topics, and comprised three groups: (1) self-relating-to-self; (2) self-relating-to-other; (3) self-relating-to-society. Possibly the communication-as-procedure framework might have been used by Genuis and Bronstein (2017) and Naveh and Bronstein (2019), as there are shared concerns about dialogue in online groups. However, the Schaefer and Dervin (2001, 2009) research on student online discussion groups used a teaching approach that used the SMM metaphor as a guide for the discussions. The communication-as-procedure framework has been used by Lam (2014) in research on knowledge sharing among health professionals, to identify how individual sense-making efforts can be influenced by macro-level structures, context, and culture. Although Heverin and Zach (2012) cite Schaefer and Dervin (2009) in their research on social media responses to campus shootings, they did not report using the communication-as-procedure framework. A research study of women's health misinformation on social media (Malki, 2022) considers the situational aspects of misinformation (and structural power) and uses Dervin's sensemaking framework to study how women frame and process misinformation, and the socio-technical factors shaping their experience.

Several of the case studies in information science alluded to the ongoing and iterative process of sensemaking (Genuis & Bronstein, 2017; Koh et al., 2019; Lekic et al., 2020; Madsen & Schmeltz, 2022). In the latter study, the perceptions about the possible uses for internal social media changed, and this was tracked through document analysis, observations of communication on the internal social media, and interviews with managers. Qualitative content analysis provided composite narratives of the shifts and reflections on possible reasons why. McConnell (2016) describes how sense-making methodology (SMM) was combined with elements of organizational sensemaking (Weick, 1995). The doctoral research examined sensemaking of employees of local authority councils, and the sense-giving strategies of senior management, during a period of organizational restructuring. Qualitative data was obtained using the SMM's MicroMoment Time-Line interview technique (Dervin, 1983) and the findings showed cycles of sensemaking processes that might be prolonged, and provoke anxiety among employees.

In summary, use of SMM to inform the research strategy varied in apparent depth and extent. Sometimes the journal publication guidelines may not permit space to present enough detail about the methodology (e.g., Davies, 2020) although there may be sufficient

indications in the way the findings were presented that the researchers were acting in accordance with SMM principles. Another difficulty is that there is no single toolkit for SMM as the methodology has developed over decades, and some of the publications on potentially useful approaches, such as the communication-as-procedure framework, may be hard to locate. Interviewing is not an option when working with data sets from online communities, but it seems possible to demonstrate other SMM principles in the analysis (Genuis & Bronstein, 2017; Naveh & Bronstein, 2019). For practical advice on interviewing people who might be potential users of information systems or services, the guidance in Dervin, Reinhard, Song, and Reed (2006) deserves to be wider known, and certainly ethnographers working in industry agree that such methods are not just for data collection, they are truly communicative and co-creative (Jones, 2015).

## 5.1.4 | Looking ahead—Difficult policymaking, new approaches

The need to study sense-making seems relevant to many practical policy problems, and sense-making is often reinvented as a term, out of necessity perhaps, to deal with the transitions that face individuals, nations, and international organizations. The immediacy of the problem is paramount, and the researchers' familiar discipline is used. In the education field, references might be made instead to theories of learning or meaning-making (e.g., Bruner, 1990 on narrative and storytelling for meaning, Eberbach & Crowley, 2017 on scientific observation, Stahl, 2006, on group cognition). Hasan et al. (2017) coined the term deep sense-making when using action research to study how information systems may contribute to climate change activities. Other studies that discussed global problems did cite Dervin's sense-making. Reser and Bradley (2020), in a transdisciplinary review on the influence of personal experience on climate change, contrasts individual perceptions, and sense-making in natural environments with the hard science status of individual/nature transactions. In another study that also cited Dervin and Naumer (2009), the researchers asked how respondents understood key terms and arguments used by Controlled Environment Agriculture (CEA) producers about their systems and products, and (2) what value judgments respondents made about CEA systems and products when given both supportive and critical information (Broad et al., 2022).

Time and space factors are important here and well, particularly for sense-making that involves body and mind. We considered how many studies used related

approaches to study "individual patient experience" (Section 3.4). Mamykina et al. (2015) developed a sensemaking framework for chronic disease management, using key ideas from Dervin and Weick of the gap, but also stressing the importance of individual experiences for sensemaking. Sense-making that involved physical experiences and emotions, incurred over a period of time, relates to the enactive approach to social cognition (Gallagher, 2000, 2014; Shapiro & Spaulding, 2021; Stewart et al., 2010). Embodiment featured in one of the case studies (Olsson, 2016). For some of the science sensemaking studies, there did seem to be links between their underlying assumptions (e.g., spatial sensemaking, Ramey et al., 2017) and social enaction principles, embodied cognition (a debated concept, see, e. g., Zwaan, 2021). Sense-making in virtual environments, such as social media, may provide technical affordances to expand the possibilities of individual sensemaking to inter-subjective sensemaking (Stieglitz et al., 2018). Kiesow et al. (2021) combined SMM with Gibson's affordances to understand what affordances digital news sites offered readers, and how readers made sense of those affordances. An eco-feminist study (Hoarau-Heemstra & Kline, 2022) of animal-based tourism studied how operators make sense of the abilities and needs of working animals during the co-creation of a tourism experience in order to "make kin across species," rather than reducing the experience to one of animal exploitation.

Educational reform is complicated, and Snyder (2013), in an OECD Working Paper, examines the nature of complexity theory and its application to educational reform. Snyder includes a diagram of the Cynefin framework (Snowden & Boone, 2007) to illustrate the strategies leaders might take in different situations: the known (sense, categorize, respond); knowable (sense, analyze, respond); complex (probe, sense, respond); chaotic (act, sense, respond); disordered domain (possibly do nothing). Snowden's ideas on sense-making and working with complexity have been applied in the health care sector (Sturmberg & Martin, 2008, 2009). Grassick (2016), in doctoral research, used a complexity approach, based on theorists' work on complexity and the social sciences, to study sense-making (as described by some of frequently cited researchers in education) among teachers of English as a second language in Vietnam when dealing with major curriculum changes. Cuevas Shaw (2021) used aspects of complex adaptive systems theories to study scholarly publishing reaction to the COVID-19 pandemic, and Lanham et al. (2018) similarly examined the complex problems of secure messaging in health care.

In summary, sense-making around policymaking and policy implementation may require one or more theoretical frameworks for complexity. Weick's organizational

sensemaking, Dervin's SMM, ideas around embodied cognition and affordances may be used for understanding sense-making by individuals in those settings.

## 5.1.5 │ Language problems for collective sensemaking

The terms collective, group, and team sensemaking may be used differently, and in contradictory ways in different settings (and with different emphases on time and space). Coherence (Honig & Hatch, 2004) is defined as sense-making by a group of people in situations of complexity, as multiple (and sometimes) contradictory policies (e.g., Hodge & Stosich, 2022) pose uncertainties that complicate sense-making outcomes for a group.

David Snowden's ideas on sense-making (developed while working as the Director in the IBM Institute for Knowledge Management) have evolved for helping organizations to deal with difficult problems in uncertain settings. Sense-making should therefore enable sufficient grasp of the situation, to take some action, as illustrated in the Cynefin framework (Section 4.5). The problem in some settings is that there will be justifiably diverse opinions on what to do. Congruence of opinion may be an unrealistic goal for those involved, but the value of coherence is that "it allows for contingent truth, a determination that while we don't know everything we are at least going in the right direction .... So overall, as we start to look at different methods, approaches and philosophies some will be coherent, with considerable potential for creating something more than the sum of the parts." (Snowden, blog post November Snowden, 2020). The moral of this for doing sense-making for messy problems, complex situations is that it is helpful to bring in other ways of thinking about the problem, other theorists but the key point is gaining coherence, or aligning sensibly on how to get there. As Snowden (blog post March Snowden, 2023) notes "the goal of coherence testing is not to settle on what is right. It is to create a series of safe-to-fail probes around any coherent idea which isn't clearly wrong."

Sometimes, as some of the education case studies indicated, gaining coherence takes time. Coburn (2001) used the term collective sensemaking, to describe how a teacher would discuss with another colleague some uncertainties about a policy reform, for example. Collective sensemaking, in Coburn's view, depends on social interactions and negotiation. Olsson and Lloyd (2017), in a theoretical paper consider collective sensemaking part of embodied information practices, pointing to the enactive nature of individual and collective sensemaking. McClain and Zimmerman (2019) in the science

sensemaking education research set described family-based learning and science workshops in public libraries, and there are many settings that might offer possibilities for collective sensemaking about science.

Information science research that used the term collective sense-making often studied virtual communication rather than face-to-face communication. Heverin and Zach (2012) used Dervin's SMM (partially) to examine microblogging communications sent in response to three campus shootings in the USA. Godbold (2013) also used Dervin's SMM ideas, together with ethnomethodology, to study the role of emotion in collective sensemaking, as found in online renal discussion groups that supported patients with renal failure. Collective sense-making was evident, for example, in the steer that some contributors would make to the discussion, providing emotional support and guidance. Mirbabaie and Marx (2020) point to the importance of early "sense-giving" in their social network analysis of Twitter postings, and content analysis of some original tweets concerning the Manchester bombing in 2017. Early sense-giving (from tweets by emergency management organizations) might alleviate the problems of sense-breaking and later collective sensemaking that takes a wrong turn. Collective sense-making on public social media may differ from collective sense-making in virtual health communities. Mirbabaie and Marx (2020), using the theory of connective action (Bennett & Segerberg, 2013) contrasted connective action (no need for a collective identity, easy for individuals to share ideas, may result in temporary action, dependent on technology) with collective action (requires a collective identity, action frames reinforce shared beliefs and values and often linked with, or part of an organization). Weick and collaborators have developed ideas about collective sensemaking (individuals acting as a group) toward study of collective mindfulness, defined as "five interrelated processes at multiple organizational levels: preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, and deference to expertise" (Sutcliffe et al., 2016)—and one of the information science case studies used these ideas to reflect on the implementation of an electronic health care record system in a health care organization (Lichtner & Westbrook, 2019).

Collective sensemaking has a dark side in the "post-truth" era, fostering misinformation and disinformation. A proposal by Feinstein and Waddington (2020) concerns science education's response to the problems of "post-truth" and the role of collective sensemaking. They contend that science does not offer foundational truth, but that science knowledge is pretty good, and rather like the comments above on coherence, scientists can agree on a general direction of travel. People who interact with science in their personal, social, and political lives are generally thinking of science as part of a solution to some practical problems. Moreover, they are within their own social and cultural groups when they meet science questions and interact with people within those groups to help answer their questions. Science educators need to prepare people for the collective sensemaking that takes place in other social contexts, and help people to work together to make appropriate use of science. The route to go may be practical action (for problems that matter to the group) but thinking about the possible consequences. This does have echoes of the Cynefin framework of what to do in situations of complexity—probe, sense, respond or for chaotic situations—act, sense, respond.

In summary, use of terms such as collective, connective, group, team or collaborative sensemaking vary according to setting. We may contrast the sensemaking processes (or lack of them) in connective action on social media with group sensemaking as collective mindfulness in organizations. In between those extremes, collective sense-making may require discussions, reflection, different perspectives considered, to allow individuals to move forward with a degree of coherence. That is the area of interesting research, where the muddles, confusions and uncertainties occur and which demands researchers to communicate dialogically (Dervin, Reinhard, & Shen, 2006). Encouraging collective sensemaking as a type of communication practice requires techniques such as group interviewing dialogically (Dervin & Devakos, 2011), and perhaps some awareness of the theoretical linguistic background (e.g., Linell, 1998) or the use of narrative and storytelling (Bietti et al., 2019; De Luca Picione et al., 2022). For working with and within organizations, Cheuk and Dervin (2011) discussed dialogic practices for leadership practices in digital transformation, Cheuk (2013) described examples of dialogic principles drawn from SMM for knowledge management (knowledge sharing, communication and collaboration) and Cheuk and McKenzie (2018) discussed online leadership. (See also examples in the blog on sense-making.org).

### 5.1.6 | Support tools for sense-making

We mentioned earlier that group sensemaking has been used as a term in some of the management literature. Klein's work on sensemaking has extended to team sensemaking, which is viewed as an aspect of macrocognition. Klein et al. (2010) examined processes of team sensemaking, and Klein et al. (2015) explored why some police and military staff are seen as "good strangers" by

the public, able to prevent difficult situations escalating. That research identified effective behavioral strategies and the five "frames" of the mindset of "good strangers."

Much research on group or more commonly termed collaborative sensemaking has focused on software tools to support collaborative sensemaking for complex problems, such as SenseMaker® by Cognitive Edge/Cynefin which collects and analyses narratives in complex situations of sense-making (Lynam & Fletcher, 2015; Milne, 2015; van der Merwe et al., 2019). Others include the CoSense tool for collaborative web search (Paul & Morris, 2011) and SenseCatcher (Martins & Rodríguez Ortiz, 2019). Other sensemaking tools include Spryng (Liberating structures and Spryng, http://www.spryng.io). Situation awareness researchers use the term "distributed situation awareness" (Salmon et al., 2017). There are many varieties, suggesting that what counts as acceptable norms of collaborative sensemaking in one cultural work setting may be applicable to another—or that there may be many similarities but the terminologies are different, as already noted. Current military research refers to sensemaking. A 2021 report by the NATO Scientific & Technology Organization (Preece et al., 2021) discusses "situational understanding" and "a range of sensed modalities" as well as the distributed artificial intelligence (AI) analytics involved in building resilient systems, citing Pirolli and Card (2005) on cognitive task analysis (HCI sensemaking).

## 5.2 | Main messages for research and practice

Sense-making/sensemaking is a thriving field of research. Some varieties of sense-making from different disciplines have evolved, apparently "new" perspectives on sensemaking. Researchers and practitioner need to be aware of the problem of disciplinary silos, of researchers within one discipline unaware of the insights that may be available from other disciplines. Use of the term collective sensemaking varies from one discipline to another, and there are nuances in meaning depending on the research setting. That was particularly apparent when comparing research on collaborative sensemaking tools with the education research meaning of collective sensemaking (Sections 5.1.5 and 5.1.6).

The meta-synthesis emphasized the importance of doing in-depth research on sense-making. A variety of methods could, and often should be used to understand sense-making, that may be iterative, ongoing, and interrupted. Many of the education case studies used a mix of interviews, observation and analysis of documentation. More importantly, perhaps, study of the affordances that may be offered by social media, or ideas about

embodiment, social enaction, narrative sense-making may require different methods. To study sense-making (in full) then it might be necessary to consider complementary research methods, using ethnographic principles. But how might AI assisted tools help, or even do away with the need for ethnographic research? Ethnographers working in large information technology organizations presented some scenarios for future interaction of data science and ethnography (Zafiroglu & Chang, 2018), and argue that ethnography leads us to truths that data science cannot provide on its own. There are opportunities as well as risks. Without a coherent understanding of a set of sense-making methods to provide the guardrails, this could mean that power is hidden in the design of AI system, that dialogue and collective exploring of meaning could be replaced by the "correct prediction and recommendation" by the AI machine (controlled by the technocrat who holds the algorithm and the power). Diversity of thought could be reduced to a limited range of predictable responses, thus suppressing human creativity with the mirage of creating something new.

Guided by sense-making methods, when applied well, AI-driven applications (such as ChatBot) not only can appear converse with the users, the conversation interface and the two-way dialogue can be designed in a way that is based on person-in-situation needs, using language that make sense to the person (rather than the experts). Human experience, emotions, uncertainty and "gappiness" are being valued throughout the conversation and complement any AI/data-driven solutions that are more analytical and mechanical in nature.

There are certainly other tools and techniques available to help. We have indicated some linguistic techniques that may need further investigation, and there is a wealth of methodological advice on Dervin's SMM (www.sense-making.org). It is important to stress that SMM is a dialogic process allowing the researcher to understand the participant's perspective—it may be challenging both for the researcher and the researched, but there are guidelines to follow. For practitioners, who may be coping with organizational change and complexity, the processes of collective sense-making are likely to be important and there are tools available for collaborative sense-making, to make that process easier and more transparent.

## 5.3 | Limitations

This meta-synthesis used some systematic review principles, but readers need to consult the chapter in a previous review (Urquhart et al., 2020) for a fuller account of earlier research. We have cited some of the earlier key studies, but there are more. We used the Web of Science as

the main approximate proxy for finding high quality research, as we wanted detailed descriptions of the qualitative research methodologies for sense-making. We searched additional databases for the information science research, and managed to identify some valuable doctoral research and related publications, but acknowledge that we are likely to have missed other relevant doctoral research on sense-making. The meta-synthesis deviated from conventional meta-ethnographic research as we were not attempting to synthesize outcomes, but instead to synthesize evidence on sense-making methodologies. We hope that we have kept to the meta-ethnographic principles in analysis of the case studies, and construction of the line of argument. Ideally a larger team might provide more constructive discussion, but reading through personal blogs of two of the co-authors helped to understand their stance on sense-making.

## 6 | CONCLUSIONS

One of the aims of the review was to explore some of the concepts used in different approaches to sense-making, to consider similarities and differences, and the development (or not) of the approaches. We conclude that the situation in which sense-making is being observed should influence the research strategy and choice of additional theoretical frameworks or methods. Dervin's SMM uses the terms sense-making and sense-unmaking, focusing on processes (verbing) rather than nouns and descriptors. SMM is not itself tied to particular settings, but focuses on the person within a context and trying to bridge gaps in their ever changing and "gappy reality," moving across time/space. In organizational settings, sensemaking of the Weick school examines similar ideas, but there is more emphasis on the role of people within, and possibly external to the organization. Sense-making, sense-breaking and sense-giving are the processes observed as well as group sensemaking as collective mindfulness. Snowden's research on dealing with complex situations again emphasizes what staff should do, and the interactions that may lead to coherence for decision making. Klein's cognitive systems engineering envisaged framing and reframing and a related "human factors" approach (situation awareness) share an emphasis on sense-making that requires rapid decision making. These approaches reflect the priorities of their funders (such as the defense industry, high reliability organizations). There are also connections between Klein's data/frame model, Russell's sensemaking and "searching as learning" models in information science.

Time and space factors affect choice of approach to study sense-making, and researchers need to be wary of different perspectives on collective sensemaking. A coherent methodology, using dialogic principles, and complementary methods for triangulation, may produce more credible findings—and the education research highlighted the value of ethnographic methods.

Looking to the future, the number of publications on sensory processing has expanded rapidly over the last 10 years or so, with emphasis in the health field on sensory processing disorders, and in education and human resources management on improving the education and work environment for neurodiverse individuals. Several of the case studies mentioned affordances (specifically whether virtual communities and social media expanded the sensory world of the individual), and interest in embodiment and social enaction seems likely to increase, particularly with the support that AI may provide to sense-making tools in different settings.

## AUTHOR CONTRIBUTIONS
Christine Urquhart designed the approach to the ARIST review, conducted the literature searches, screening of the education and information science research on sense-making/sensemaking, selection of possible case studies, reflections on case studies, and was responsible for the synthesis of the findings. Bonnie Cheuk analyzed and reflected on several of the case studies, contributed further reflections on Dervin's SMM, and commented on drafts. Louisa Lam analyzed and reflected on several of the case studies, commented on drafts and also assisted in the writing one of the articles that preceded this review. David Snowden has commented on drafts, and contributed reflections on working with complexity, which are pertinent to the organizational research on sense-making/sensemaking and knowledge management.

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# APPENDIX A

**TABLE A1**　Group one education included and excluded studies (* = possible case study, ** = selected case study).

| Author/ref | Topic | Cites | Notes |
| --- | --- | --- | --- |
| Au-Yong-Oliveira (2020)<br>DOI: 10.3390/educsci10040120 | Use of autoethnography in academia—research and teaching (essay) | "Storytelling involves sensemaking and plays a significant role in autoethnography. Prominent authors have put forward a rebalanced model of sensemaking to make the sensible once again sensible and open up the sensemaking perspective to understand learning as a process that is more than mere interpretation" (Colville et al., 2016) | "Educating through autoethnography to be reflexive and introspective" |
| Barbera et al. (2018)<br>DOI: 10.1177/0894486518780795 | Entrepreneurship legacy within families | Symbolic interactionism/Narrative performance theory, Langellier and Peterson (2006) collective sense-making and sense-giving within the family | "Proposes that stability or fluidity of legacy stories are linked to … anticipated futures" Identified stable, abstracted, reframed and omitted legacy stories. |
| Canipe and Gunckel (2020)<br>DOI: 10.1177/0022487119840660 | Mentor/preservice teacher interaction | Wenger CoP framework—group sense-making—three modes of belonging (engagement, imagination, alignment) | "teacher educators can act as brokers to create openings that allow preservice teachers to get their ideas on the table and participate with mentor teachers in group sense-making processes" |
| ** Chu (2022)<br>DOI: 10.1177/0022487121059161 | Sensemaking of district and university stakeholders in implementing teacher residency policy | Cites Spillane et al. (2002), Weick (Weick, 1995, 2005) and others including Coburn (2001) Qualitative case study | "teacher educator stakeholders primarily made sense of the residency by themselves when implementing the policy (*limited opportunities for collaboration*) … varied expectations and incoherent implementation, corroborated by residents' reported confusion and frustration." |
| ** De Luca Picione et al. (2022)<br>DOI: 10.1007/s42087-020-00128-4 | Sensemaking process of the experience of academic inclusion | Framework—semiotic narrative analysis—oppositional semiotic dynamics of the sensemaking process "The construction of meaning and its expression are based on a dynamic process based on the detection of differences and the emergence of a sense through opposition." Cites Greimas (1983) and others. Uses polar pairs of words as prompts … Also cites Linell (2009) | "The used semiotic narrative device allowed to observe, analyze, and discuss the process of sensemaking starting from the differential/oppositional relationships of meaning that we have triggered through the process of reversal of the narratives. In fact, the second narrative delivery, 'Turn your story into its opposite version. You are invited to turn your narrative upside down in its opposite, without believing |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| | | | that each meaning corresponds to an objectively valid opposite', has allowed a confrontation with the polysemy of meaning due to the infinite possibility of associating a single word and more precise and rich keys for the analysis of sensemaking processes." |
| De Voto et al. (2021) DOI: 10.1177/0022487120909390 | Educative Teacher Performance Assessment (USA) | Spillane et al. (2002) cognitive implementation framework plus other research relevant to studying the organizational will and capacity related to sensemaking. Also cites Weick (1995). 2 × 2—voluntary versus coercive design, high will/capacity versus low will/low capacity framework proposed | "stakeholders' sensemaking ... edTPA. as an inquiry based or a compliance tool" "complexities in the policy sensemaking process" |
| DeWart et al. (2020) DOI: 10.1177/1077800419838567 | Lugones's metaphor of world traveling in narrative inquiry | Lugones + narrative inquiry only | Identifying connections with others "shows openness to multiple ways of sense making and to creating texts where expectations are broken" |
| Elgayeva (2021) DOI: 10.1177/10778004211046271 | Vulnerability and change capacity (essay) | Uses the terms sensemaking and sensegiving but not references to sensemaking literature | |
| Etheridge (2022) DOI: 10.1177/10778004221093420 | Methodological "mattering" tool—word association as inquiry Understanding of academics and publish or perish | Deleuze (2004) understanding of sense—denotation, manifestation, signification, proposition/sense Bowden (2014) sense-event | "By putting three nonrepresentational concepts to work—becoming, sense, and affect—it is argued that word association tasks and the 'sense-event' they incur both highlight and interrogate taken-for-granted truths and ways of being." "As propositions emerge from common sense, any resulting good sense—including criticisms and hopes—will reflect the political and social order from which the common sense was formed" |
| *Finch et al. (2020) DOI: 10.1007/s11251-020-09518-1 | Sensemaking practices that break down disciplinary silos (Luminous Science) | Cites Dervin et al. (2018) Relational sensemaking: associative thinking forming connection between unrelated ideas plus reflective thinking. | "we found that about half of the groups across the classes used transdisciplinary sensemaking—that is the simultaneous use of both relational and mechanistic |

(Continues)

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| | | "What we will call relational sensemaking is then a combination of associative thinking, forming connections between seemingly unrelated ideas that may be nonsensical (Marshall & Donahue, 2014), and reflective thinking, drawing connections between pieces that together form a whole (Dewey, 1944; Rodgers, 2002), to make meaning of the phenomena via experiences, emotions, histories, cultures or values (Giladi, 2016)." | "(past a pre-sensemaking level) sensemaking practices." |
| Fiock et al. (2022) DOI: 10.1007/s11423-021-10,075-8 | Making sense of theory in instructional design | Collaborative autoethnography Cites Yanchar (2010) Also Weick | "we recognized that our sensemaking relative to ID theory was a process of acquisition, reflection, and interaction that would continue as we develop expertise." |
| * Flamand et al. (2022) DOI: 10.1177/13505076211990256 | Arts-based learning in management education | Uses Weick et al. (2005) | "We show that people can benefit from the potential of arts-based business learning when collective meaning-construction processes such as sensemaking or sensegiving can unfold and work in an iterative, active and intense way, to take people towards new experiences." "Students experience iterative sensemaking alongside the sensegiving provided by the instructors who used the students' zone of proximal development (Vygotsky)" |
| * Graham and Donaldson (2020) DOI: 10.1080/03075079.2019.1586867 | Academic leaders' response to volatility in HE (in terms of institutional logics) | Weick | "A conceptual Model of Strategy Choice by Higher Education Leaders is proposed to capture the dynamics between exogenous pressures and problems and leaders' choice of strategy, and decision-making. The model addresses two social processes (sense-making and decision-making) associated with reproducing and altering institutional logics. |

**TABLE A1**  (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| ** Hodge and Stosich (2022) DOI: 10.3102/0162373721079650 | Educator sensemaking of a complex policy environment | Organizational sensemaking (Weick, Spillane et al., Coburn) plus research on coherence (Honig & Hatch, 2004)—looking at sensemaking of multiple policies | Crafting coherence related to active sensemaking, with strength of accountability assumed to shape sensemaking. 'sense of overwhelm'—sense of incoherence when implementing many policies simultaneously" "sense of policy coherence (policies apparently aligned) but … lack of instructional change" |
| Ghousseini et al. (2022) DOI: 10.3102/0013189X211058751 | Teachers' sensemaking and collaboration | The recognition that professional learning contexts are characterized by actions and social modes of behavior leads us to view them as performances, in the theatrical sense, with scripts, actors, and spectators. A performance involves the display of skills or of culturally coded patterns of behavior that are loaded with intended and unintended meanings (Carlson, 2004; Schechner, 2020). The notion of 'fourth wall' is a performance convention, which originated as a play on the fact that stages are often surrounded by three physical walls. The fourth wall, then, is the invisible line that divides the stage from the 'house' where the audience sits | "Although awareness of the fourth wall in teaching and teacher learning does not (and should not) eliminate persistent tensions, it does make them visible, tangible, and part of the sensemaking educators can do together" |
| Haas et al. (2022) DOI: 10.3390/rel13020133 | Reactions to police-involved shooting | Cosmology Episode Model—understanding and interpreting catastrophes. Sense-losing (Orton & O'Grady, 2016) and sense-remaking to accommodate the trauma Cites Weick (various) | "Universality serves to remove a group member's sense of isolation, validate their experiences, and increase self-esteem by normalizing experiences, feelings, and thoughts related to racism trauma at community level interventions and in individual and group counseling settings." |
| * Hillmann et al. (2018) DOI: 10.1177/1052562918766350 | Role of scenario planning in management education—case based learning intervention with MBA students (with control group) Mixed methods (comparison study) | Sensemaking regarded as a resilience capability. Collective sensemaking (Rohrbeck & Schwartz, 2013) & Weick (1995) | The combined learning intervention positively influenced collective sensemaking and individual sensemaking "it supports individuals to be strategic bricoleurs by enhancing the individual capacity to interpret contradictory |

**TABLE A1**  (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| | | | messages and transform into a coherent overall picture" |
| Jonker et al. (2019) DOI: 10.1016/j.stueduc.2019.03.010 | Collaboration in teacher design teams (change and reform) | Cites Marz et al 2013 and Ketelaar et al. (2012) | The way in which teachers experience a curriculum innovation and the degree to which they implement change are determined by individual and social processes of sense-making. Teachers' interpretation and implementation of a curriculum innovation strongly depends on the congruence between their perceptions of the curriculum on the one hand and the rationale underpinning the curriculum on the other (Ketelaar et al., 2012; März et al., 2013). |
| Kaul et al. (2022) DOI: 10.1177/23328584221077303 | School principals' reactions to crisis—and district guidance | Organizational learning theory Sense-making (Coburn, 2001) | "together with existing literature our findings offer a deeper understanding of principals both as agentic sense-makers of district policies as well as leaders of their own organisations" |
| Kluge (2019) DOI: 10.1080/09500693.2019.1590881 | Students' processes of conceptual learning as interactive sense-making | Di Sessa & Sherin (co-ordination class) for conceptual learning | "the knowledge and presence of physical principles are instrumental for the students to make sense of their previous knowledge and experience when they use and discuss the simulation" |
| Lambert et al. (2020) DOI: 10.1037/edu0000425 | Participation of a student with autism into new mathematical standards (case study) | Sensemaking refers to the CCS for mathematical reasoning, sensemaking and discussion | "After the classroom intervention, along with additional scaffolds such as increased peer accountability and collaborative strategy shares, Oscar increased his verbal and nonverbal participation in both small- and whole-group discussion. Through our year-long study, Oscar shifted from a student who did not speak in math class to one who explained his mathematical thinking in multiple contexts." |
| Lee (2018) DOI: 10.1111/jade.12183 | Design thinking (for street market improvement) | Dervin (and Savolainen) | "by applying design thinking steps (Discovery, Definition, Development, Delivery), the double diamond model and sense-making methodologies" |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| ** Mackwordt et al. (2022) DOI: 10.1002/sce.21691 | Cross cutting concepts in science education (as used by science teachers)/Next Generation Science Standards: patterns, cause and effect: mechanism and explanation, scale, proportion and quantity, systems and systems models, energy and matte: flows, cycles and conservation, structure and function, stability and change) | Sensemaking for science Cites Odden and Russ (2019), Ketelaar et al. (2012), März and Kelchtermans (2013)—and group sensemaking including Coburn (2001). Also Rivet et al. (2016)—conceptual framework for thinking about enacting CCCs | Confirmed that using Rivet's framework—lens, bridge, tool, rules of the game—helped explain observation of teachers' use of CCCs—suggests that using these roles in CPD might help teacher sensemaking in understanding how to implement CCCs |
| * Manuti and Giancaspro (2018) DOI: 10.4473/TPM28.1.8 | Metaphors as sensemaking tools | Weick and Morgan (Images of organization) | "diatextual analysis and metaphor analysis specifically could allow a 'journey' inside the sense-making processes employees use to figure out their organisation" |
| McClain and Zimmerman (2019) DOI: 10.1080/21548455.2019.1584419 | Family based learning at science workshops in public libraries | Cites Zimmerman (2010)—sensemaking is a social effort between people that creates a shared understanding of new information. "We view family learning from a sociocultural perspective where parent–child interactions and sensemaking practices are the focus of our analysis. We analyzed three water quality-themed workshops held at public libraries consisting of 25 h of video data. With a focus on 17 participant family groups, we closely examined the influence of questions asked by three different scientists (each leading a workshop) to understand how the structure of these questions supported or did not support the families in sensemaking conversations." | "time for parent–child sensemaking" important Also the "think-pair-share dialogical pedagogical technique may be important" (Lyman, 1987) |
| Midha (2022) DOI: 10.1080/13603124.2022.2076287 | School leadership meetings that make sense | "principal meetings are conceptualized as interconnected sense-making episodes to analyze evidence from a five-month mini-ethnographic case study of the meetings of two elementary school principals in India." Cites Duffy and O'Rourke (2015), Weick (1995) and some other literature on meeting science (D&R meeting framework based on Weick ideas) | "principal meetings create sense and may have inherently frustrating aspects due to the messiness in clarifying ambiguity and the repetitions needed to enhance focus" "when the talk is mostly repetitive about what responsibilities, it is unlikely to develop a shared understanding of how and why such responsibilities acquire priority … for school improvement" |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
|  |  |  | "sensemaking clarifies ambiguity to create meaning but that meaning may not be an accurate reflection of reality or the right action to take" (agrees with Weick) |
| Minichiello and Hanks (2020) WOS:000561987400010 https://www.jjee.ie/latestissues/Vol36-5/10_ijee3963.pdf | Narrative writing as identity work in undergraduate engineering | Identity frameworks | "we identify and describe multiple instances of personal and professional identity recognition, role-based tensions, and identity re/construction and sense-making within participant narratives" |
| Moshel and Berkovich (2020) DOI: 10.1177/1741143218814007 | Early childhood education leaders' first experiences of mid-level management | Weick (also some educational research based on Weick) | "address ambiguity by sense-making and reframing of the boundaries of their role … three types of leader identity (found)" |
| Muller et al. (2022) DOI: 10.1007/s42087-022-00272-z | Managerial sensemaking during a crisis—how individual managers make sense of a crisis (not collective sensemaking) | Used Interpretative Phenomenological Analysis and existential Hermeneutic phenomenology. Cites Weick (1988, Weick, 1995) "Langenberg and Wesseling (2016, p. 222) note that although Weick refers to philosophy sporadically, his conception relates to philosophical insights that can be derived and point to parallels between Heidegger's work and Weick's retrospective sensemaking. Holt and Cornelissen (2014) suggest that Weick's sensemaking perspective is implicitly based on Heidegger (2001) phenomenology. Existential phenomenology, as Sandberg and Tsoukas (2015, 2020) mention, helps to preserve the unity of thought and action, avoiding the separation of subjects from objects, equipping us with a promising ontology." | "The managers make sense of personal crisis in three ways. The first type of meaning is based on the redescription of crisis as an opportunity for life change … new values can be discovered and relationships with other people can be developed. The second way … is to see it as an opportunity to change the managerial position …. Managers want to work in dignified conditions in ethically responsible companies. The third sense of crisis is formed in the context of using the development potential of the current managerial position" |
| Muñiz (2022) DOI: 10.14507/epaa.28.5235 | Making sense of socio-emotional skills in vague policy context | Cites Porac et al. (1989), Weick (1995, 2005)—also Spillane et al. (2002), Coburn (2001) Uses CASEL framework of socio-emotional skills | CASEL framework useful for participants in sensemaking about socio-emotional skills—what they are and how to articulate these skills. "First, the federal policy influenced the sensemaking process by establishing the |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| | | | local environment in which practitioners must operate … the role of the program leaders became crucial. Second, the practitioners articulated their understanding of SEL skills at the beginning of the program, displaying a partial understanding of the concept. Articulation is important in the sensemaking process because it helps make abstract understandings concrete (Weick et al., 2005). Third, in articulating the concept of SEL skills after the conclusion of the program, a conceptual framework (CASEL) was useful as an organizing scheme and in providing greater clarity, though a few practitioners reported experiences that the framework did not capture." |
| Naidoo (2019)<br>DOI: 10.17159/2520-9868/i77a01 | Impact of new educational policy (South Africa) on teaching and learning | Situated change—and sense-making, but no reference to theory—does refer to Spillane et al. (2002) Policy implementation and cognition | "The new ideas are subject to the danger of being seen as minor variations of what is already understood rather than as different in significant ways (Spillane et al., 2002). Situated cognition refers to how the individual agent's context is critical in shaping her or his sense of the change. A situated cognition perspective holds that the situation is constitutive of the sense making process." |
| Olmstead and Turpen (2017)<br>DOI: 10.1103/PhysRevPhysEducRes.13.020123 | Workshop design—pedagogical sensemaking (vs. doing school?) | Sandoval's conjecture mapping framework<br>Hammer, Vygotsky and Cohen (on learning)<br>Contrasts answer making with sensemaking<br>Pedagogical sensemaking deemed similar to science sensemaking (NRC 2007 report) | Contrasts effects of two different workshop facilitation strategies.<br>"our data suggest that many physics faculty have the capacity to engage both in doing school and pedagogical sensemaking and that workshop leaders who are attuned to these different modes of participation may be able to shift faculty into sensemaking" |
| Orucu (2021)<br>DOI: 10.1080/15700763.2020.1833044 | School leaders' responses to post-migration (Syrian refugees) | Weick<br>Post-migration ecology framework | Compared ethics of care, principal agency (active or passive) and sensemaking among principals in three countries<br>"school level navigation between policy |

(Continues)

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| | | | and practice is based on agency (*what is feasible in the setting*) and sense making" |
| Pederzini (2018) DOI: 10.1177/1056492617696891 | Leadership and power, paradoxes | "In other words, in our efforts to 'resolve the cognitive disorder created' by a world that was simply not designed to make sense (Balogun & Johnson, 2004, p. 523), human beings, through our ideas, have come to construct symbolic orders (Freud, 1929)." | Not immediately relevant to current analysis |
| Ozuem et al. (2022) DOI: 10.1108/QMR-07-2021-0092 | Critique of thematic analysis | "The first major element to note about thematic analysis is the link with qualitative data (Girei, 2013). Phenomenology uses qualitative approaches to undertake data collection; Denzin and Lincoln (2018) argued that qualitative researchers use interpretation to make sense of natural settings and meanings about individuals within various and different environments (lifeworlds). Similarly, Skinner et al. (2000) noted that qualitative approaches focus on people's experiences and the meanings they place on events, processes and the structures of social settings and lifeworlds." | "our framework adopts the perspective of descriptive phenomenology because to understand the multidimensional data in the burgeoning technological environment, we need to understand how our lifeworlds and contextual characteristics can be reassessed through our experiential interpretations" Dynamic thematic analysis—figure depicts circular processes of developing and refining categories, meaning-making and consolidation, scoping and excavation, data segmentation, manifestation and categorization. |
| Ramey et al. (2017) DOI: 10.1037/edu0000422 | Spatial reasoning/spatial sensemaking | Based on arts-enhanced STEM teaching (STEAM) | "Our analyses show that during making activities, students engaged in frequent and diverse spatial reasoning with a variety of social and material resources and that the social and material contexts of different making activities facilitated different types of spatial reasoning. Our analyses also show how spatial reasoning developed over time and led to learning" |
| Reyes (2021) DOI: 10.1080/03075079.2019.1586867 | School leaders' identities in ICT enriched landscapes | Weick Sense-making and identity creation from narrative inquiry | "The combination of *place* or the geopolitical nature of the challenges, *temporality* or the timing of responses to issues and *sociality* or the sense-making |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| | | | responses to obstacles, determines the fluidity of identities" |
| * Rom and Eyal (2019) DOI: 10.1016/j.tate.2018.11.008 | Educators (early childhood educators) making sense in complex policy environments (setting Israel) | Cites Kelchtermans, 2009, Ketelaar et al., 2012, Spillane et al 2006, also Coburn, 2001, also Weick, 1995 "at the core of sensemaking are questions of identity" Cites work on sense-breaking, sense-giving and sense-taking—analysis focused on sense-breaking, sense-giving, and sense-taking elements. | "By examining the policy's implementation as a distributed sensemaking process, our findings uncovered how educators externalized meanings, individually and organizationally, through shared interactions with others. From educators' perspective, they had made the necessary efforts to adapt to the policy, and yet they were left feeling that the policy process undermined them professionally." "Theoretically, our study contributes to research on sense-breaking, sense-giving, and sense-taking as a cohesive socio-cognitive process." |
| Schechter et al. (2018) DOI: 10.1080/15700763.2016.1232836 | School principals—sense-making of reforms, leadership metaphors | Weick, Maitlis & Christianson (review) and other organizational and management writings on sensemaking | "our central argument is that metaphors can represent and reflect administrators' efforts to make sense of a reform" "sense-making is about creating a holistic picture rather than being about finding the 'correct' answer" |
| * Sutherland (2022) DOI: 10.1177/0895904820925816 | School board sensemaking—of assessment policies | Cites Spillane et al. (2002), Weick et al. (2005) Uses theory of sensemaking as an analytic frame to understand sensemaking at local level and enaction/ implementation—refers to "hortatory policy instruments" | "Deviating from previous work on practitioner sensemaking, the participants' interpretations of assessments did not align with their ensuing use of the data. Furthermore, board members' use of assessment data diverged from both federal and state messaging, illustrating board members' synthesis and adaptation of external messaging into a locally driven narrative." |
| Van Niekerk and van Rensberg (2022) DOI: 10.1080/14697017.2022.2040572 | Middle managers' response to change (HEI in South Africa)—strategizing practices | Used Interpretative Phenomenological Analysis Strategy-as-Practice Research (various, including Balogun, 2015; Jarzabkowkski, 2008; Rouleau, 2005)—all these refer to sensemaking | "The IPA method, which acknowledges the participants' cognitive, emotional and physical nature, provided a holistic perspective to describe the research. The approach confirmed that strategising practices were not the result of actions only but were also influenced by |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| | | | cognitive, rational and emotional experiences and is therefore considered a valuable contribution of the study." |
| Vass & Deszpot (2017) DOI: 10.1016/j.tsc.2016.11.003 | Experience centered approaches in music teacher education | Body–mind "The simultaneously emerging philosophical and empirical work on bodymind point towards the fundamental role of embodied experience in sense-making, knowing and relating" Kokas pedagogy | "we found that students' journeys and conclusive reflections were mediated by the way they made sense of the otherness of the pedagogy." |
| Wagner et al. (2021) DOI: 10.1177/1521025119830945 | Hardship funding and student retention—how do students make sense of this support | Cites Weick (1993)—retrospective accounts of sensemaking, also students' sense of belonging (various authors, including Strayhorn, 2012) Also Bruner (1990) (stories) and Weick et al. (2005) | "themes that underpin a sense of belonging—family, community and a sense of worth" "highlights the sensemaking activities of student awardees whose interviews show their commitment to the institution, belief in themselves because of the institution's care for them and their commitment to paying it forward" |
| Wan et al. (2019) DOI: 10.1103/ PhysRevPhysEducRes.15.010117 | Born rule (quantum mechanics) | Mathematical sensemaking | "This paper demonstrates how the structural features of quantum notations framework can be applied to analyze how students make sense of quantum mechanics" |
| Watts et al. (2017) DOI: 10.1080/08989621.2016.1274975 | Ethics education—systematic review of qualitative evaluation methods | In the context of ethics, sensemaking involves activating and applying mental models—cognitive representations containing information such as knowledge of prior cases, norms, professional guidelines, and forecasts—to form responses to ill-defined, high-stakes ethical dilemmas (Mumford et al., 2008). | Conclusions concern best practice in conduct and reporting of qualitative research in ethics education |
| Wei and Wang (2021) DOI: 10.1007/s11191-020-00172-0 | Critique of presentation of science practice in textbook | Uses McNeill et al. (2015) classification of science practices—which has a broad category of sense-making | Sense-making practices (developing and using models, analyzing and interpreting data, constructing explanations)—much less evident than investigating practices in textbooks—problems for teachers. |
| Wild et al. (2018) DOI: 10.1108/JPCC-12-2017-0034 | Collective teacher agency (IB Physics teachers) using online tools | Cites Ketelaar et al. (2012) (agency and sense-making), März and Kelchtermans (2013) "Sense-making and structure ..." | "... has exercised collective agency, how the group members feel a sense of agency, and a condition they established to enhance their work" |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| Woulfin and Rigby (2017)<br>DOI: 10.3102/0013189X17725525 | Instructional coaches/teacher evaluation systems (review/essay format) | Collective sensemaking of reforms (cites Coburn, 2001 and Honig & Hatch, 2004) | Proposals only—to suggest that instructional coaching should be accompanied by teacher evaluation to broker ideas on reforms. |
| **Excluded studies (no access to full text)** | | | |
| Akella and Khoury (2022)<br>DOI: 10.1108/QROM-06-2021-2170<br>No access to full text | Transforming employee resistance into organizational learning (in an HEI) | | "This study utilizes the qualitative research method of auto-ethnography. Sensemaking auto-ethnographic narrative accounts of two change agents, internal and external is used to synchronize resistance and learning as well as reflect on the positive impact of organizational change." |
| Godejord et al. (2017)<br>WOS:000429975304144 (no full text)<br>Conference abstract only | Knowledge processes in networked environments | | "The theoretical research focuses on identifying sense-making activities leading to the engagement in what a community of learners needs to accomplish to create knowledge practice in digital environments. Empirical research focuses on analysing students' perceptions of networked learning and linking the analysed data to the outcome of the theoretical analysis." |
| Lawson et al. (2021)<br>Can't access full text<br>WOS:000709202200014 | Pre-service teachers' sensemaking about STEM | ? Coburn educators' sensemaking<br>? Maitlis & Christianson | |
| Louick et al. (2019)<br>No full text access | Examination of how teachers used a novel student-directed online literacy platform | | "This study uses sensemaking theory to investigate teachers' efforts to create order for themselves in a novel student-directed online literacy platform. Qualitative analysis focused on weekly log data from 20 teachers. Results indicate that approaches fell along a continuum, including instances when teachers reject autonomy, embed the platform in familiar teacher-centered approaches, promote students' future abilities to learn autonomously, or embrace autonomy. Some teachers demonstrate an inclination |

(Continues)

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
| --- | --- | --- | --- |
| | | | toward one extreme, but most blend approaches." |
| Mars and Hart (2022) DOI: 10.1108/SGPE-09-2021-0068 | Entrepreneurial sensemaking (graduate students) | Case study design, semi-structured interview No further details (only abstract available) | "A novel entrepreneurial sensemaking approach to the integration of entrepreneurial content with transdisciplinary curricula that is directly responsive to calls for graduate education transformation is introduced" |
| Martins et al. (2019) DOI: 10.1108/QRAM-03-2018-0018 (full text not available) | Storytelling and impression management—analysis of electricity company president letters through a period of controversial changes | "examines annual report letters from 1995 to 2013 using a methodological interpretative approach" | "By demonstrating how presidents use sensegiving as a means of legitimacy-claiming, this study adds to the literature on legitimating accounts. In doing so, this paper bridges the gap between theories about organizational legitimacy, storytelling and IM." |
| Tauginiene and Gaizauskaite (2022) DOI: 10.1080/08989621.2022.2044318 No access to full text | Examines the promotion of research integrity in HE | | "we discuss our findings in light of the structural symbolic interactionist approach and sensemaking theory. We conclude that encapsulated in challenging prerequisites of the national research integrity promotion work, the meaningfulness of such work emerges through integrating research integrity in all aspects of academic life to entail indispensable systemic changes in academia." |
| Van Es et al. (2022) DOI: 10.5951/jresematheduc-2019-0018 No access to full text | Maths education and equity for students | ? | "noticing of sociocultural selves, history of maths education …" |
| Vermeir and Kelchtermans (2020) WOS: 000537943800002 No full text in English—journal in Flemish | School improvement and negotiations | (Possibly Weick—but cannot get full text) | "drawing on sense-making, we show how the meaning—and the possible use—of the artifact changed and developed over time in response to changes in context" |
| Wilczewski et al. (2020) DOI: 10.1108/JGM-04-2020-0022 (full text not available) | Role of spirituality in missionary intercultural experience | "We used thematic analysis to establish spirituality in missionary experience, and narrative analysis to examine sensemaking processes." | "Narrative interviewing could be used to enhance missionaries' cultural and professional self-awareness, to better serve the local community. Their stories of intercultural encounters could be incorporated into cross-cultural training |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| | | | and the ethical and spiritual formation of students and future expats" |
| Excluded studies (no sensemaking theory, passing mention) | | | |
| Bhattacharyya and Nair (2019) DOI: 10.1108/JMD-01-2019-0032 | Future of work—qualitative research with positivist approach (India) | No sense-making theory | "Future jobs would have significant data dependency, and employees would be expected to analyze and synthesize data for sense making." (Notes substantial data to be sifted in future work) |
| Boveda and McCray (2021) DOI: 10.1080/09518398.2020.1771465 | Collaborative sense-making of mentorships and interconnected guidance | Passing mention of the term | "as we navigate a field that largely resists our culturally grounded ways of making sense of our work" (contributions of Black women in special education) |
| Gurkan and Golpancioglu (2020) DOI: 10.15390/EB.2020.8474 | Development of creative thinking skills in social studies course—through aesthetic creativity | No theory cited | "The codes included in the theme of creative thinking skills were imagination, product creation, sense-making, research, and idea generation." |
| Martinez et al. (2019) DOI: 10.1007/s11422-018-9900-2 | Contextual mitigating factors of STEM teaching successes | "emergent sense-making of the data" No sense-making theory per se. | Emphasis on CMF analysis |
| Rienties et al. (2017) DOI: 10.1080/02680513.2017.1348291 | Making sense of learner and learning Big Data (at Open University UK) | Uses the term sense-making but no reference to theory | "data wrangling provides strategic, pedagogical and sense-making advice to Faculties" |
| Rivera et al. (2020) Translation from Spanish DOI: 10.17811/rifie.49.3.2020.245-251 | Interview design—for examining learning to learn | No theoretical framework for sense making per se? | "The first step in the construction of the interview consisted of identifying three key categories from a rigorous theoretical analysis: sense making, coping with the uncertainty and self-confidence (Deakin Crick et al, 2004; Hautamäki & Kupiainen, 2014; Stringher, 2014)." |
| Slemming (2019) DOI: 10.5842/57-0-815 | Developing agency in a writing center | Social realist theoretical framework No specific sense-making | "human agency, as a sense-making concept …" |
| Stokes et al. (2017) DOI: 10.1002/tie.21843 | Emerging Market Economies operating in private HE in London | Theoretical framework of organizational ambidexterity Sense making—passing mention | "differing dynamics in relation to institutional frameworks and and sense making" |
| Stringher et al. (2021) DOI: 10.1080/00131881.2021.1871576 | Learning to learn/assessment relationship (see prior reference, Rivera?) | No reference to sense-making except as L2L requiring individual or group resources in a sense-making effort to update learning | |
| Supadi et al. (2021) | | No sensemaking framework cited. | |

**TABLE A1** (Continued)

| Author/ref | Topic | Cites | Notes |
|---|---|---|---|
| DOI: 10.1108/IJEM-08-2020-0408 | School principals' sensemaking of teacher evaluation (Indonesia) | | "In the sensemaking of teacher evaluations, (1) ranking teachers using a pattern of ascending list based on seniority, (2) rating teacher based on measurable aspects instead of observable aspects, (3) rating senior teachers higher than what they deserve and make this as an agreement with all teachers and (4) prioritizing the harmony of principal–teacher relationship and teacher–teacher relationship are employed." |
| Valle et al. (2021)<br>DOI: 10.1111/bjet.13089<br>(not directly relevant) | Learner analytic dashboards—systematic literature review | No sense-making theories cited by authors—cognition, emotion, motivation and behavior focus. Some of the included studies mention sense-making | "Out of the 1297 papers retrieved from 15 databases, 28 were included in the final quantitative and qualitative analysis. Results suggested an intriguing lack of alignment between LADs' intended outcomes (mostly cognitive domain) and their evaluation (mostly affective measures)." |
| Williams et al. (2019)<br>DOI: 10.1177/1362361317723836 | How pupils with autism make sense of themselves in the mainstream setting (qualitative metasynthesis) | Sense of self—as different (good and (mostly) negative aspects)<br>No sense-making theory cited | "This (diversity) highlights a need to examine whether certain ways of making sense of experiences in relation to the self and others are linked to better outcomes for self-esteem, sense of self-worth and mental health than others." |

TABLE A2 Group two health included and excluded studies (* = possible case study, ** = selected case study).

| Author | Topic | Cites | Notes |
|---|---|---|---|
| Burton et al. (2017) DOI: 10.1080/14780887.2017.1322650 | Quality of life research (paraplegia, etc.) | Combining photo-elicitation with Interpretative Phenomenological Analysis (method study) | |
| Brunton et al. (2019) DOI: 10.1111/jocn.14968 | Migrant nurses—communication and culture and acculturation (comparison of two settings) | Weick (1979, 2005) sensemaking lens used to understand how internationally qualified nurses (IQNS) make sense—reducing ambiguity and unpredictability in new settings—but only loosely applied as sensemaking | "As culture frames the way people understand and act, as they construct meaning for themselves through interpretation of events, the data suggest that a focus on more specific cultural insight needs of IQNs would assist in the process of reducing ambiguity when understanding is disrupted in a foreign environment." |
| Chen et al. (2017) DOI: 10.1080/17482631.2017.1350550 | Body listening, body awareness | Making sense of chronic illness—"sense-making and conveying what your body tells you in health care contexts" No reference to other sensemaking theories (strangely)—emphasis on body awareness, body listening | "We developed a platform for participants to share and collaboratively reflect on how they engaged in this dialogic process, in which participants contributed to a discussion on topics relating to body listening and body awareness." |
| * Despins and Wakefield (2020) DOI: 10.1111/jocn.15280 | Making sense of blood glucose data/diabetes self-management | Cites Dervin and Weick. Uses Mamykina et al. (2015)—framework (Adapting the sensemaking perspectives for chronic disease self-management—active and habitual sensemaking) | "There were three main themes describing how participants made sense of both the hypothetical and their glucose data and the influences on their actions:<br>• Classifying blood glucose data<br>• Building mental models<br>• Making self-management decisions" |
| Entilli and Ross (2021) DOI: 10.3390/ijerph18020564 | Suicide bereavement | Qualitative analysis. Refers to Stroebe & Schut dual process model | "search for answers and struggle to make sense"<br>"The oscillations between the sense-making and meaning-making phases observed at 6, 12, and 24 months confirm that the dual process model is an appropriate representation of the adaptation processes of bereavement as a dynamic and fluctuating process." |
| ** Lambert et al. (2019) DOI: 10.1111/1747-0080.12443 | Renal dieticians and treatment of end stage kidney disease | Used Dervin/Foreman-Wernet | "This suggests that both health literacy (the degree to which individuals can obtain, process and understand information to make informed health decisions) and patient empowerment (the psychological sense of control and efficacy that an |

(Continues)

**TABLE A2** (Continued)

| Author | Topic | Cites | Notes |
|---|---|---|---|
| | | | individual can manage their own health behaviours) are considered essential for patients to make sense of, and adhere to the renal diet" |
| Lin et al. (2021) DOI: 10.1177/0030222819868107 | Child sex abuse survivors' grief experiences after death of abuser | Used Interpretative Phenomenological Analysis (IPA) Participants sense-making the priority. | "Participants described sense-making regarding the abuser, their own personhood and their current relationships. For some, forgiveness helped with sense-making" |
| Rattray et al. (2018) DOI: 10.1186/s12909-018-1350-8 | Improving end of shift handoffs by residents | Cites Barach and Phelps (2013)—on clinical sensemaking—emphasis on the dynamic process of sensemaking—and the problems of institutionalized deviance from acceptable standards | "Formal education alone can miss the critical role of real-time sense-making throughout the process of handing off from one trainee to another" |
| Smith et al. (2018) DOI: 10.1136/bmjopen-2017-018624 | Experience of living with patello-femoral pain | Cites Aldrich & Eccleston—Making sense of everyday pain | Sense of loss (self and identity), confusion and sense making about pain |
| * Szulik and Cachia (2021) DOI: 10.15557/PiPK.2021.0028 | Doctors' professional identity and perceived well being | Interpretative phenomenological analysis Cites Weick (1995) and Eliot & Turns (demands and expectation of professional role vs. internal evaluation) | "Three superordinate theme clusters representing professional identity, personal identity, and sensemaking processes were identified from the data. The professional identity theme focused on data about doctors' characteristics such as benevolence and a sense of commitment. The personal identity theme distinguished different ways the participants thought and felt about themselves. The sensemaking theme, however, referred to the experience by the professionals' cognitive processing and cognitive dissonance (*worries and family/work balance*)" |
| Tagaki et al. (2022) DOI: 10.1007/s12124-022-09720-5 | Residents' meetings for policymaking for disability interventions (researcher with disability) | Cites Weick (and antecedent, Bruner (1986) on meaning making through narratives) | "my role in the RMs was to facilitate the creation of a movement wherein RM members could develop new perspectives in an imaginary context, as well as recognize the uncertainty and new difficulties related to the generation of prosperous narratives by strengthening the three goals of community organization. I further argue that the goals |

**TABLE A2** (Continued)

| Author | Topic | Cites | Notes |
|---|---|---|---|
| | | | were not something to achieve, but criteria through which to determine meanings." "If sense-making theory considers behavior and meaning as dynamic (Langenberg & Wesseling, 2016), the criteria and goals are not fixed and independent, but rather mutually dependent." |
| Zhu et al (2020) DOI: 10.1017/S146342362000064X | Living with diabetic lower extremity amputation | Used Interpretative Phenomenological Analysis | "four domains of sense making: physical loss disrupted normality, emotional impact aggravated the disrupted normality, social challenges further provoked the disrupted normality, and attempt to regain normality" |
| Excluded studies (no access to full text) | | | |
| Waterschoot et al. (2021) WOS:000657564500001 No full text available | Person-center care for persons with dementia in care homes—care staff sense-making | Used Interpretative Phenomenological Analysis | |
| Excluded studies (no sensemaking theory, passing mention | | | |
| Guo et al. (2020) DOI: 10.1016/j.midw.2020.102853 | Birth second child in China | Sense used mostly in terms of "common sense" Not relevant | |
| Sunthararajah et al. (2022) DOI: 10.1192/bjo.2022.542 | Comparisons of standard care versus "open dialogue" after mental health crisis | Approach pioneered in Finland. "Key aspects of open dialogue include continuity of care, immediate care, tolerance of uncertainty, dialogic practice and clinical meetings that involve patients' networks. A core feature of the open dialogue model is valuing individuals with 'lived experience' and therefore peer support workers are integral members of the clinical team." Interesting in the idea of open dialogue but no apparent link to sensemaking theories. | "There is good representation of the themes across both groups, although two themes ('having a choice and a voice' and 'confusion and making sense of experiences') are more represented in the open dialogue group." |

# APPENDIX B

Selected studies from Library and Information Science Collection, LISTA and WoS searches 2016–28 February 2023 on sense-making/sensemaking, knowledge management/complexity and sensemaking, selected communication studies (citing Dervin) plus reviews and studies identified in earlier updates (** signifies selected case study).

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
|---|---|---|---|
| Aanestad et al. (2016)<br>DOI: 10.1016/j.infoandorg.2016.02.001 | Information systems continual adaptation—collective mindfulness | Organizational sensemaking | (full text not available)<br>See Lichtner & Westbrook (below—similar authors, same topic) |
| Abbas et al. (2018)<br>DOI: 10.25300/MISQ/2018/13239 ** | Text analytics to support sense-making in social media | Cites Russell et al. (1993), Weick (1995)—passing reference to organizational sensemaking | Uses Winograd & Flores (1986) Language Action Perspective—pragmatics to analyze what people do, rather than what they say |
| Agarwal (2022)<br>http://InformationR.net/ir/27-1/paper922.html | Integrating models and integrated models: towards a unified model of information seeking behavior | Cites Dervin (various dates) | Theoretical approach, compares how a unified model maps to other approaches |
| Allard (2022)<br>DOI: 10.1108/JD-02-2021-002 | Settlement information practices of newcomers to Canada | Cites Mehra (2004), Kuhlthau (1991) and Dervin (1992, 1997) as influences on research design | Examined information practice, reflection and sense-making of others' stories of settlement |
| Anderson and Fourie (2017)<br>http://InformationR.net/ir/22-1/isic/isic1622.html | Palliative care—how caregivers understand empathetic care for the dying | Collaborative autoethnography (outsider and insider perspectives) | Cites Dervin's SSM as a possible method for analysis of visceral autoethnographic writing |
| Andrews et al. 2021<br>DOI: 10.1109/TEM.2021.3132798 | Technology transfer offices in universities—mediating between academics and industry by sense-making | Cites Weick (Weick, 1995, 2005)<br>Gephart (2010) | Ethnographic research, case study research—observation plus interviews. Considers Weick's "noticing and bracketing" and discusses that mediated sense-making may require "dumbing down" by TTO staff—developing understanding from different points of view (deliberate sense-breaking to enable sense-giving and sensemaking) |
| Ask et al. (2019)<br>DOI: 10.1080/1369118X.2017.1355008 | Online playing of World of Warcraft—how guilds develop practices | Collective domestication | Independent use of 'sense-making'<br>Participant observation plus interviews |
| Barrett (2022)<br>DOI: 10.1108/ITP-07-2019-0329 | Healthcare workers' communication for resilience during health information technology changes | Weick (1979)<br>Organizational sensemaking | Interviews as "communicative events"—allowing reflection and explanation |

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
|---|---|---|---|
| Bhappu and Schultze (2019) DOI: 10.1108/INTR-02-2018-0078 | Implementing an organization sponsored sharing platform as a corporate social responsibility (CSR) initiative | Weick (1995)—organizational sensemaking, sensegiving, sensebreaking (Maitlis & Christianson, 2014) | Interviews—little detail on methodology—examined how views developed about the sharing economy |
| Borge et al. (2018) DOI: 10.1007/s11412-018-9270-5 | Collective thinking among students and sense-making processes (computer supported collaborative learning) | Theories of group cognition (Stahl, 2006) and knowledge building (Scardamalia & Bereiter, 1996). | Design and evaluation of platform |
| Bowers and Krumm (2021) DOI: 10.1108/ILS-09-2020-0212 | Evidence-based improvement cycles using large, complex data sets (learning management systems) | Reference to previous similar education research using the term sensemaking—presents a theory of action for data-driven decision-making, educational data science and data use practices. | Relevant to information visualization and "making sense" Emphasis of data use for different purposes |
| Broad et al. (2022) DOI: 10.1007/s10460-021-10261-7 | Controlled environment agriculture (CEA)—consumer perceptions and sense-making | Dervin (1998) | Semi-structured interviews, grounded theory—CEA sense-making and good food sense-making |
| Bronstein (2020) DOI: 10.1108/JD-06-2019-0108 ** | Integration of migrants | Revisits Ager and Strang (2008) framework of migration using Gibson and Martin (2019) ideas on information marginalization and Dervin (1983, 1999) concept of resistance in sense-making | Interviews with intermediaries—inductive and deductive coding. Information resistance described as secrecy and disinformation—need for situational relevance, social connections and trust |
| Chang and Li (2020) DOI: 10.6120/JoEMLS.202007_57(2).0013. RS.AM | Tracking how SMM (Dervin, 1983) has influenced other researchers | Bibliometric analysis | SMM of interest largely to information behavior research, Gaps the most frequently cited concept, followed by situations, uses |
| Cuevas Shaw, 2021 DOI: 10.1002/leap.1350 ** | Scholarly publishing reactions to COVID-19 pandemic—discourse analysis of communications | Organizational sensemaking—Weick (1995), Maitlis and Christianson (2014) Also Holland (1992) on complex adaptive systems (CAS)—common behaviors | Discourse analysis of type of communication, purpose, style of discourse—analysis of organizational sensemaking—used CAS notions of evolution, aggregate behavior, and anticipation |
| Davies (2020) DOI: 10.1108/JCOM-08-2019-0120 ** | University communications practice | Cites Weick and Dervin—mostly focused on internal sensemaking on communications aimed at an external audience | Interest in "verbing" and the process of sense-making, in contentious areas |
| De Moor (2018) DOI: 10.3390/info9070151 | Development of a community network ontology for participatory mapping and sensemaking across communities | Collective intelligence for the common good—sociotechnical development initiatives Community of practice/Wenger (1998) | Participatory approach to network ontology |
| De Souza et al. (2021) DOI: 10.1108/JKM-05-2020-0392 | Knowledge management in health care organizations—development of integrative model | Choo (1996) sensemaking for knowledge management Also integrated notion of absorptive capacity | Qualitative research. Sense-making seen as belief-oriented processes, action-oriented |

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
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| | | | processes and development of shared meanings. |
| Dennerlein et al. (2020) DOI: 10.1108/ILS-09-2019-0093 ** | Design based research on informal workplace learning (healthcare setting) | Pirolli and Card (2005) (information foraging, and sensemaking loops) | Discusses rationale for design elements that support informal learning "appropriation of affordances" |
| Doppler Haider et al. (2019) DOI: 10.1080/0144929X.2018.1519036 ** | Intelligence analysis—and examination of evolving social networks | Draws on Klein data/frame ideas (2006a, 2006b) Analysis of analysts' sensemaking strategies | Emphasis on visualization design—guided by analysis of strategies used for sensemaking |
| Dorner et al. (2017) DOI: 10.1177/0340035217727554 | Integrating view of the future of libraries | Weick (1995) organizational sensemaking | Used Gephart et al. (2011) notion of future oriented sensemaking |
| Ferrara, 2017 http://InformationR.net/ir/22-4/rails/rails1612.html ** | Information practice of volunteer guides at a museum for contemporary art | Sensemaking (Dervin, 1992) as bridging the gaps Embodied sense-making—using the layout, previous experience to help with guide work | Dervin and Dewdney (1986) neutral questioning used in interviews Analysis of embodied sense-making |
| Ford, J. R. (2020). Beyond information behavior: PhD thesis. University College London https://discovery.ucl.ac.uk/id/eprint/10108688/ | Evidence based practice as sense-making in public health. | Used SSM—Dervin (several references) | SSM used in semi-structured interviews. Also used vignettes |
| Fu et al. (2023) DOI: 10.1108/JD-02-2022-0035 | International students' library experience | O'Brien (2011) on the links between user experience (UX), and information behavior—examining context and sense-making (Dervin, 1996, 1998). Ancona (2012)—sensemaking in a changing environment | For sense-making and narrative elicitation—used cognitive mapping and semi-structured interviews (also quantitative log analysis, not reported in this paper). Qualitative content analysis |
| Genuis & Bronstein, 2017 DOI: 10.1002/asi23715 ** | Sense-making—to regain "normality" in health crises/disruption (two studies compared/analyzed/integrated | Dervin SSM (study one) Online communities—for stigmatized conditions (study two) | Semi-structured interview plus "in the moment elicitation"—study one did not use SSM interview methods. Study two used content analysis. Used dialogic approach to discuss/compare interpretations gaps and of socially constructed normal—new normal |
| Giuliani, 2016 DOI: 10.1108/JIC-04-2015-0039 | How organizations make sense (sensemaking, sensegiving, sensebreaking) of intellectual capital measurements | Organizational sensemaking—cites Maitlis and Christianson (2014) review and Weick (1995) | Case study (management science) |
| Gomes et al. (2021) DOI: 10.1108/JKM-03-2020-0239 | Dispersed knowledge management—distributed sensemaking | Cites Weick et al. (2005), Maitlis and Christianson (2014) | Interviews with innovation managers, other relevant informants, document analysis. Multiple case comparison—within and |

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|---|---|---|---|
| | | Also "Theory base View" (Felin & Zenger, 2017) Ecosystem management | cross case analysis. Identified nurturing of distributed sensemaking. |
| Grassick, 2016 PhD thesis, University of Leeds. https://etheses.whiterose.ac.uk/13388/1/Grassick_LJ_Education_PhD_2016.pdf | Complexity, connections and sense-making: Stakeholder experiences of primary English language curriculum change in one province in Vietnam. | Discusses many theoretical approaches to complexity science in social sciences—including Weddell and Malderez (2013), Mason (2008) | Examined sense-making within layers and across organizational layers—considered "emergence" as a paradigm shift |
| Greyson, 2018 DOI: 10.1002/asi.24012 ** | Information behavior in contested areas such as health information | Dervin (1992)—and ideas about agency in information practice | Relates sense-making (Dervin) to information triangulation (verification, clarification and sense-making) |
| Guenduez and Mettler DOI: 10.1016/j.giq.2022.101719 | Analysis of development of government policies for artificial intelligence (AI) | Human sense-making as narration (Bruner, 1990) | Structural topic modeling plus qualitative narrative analysis |
| Harviainen and Melkko (2022) DOI: 10.1016/j.lisr.2022.101172 | Organizational information creation through playing organizational design card game, Topaasia® | Discusses Weick (Weick, 1995, 2003) and Dervin as complementary type of sensemaking—also considers information and knowledge creation | Analyzed video-recordings of card-playing sessions—examined turn taking, and "sense-breaking" required to create new information |
| Hasan et al., 2017 DOI: 10.1111/isj.12104 | Information systems and contribution to climate change activities | Independent use of the term deep sense-making Used activity theory as theoretical framework | Used CAR (variation of action research)—to identify potential contribution of information systems in boundary objects, information tools and activities |
| Hekkala et al. (2018) DOI: 10.1111/isj.12133 | Conceptual/cognitive metaphor use in employee sensemaking in an information systems project | Cognitive metaphor (Lakoff & Johnson, 1980) Organizational sensemaking (Maitlis & Christianson, 2014; Weick, 1995) | Qualitative case-study |
| Hickey (2017) DOI: 10.1080/10477845.2016.1273027 | How Catholic women seek information about a vocation to religious life | Used Dervin's SSM | Online survey, organized by framework informed by Dervin (context, gaps, bridges, and outcomes) |
| Hoarau-Heemstra & Kline, 2022 DOI: 10.1016/j.ecolecon.2022.107396 | Tourism—and experiences of operators in animal-based tourism | Dervin's SSM | Eco-feminist approach |
| Jivet et al. (2020) DOI: 10.1016/j.iheduc.2020.100758 | Student sensemaking of learning analytics dashboards | Cites Klein et al. (2006a, 2006b), also considers self-regulated learning ideas, learner goals and Verbert's learning analytics process model (2013) | Qualitative pre-study, followed by quantitative study and analysis |
| Kiesow et al., 2021 | How digital news readers make sense of the reading—and what benefits they perceived | Dervin's SSM Gibson's Affordances Theory | Used SSM together with Gibson's affordances theory |
| Kelly, 2021 DOI: 10.1080/01972243.2021.1897915 | Interview with Brenda Dervin | Reflection on Dervin's personal journey as a researcher, across the information and communication science domains | General development of Dervin's Sense-Making Methodology |

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
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| Koh et al. (2019) DOI: 10.1002/asi.24197 ** | Maker learning and information behavior in a technology-rich high school class | Refers to "information creating behaviour," guided inquiry in learning in maker-spaces Cites Dervin (2015) | Used visual process mapping and interviews informed by Dervin's SSM—how gap building occurs through making. |
| Lanham et al., 2018 DOI: 10.2196/jmir.9269 | Secure messaging in patient care | Information systems theories, complexity science Cites Dervin et al. (2003), Weick (1995) organizational sensemaking—and other authors on uncertainty management. Refers to "relationship building and sensemaking" for uncertainty management | Qualitative analysis of messages in threads: "(1) content analysis focused on uncovering general themes in the data and then developing subcategories under each theme, (2) systematic coding of the data, and (3) medical record auditing." |
| Lee and Meng (2021) DOI: 10.1108/JCOM-10-2020-0116 | Framework of digital competencies for communication professionals | Abstract mentions sense making Full text not available Likely organizational sensemaking | |
| Lekic et al. (2020) DOI: 10.47989/irpaper884 ** | Information behavior of top managers in a French telecommunications company | Two "constructivist" methodologies: sense-making methodology (Dervin, 1983) and grounded theory (Guillemette & Luckerhoff, 2012). | Used Dervin (2008) interviewing technique—identified sense-making situations |
| Li and Luo (2021) DOI: 10.1145/3447934.3447940 (abstract only) | Information security behavior and sensemaking | Organizational culture Organizational sensemaking | Theoretical framework for understanding security behaviors as outcomes of sensemaking—and how organizational culture enables an constrains sensemaking |
| Li & Todd, 2016 http://InformationR.net/ir/21-4/isic/isics1601.html | Makerspaces in public libraries—information practices during 3-D modeling | Dervin (1992, 1992) and Savolainen (1995) everyday life information seeking | Social constructivist approach—uses Dervin situation, gap, gap-bridging and help framework to guide interviews |
| Lichtner & Westbrook, 2019 DOI: 10.3233/SHTI190115 ** | Collective mindfulness and sensemaking in health IT implementation | Weick and Roberts (1993), Langer (1989), Sutcliffe and Vogus (2014) on mindfulness | Discusses manifestation of collective mindfulness and sensemaking—uses Aanestad et al. (2016) (above) as example |
| Lund and Ma (2022) DOI: 10.1108/AJIM-04-2021-0118 | Impact of the COVID-19 pandemic on information seeking by older adults | Cites Dervin, (various dates) and Williamson's Ecological Model of Information Behavior | Interviews—protocol based on Dervin (1998). Examined background information, situational factors that influence information seeking, types of needs or gaps and how/where bridged. |
| Madsen & Schmeltz, 2022 DOI: 10.1108/CCIJ-11-2020-0156 ** | Changes in the sensemaking of the purpose of internal social media in a public sector organization | Weick (1995) and Maitlis and Christianson (2014) review | Interviews, longitudinal research, analyzed composite narratives |

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
|---|---|---|---|
| Marchionini, 2019<br>DOI: 10.1108/ILS-06-2018-0049 | Searching for information, sense making and learning | Mentions Weick, Russell and Dervin (different approaches) | Theoretical framework linking information searching, sense making and learning |
| Marshall (2016)<br>www.yalsa.ala.org/jrlya/wp-content/uploads/2016/03/Marshall_Sex-in-the-Stacks.pdf | Teenager sex education information seeking behavior | Influenced by Dervin's ideas on context (Dervin, 1997) | Qualitative analysis of information seeking behavior/use of sources |
| McConnell, 2016<br>PhD thesis. University of Ulster. | Making sense of change communication during restructuring: a case study of a public sector authority in Northern Ireland | Combined Dervin (1984) with Weick (1995) | Case study in a public sector organization, emphasis on how change was communicated |
| Mesgari and Okoli (2019)<br>DOI: 10.1080/0960085X.2018.1524420 | Critical review of organization-technology sensemaking | Processes of individual and collective sensemaking and sensegiving in organizations, with respect to technology use (Weick and many more cited) | Proposes an ecological approach to studying organization-technology sensemaking, stressing role of the IT artifact |
| Miller (2019)<br>DOI: 10.25159/2663-659X/6999 | How media & publishing manage publishing "sensitive" information in South Africa | Draws links between "gatekeeping" and Dervin (1983) sense-making—in bridging uncertainty. | Analysis of publishing strategies, Dervin framework used—gap/uncertainty and bridging (role of publishers) |
| Mirbabaie and Marx (2020), "Breaking" news: uncovering sense-breaking patterns in social media crisis communication during the 2017 Manchester bombing.<br>DOI: 10.1080/0144929X.2019.1611924 | Rumor sense-making during Manchester bomb attack | Affordances of social media<br>Cites Weick et al. (2005) and Dervin (1998) | (abstract only, see below and also Stieglitz et al., same research team, similar topic) |
| Mirbabaie et al., 2022<br>DOI: 10.17705/1thci.00165<br>** | Rumor correction in social media crisis communication—connective sense-breaking (and role of emergency management agencies) | Organizational sensemaking (Weick, 1995, 2005) with emphasis on crisis communication (Heverin & Zach, 2012; Oh et al., 2015) | Distinguishes between connective action and collective action in sense-breaking/sensemaking. Social network analysis demonstrates the problems of correction tweet dissemination. |
| Mohyuddin et al. (2022)<br>DOI: 10.1108/JIC-01-2021-0031 | Expatriates from India working in Australia—and loss of intellectual capital | Sensemaking (Salancik & Pfeffer, 1978) individuals' sense of their environment and rationalization their behavior based on interpretation of the environment<br>Cites Weick (1993, 1995) | Interviews, using Weick framework for sensemaking—identity, retrospective reflection, socialization, extracting cues |
| Montesi (2022)<br>DOI: 10.1108/JD-03-2022-0056 | Everyday information behavior during COVID-19 pandemic at new "normal" stage | Used concepts around Local knowledge and Experiential knowledge—local knowledge (customs, lore, practices, expectations of the local environment)—experiential is personal lived experience.<br>Cites Genuis (2015)—lived experience | Draws parallels to sense-making (perhaps also information grounds)—collaborative and collective aspects of experiential knowledge |

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
|---|---|---|---|
| Nagaraj (2022) DOI: 10.1080/08956308.2022.2014718 | Sense-shaping by product managers in digital production innovation | Oduntan and Ruthven (2020) Cites Weick (1995, 2005), Maitlis and Christianson (2014), emphasis on prospective sensemaking and sense-giving (by middle managers) | Semi-structured interview technique (based on critical incident technique) to develop vignettes to illustrate that "Senseshaping is a dynamic, feedback-rich, contextual, and improvisational process of building understanding and commitment to action across the innovation stakeholder network" |
| Naveh & Bronstein, 2019 DOI: 10.1108/AJIM-02-2019-0049 ** | Sense-making in virtual health communities for diabetic pregnant women | Cites Dervin's SSM (Dervin, 1983, 1992) Uses Genuis and Bronstein (2017) | Deals with transitory complex health situation of sense-making |
| Nyambandi and de la Harpe (2022) DOI: 10.4102/sajim.v24i1.1588 | Social media affordances in sense-making and knowledge transfer | Dervin's (2003) individual and Weick's (1995) sense-making theories used alongside Szulanski's (1996) knowledge stickiness and Cohen and Levinthal's (1990) absorptive capacity theories | Little detail on methodology in published paper. |
| Oduntan and Ruthven (2017) DOI: 10.1002/pra2.2017.14505401034 ** (with items below) | Information gaps in refugee integration | Context influences on information behavior, Dervin et al. (2003) | Semi-structured interview, using Situation-gaps-outcomes metaphor from Dervin et al. (2003), also used micromoment timeline ideas |
| Oduntan, 2018 University of Strathclyde. Doctoral thesis. uk.bl.ethos.759477 | Information behavior in refugee integration | Used Dervin's SSM (Dervin, 2003)—sense-making with elements of everyday life information seeking (Savolainen, 1995) and information grounds (Fisher, 2005) | SSM used for interviews of the migration/integration journey (situations, gaps, bridges, outcomes), Observations/Shadowing in refugee agency Emphasis on situational information behavior |
| Oduntan & Ruthven, 2019 DOI: 10.1016/j.ipm.2018.12.001 | Information needs matrix | As above, used Dervin's SSM (Dervin, 2003) | Development of information behavior findings |
| Oduntan & Ruthven, 2020 DOI: 10.2307/48645206 | Situational information behavior—refugee integration | Dervin's SSM (Dervin, 2003) Situational approach (Clarke, 2005, 2018) Situation as both input and output Relates also to Sonnenwald (1999) | Analysis of data to identify macro- and micro situations affecting information use (time–space ideas of SSM) |
| Olsson (2016a) DOI: 10.1177/0165551515621839 ** | Embodied information practices of field archeologists | Dervin et al. (2003) sense-making Savolainen (2007) information practices | Ethnographic fieldwork and in-depth interviews (used Seidman, 1991 conversational approach to interviewing as well as SSM) |
| Olsson (2016b) DOI: 10.1080/00048623.2016.1253426 | Rethinking the concept of information users | Draws on Dervin's SSM, work of Michel Foucault and author's own research | |

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
|---|---|---|---|
| | | | Conceptual paper—advocates a more holistic approach, taking context, emotion and embodied practice into account. |
| Olsson & Lloyd, 2017 http://InformationR.net/ir/22-4/rails1617.html | Capturing vanishing embodied knowledge of classic car restorers | Dervin SSM (Dervin et al., 2003) Ethnographic research—interview plus observation | In concluding the interviews, the principal researcher used an interview guide incorporating elements of Dervin's sense-making methodology (Dervin et al., 2003), although the overall approach was also heavily influenced by Seidman's (1991) less structured, more conversational approach to research interviewing. |
| Oxborrow et al. (2017) DOI: http://InformationR.net/ir/22-4/rails/rails1619.html | Making sense of indigenous knowledge by non-indigenous librarians in New Zealand | Literature review informing the empirical research—that used SSM | More information on methodology in the doctoral thesis |
| Oxborrow (2020). "It's not just a professional development thing": Non-Māori librarians in Aotearoa New Zealand making sense of Mautaranga Māori. PhD thesis. Victoria University of Wellington, New Zealand. | Making sense of indigenous knowledge by non-indigenous librarians in New Zealand (how is the dominant culture aware of the gaps in culture and practice for non-dominant culture) | Dervin SSM (several references) | Used and critiqued Dervin's SSM for this setting, also organized focus groups to complement interviews |
| Pauleen and Snowden (2017) DOI: 10.1108/JKM-08-2016-0330 | KM and big data analytics (interview with Dave Snowden) | Appropriate use of big data analytics | Algorithms need to be combined with human knowledge and reasoning |
| Pereira de Souza (2021) DOI: 10.1108/JKM-0502020-0392 | Knowledge management in healthcare | Choo's KM cycles that incorporates sense-making (Choo, 1996) Also uses "absorptive capacity" | Case study on KM. The subcategories related to sense-making are belief-oriented processes, action-oriented processes, and creation of shared meanings |
| Pontis and Blandford (2016) DOI: 10.1002/asi.23427 | Making sense of how a scientific community in a domain is organized in order to understand "influence in academia" | Used Klein data/frame (2006a, 2006b) Compares Dervin (1999) and Klein | Tasks—HCI approach, think-aloud about "being influential and becoming influential." Used Klein's sensemaking activities (and added to them), compared novice and expert approaches |
| Reser and Bradley (2020) DOI: 10.1002/wcc.668 | The nature, significance, and influence of perceived personal experience of climate change (interdisciplinary review) | Cites Dervin & Naumer, 2009 | Sense-making seen as part of risk assessment in anomalous, uncertain situations (Review article) |

(Continues)

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
|---|---|---|---|
| Reynolds (2016) DOI: 10.1177/0165551515614537 | Guided discovery game design in school—sense-making and knowledge building among adolescents | Learning theories—constructionist blended learning, collaborative work by students. Collaborative sense-making as proposed by Paul and Morris (2011) Paul and Reddy (2010). Emphasis on collaborative information seeking practices | Qualitative video data: examines tasks (type of), collaborative information seeking modes, inquiry incident outcomes |
| Rice (2018) DOI: 10.1108/CCIJ-04-2017-0032 | Collaboration as sensemaking in high reliability organizations (e.g. emergency response) | Organizational sensemaking, Weick (1995) Maitlis and Christianson (2014) | Ethnographic approach, examining collaboration practice as sensemaking, taking account of hierarchical structure and collaborative processes |
| Rieh et al. (2016) DOI: 10.1177/0165551515615841 | Searching as learning—literature review | Refers to sensemaking (searching Pirolli/Russell) and data/frame sensemaking (Zhang & Soergel) | Identifies need for search systems that support sense-making and learning. |
| Mat Saat et al. (2018) DOI: 10.1108/AJIM-06-2017-0142 | Malay children's experiences of parental cancer | Social constructionism, learning theory and cognitive theory | Participatory action research, used Interpretative Phenomenological Analysis |
| Sacramento et al. (2022) DOI: 10.32655/LIBRES.2022.1.1 | Theory of vaccine hesitancy based on information encountering | Cites Erdelez (2000) and Pálsdóttir, and Dervin et al. (2003) | Used Erdelez and Palsdottir models to help understand the encounters and gaps, and used Dervin sense-making to understand actions taken |
| Sarkar et al. (2020) DOI: 10.1016/j.ipm.2019.102069 | Examination of information need—from studying perceived barriers and helps in different stages of information search episodes | Used Dervin's SSM (1976, 1988) to frame the study, together with Kari (1998) | Lab study of online searching of three tasks—analysis aimed at identifying the sort of "helps" required. |
| Sbaffi and Hargreaves (2022) DOI: 10.1108/JD-01-2021-0014 | Formation of trust for informal caregivers of people with dementia | Cites Dervin (2015) | Semi-structured Interviews (phenomenological approach) Developed a model of trust formation using Dervin's SSM and some aspects of system-centered paradigms |
| Seidel et al. (2018) DOI: 10.1057/s41303-017-0039-0 | Design principles for sensemaking support systems in environmental sustainability transformations | Uses Design Science Research approach Organizational sensemaking (e.g., Maitlis & Christianson, 2014; Sandberg & Tsoukas, 2015; Weick, 1995) | Conceptual development of information systems using organizational sensemaking principles |
| Shen et al. (2021) DOI: 10.1108/OIR-08-2020-0374 | Rumor spreading on social media—developing a multi-attribute model | Sense-making defined as the extent to which rumors are believable. | Not relevant to this review |
| Sirikul & Dorner, 2016 DOI: 10.1108/LR-01-2016-0008 ** | Thai immigrants' information seeking behavior during settlement | Used Mwarigha (2002) three stages of settlement, Dervin's Sense-Making Methodology (1998) | Situation-gap-use/help framework used in analysis, small case study |

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
|---|---|---|---|
| Stieglitz et al., 2018 DOI: 10.1111/1468-5973.12193 ** | Sense-making in social media during extreme events | Cites Dervin (1983, 1992) Klein et al. (2006a) Considers inter-subjective sense-making | Analysis of Twitter—structure and pattern of communications. social network analysis (participative sense-making) sentiment analysis (for intersubjective sense-making) |
| Strandberg and Vigsø (2016) DOI: 10.1108/CCIJ-11-2014-0083 | Internal crisis communication (suspected fraud) | Sensemaking among employees—cites Heide (2012), Weick (1995) | Semi-structured interviews among employees personally affected by the fraud. Thematic analysis—with care taken to ensure anonymity and privacy |
| Tan et al. (2020) DOI: 10.25300/MISQ/2020/11872 | Organizational sensemaking for ERP implementation | Organizational sensemaking—Weick, 1995; Balogun and Johnson (2005) on organizational change situations Maitlis and Christianson (2014) Refers to Klein and Dervin as well. | Distinguishes technical, social and contextual aspects of organizational sensemaking |
| Tao & Tombros, 2017 DOI: 10.1002/asi.23693 ** | Collaborative sensemaking in collaborative information seeking | Refers to several disciplinary approaches to sensemaking—focuses on collaborative sensemaking research (e.g, Paul & Morris) | Tasks for collaborative sensemaking—used screen recording, chat transcripts, questionnaires and post-task interview notes. Use the Zhang et al. (2008) model of sensemaking for mapping of findings. |
| Tomlinson (2016) DOI: 10.1002/pra2.2016.14505301120 | Perceptions of accessibility and usability by blind and visually impaired people | Used Everyday Life Information Seeking (Savolainen, 2009) and SSM (Dervin, 1992) | Used SSSM to frame the interview questions (semi-structured interviews) |
| Trabucchi et al. (2022) DOI: 10.1108/JKM-07-2022-0582 | Storytelling, story making to nurture organizational change | Organizational sensemaking Weick (1995) and Maitlis and Christianson (2014) | Story making as a sensemaking tool and roles of time, criticism and iterations. Longitudinal research |
| Valaei (2019) VINE Journal of Information and Knowledge Management Systems; Bingley Vol. 47, Iss. 1, (2017): 16–41. | Small and medium enterprises (SMEs), organizational structure, sense-making activities and SME competitiveness | Dervin (1998, 2005) Sense-making and "knowledge quality" (various authors) Also Klein et al. (2006a, 2006b) and Weick et al. (2005) | Questionnaire survey Proposes that the concept of Knowledge Quality is related closely to sense-making (Dervin) Focus on knowledge management and the influences of organizational structure. |
| Waldner et al. (2021) DOI: 10.1177/1473871620986249 | Linking unstructured evidence and structured observations Sensemaking in information visualization—system design | Russell et al., 1993 Pirolli & Card, 2005 | Assessment of reactions to observation graph-controlled study, plus interviews (HCI) |
| Wu et al. (2022) DOI: 10.1108/EL-06-2021-0123 | Developing model of searching on academic social networking sites—with emphasis on learning | Cites research on searching as learning, sensemaking and learning (Russell, 1993; Zhang et al., 2008) | Constructs theoretical model |

| Author/DOI or brief reference details | Topic | Cites/general approach | Notes (on methodology) |
|---|---|---|---|
| Wylie Atmore (2017) http://InformationR.net/ir/22-4/rails/rails1613.html | Sense-making of people playing tabletop role playing games | Based on Dervin—rules-story gaps (Dervin, 1998) Games research: "mechanics and fluff" | Sense-making conceptual framework for interviews, thematic analysis |
| Xia et al. (2017) DOI: 10.1515/jdis-2017-0009 | Seeking health information online—how problematic situations moderate user intentions | Combines Theory of Reasoned Action with Dervin's sense-making (for problematic situation) (1983, 1992) | Questionnaire analysis |
| Yeomans and Bowman (2021) DOI: 10.1108/JCOM-11-2020-0130 | Internal crisis communication in universities during COVID-19 | Sensegiving (Sandberg & Tsoukas, 2015) And others (Maitlis & Christianson, 2014) | Social constructionist approach Rhetorical discourse analysis of meaning making. Builds on Heide and Simonsson (2015) on internal crisis communication |
| Yeon and Lee (2021) DOI: 10.47989/irpaper914 | Employment needs and information behavior of North Korean refugees | Dervin (1973, 1983, 1987, 1992) Situation-gap-use framework | Semi-structured group interviews Content analysis based on situation-gap-uses |
| Yip and Lee (2017) DOI: 10.1057/kmrp.2015.28 | Use of a group reflection and inquiry protocol for knowledge elicitation and organizational development | Based on adaptation of a knowledge elicitation framework for structured business process toward unstructured business processes | Aimed at knowledge elicitation of experiential knowledge—use of inquiry tools and knowledge display (no full text—full text for earlier article consulted) |
| Zhang and Soergel (2016) DOI: 10.1177/0165551515615834 | Process patterns, changes in knowledge representations during information seeking and sensemaking | Considers Russell et al. (1993) model, Klein et al. (2006a, 2006b) data/frame alongside learning theories (assimilation theory, schema theory, generative learning theory)—uses Zhang and Soergel (2014)—Klein a major influence. | Think-aloud of academic tasks for students, plus analysis of their document notes—identification of gaps (data/structure)—changes in knowledge (accretion, tuning, restructuring). |
| Zhang & Soergel, 2020 DOI: 10.10002/asi.24221 | Cognitive mechanisms in sensemaking | Uses Zhang and Soergel (2014) (comprehensive model of sensemaking)—derives from Klein et al. (2006a, 2006b) data-frame sensemaking plus learning theory ideas around schema | Think-aloud and similar methods, using screen movements, notes—qualitative analysis |
| Zhong et al. (2023) DOI: 10.1108/JD-02-2022-0044 | Systematic review of information practices research | Mentions three studies used sense-making | Incorporated cited studies into table. |
| Zimmerman & Land DOI: 10.1007/s11412-022-09366-w | Mobile learning intervention to support children's collaborative sense-making | Cites previous research by authors, Eberbach and Crowley (2017) on sensory observation in science | Discusses "collaboration scripts" as learning supports for conversational sense-making |

## APPENDIX C

**TABLE C1**   Case study analyses Information Science.

**Abbas et al. (2018)**

| | |
|---|---|
| Identified gaps | Improved social media analysis tools that can properly analyze messages and threads—keyword, topic and sentiment analysis not really sufficient |
| Research questions | Development and trial of a Language Action Perspective framework for analyzing the purpose of communication within the conversation—disentangling the conversation |
| Research framework | Winograd and Flores (1986) (Computers and Cognition)—set out Language Action Perspective—relates also to Searle's Speech Acts (assertive, commissive, expressive, declarative, directive) |
| | Also examines coherence analysis techniques (automated methods such as linkage, heuristic, classification) |
| Research design | Design science with LAP text analytics framework |
| Sample | Organization's discussion threads (web forums, Facebook & Twitter) |
| Methods | Development, trial and evaluation |
| Analysis | Examined each component of the system |
| Findings (with emphasis on sensemaking methodology) | Winograd & Flores—noted interplay between conversations, interactions and message acts. Need to identify conversation beginnings. Contextualization and lexical chaining—conversation disentanglement and coherence analysis |
| Personal reflections by review author (CU) | This was a large-scale trial to automatically do sense-making among discussion threads, social media, web forums. I can appreciate the problem having done some analysis of a virtual patient support forum to check what type of impacts that forum provided to the participants. Conversation disentanglement, sorting out whether the support offered was emotional/social, whether one of the participants then committed to action—it was all there. |
| Methodology implications | The interest in this is probably less the automated text analysis system development, more the principles of operation, and examination of the purpose of the participant's messages (assertive = represents facts of the world, commissive = speaker commits to future action, expressive = speaker says something about feelings or attitudes, declarative = speaker brings about changes (pronounces, verdicts), directive = speaker gets the hearer to do something). There's a huge amount on Twitter sentiment analysis (Foolen review for example) but less work on assessing whether it is possible to assess at least some aspects of the speaker's intent. |

**Bronstein (2020)**

| | |
|---|---|
| Identified gaps | How do those working with migrant communities make use of information in day to day work? |
| Research questions | How do intermediaries view integration, what it involves, and how it is achieved? |
| Research framework | Ager and Strang (2008) model of integration—critiques this with reference to Gibson and Martin's "information marginalization (2019)—information marginalization that describes the systematic, interactive socio-technical processes that can push and hold certain groups of people at social 'margins', where their needs are persistently ignored or overlooked" (focus on institutions unlike Chatman's information poverty)—and Dervin's notion of resistance (1999)—"assumes that articulation of one's lived experience including its struggles and resistances as well as alignments with given order is in itself a Sense-Making journey" (p. 742). |

(Continues)

**TABLE C1** (Continued)

| | |
|---|---|
| **Bronstein (2020)** | |
| Research design | Qualitative research |
| Sample | 10 intermediaries, working with migrants at NGOs or public institutions (no differentiation between types of migrants) |
| Methods | Semi-structured interviews |
| Analysis | Deductive and inductive analysis using frameworks |
| Findings (with emphasis on sensemaking methodology) | Ager & Strang—markers and means, social connections, facilitators, and foundation (must have these for integration)—this didn't occur in this study |
| | "This discontinuity or gap can be resolved through information seeking and sense-making can take place. However, humans face many barriers and constraints that block the sense-making process and bring them to resist or challenge the information encountered (Dervin, 1992). I would argue that during the integration process, migrants face discontinuities or gaps in all aspects of their lives and need to bridge these gaps by acquiring sociocultural and language knowledge of their host society." |
| | Information marginalization—associated with lack of cultural knowledge, lack of language proficiency, living in an unsafe and insecure environment, and discrimination. |
| | Information resistance—"The purpose of secrecy is to guard against disclosure, which results in people not being receptive to advice or receiving information" The problem of disinformation—migrants distrusting information from outsiders and preferring possibly unreliable information from insiders. Such resistance can be overcome through making information 'situationally relevant' and social bonds with migrant community—their leaders, for example, NGOs, churches—trusted gatekeepers. Need to overcome socio-cultural gaps |
| Personal reflections by review author (CU) | Extensive literature review on theories around migration and settlement—justified choice of theoretical frameworks, and fairly novel use of Dervin's concept of information resistance. The latter worked as it avoided problems of inbuilt bias that might occur when looking specifically for information marginalization, and helped to explain why some intermediaries have to work hard to overcome distrust among migrants—to make the information situationally relevant and credible. |
| Methodology implications | Theoretical frameworks relevant to the situation of study, justified use, and related to existing IS frameworks (Chatman's information poverty). Helpful to think of situation constraints that may hinder sense-making, and instead of "barriers and facilitators" to think of creating situational relevance. |
| **Cuevas Shaw (2021)** | |
| Identified gaps | How did the scholarly communications organizations respond to the COVID-19 pandemic? (given the changes already taking place around open access, changes to the funding model for journals) |
| Research questions | How did scholarly publishing react to the pandemic—to support researchers and the public? |
| | What do policy statements reveal? |
| | What patterns of organizational sensemaking evolved? |
| Research framework | Systems approach, used Holland's (1992) characterization of CAS—with emphasis on evolution, aggregate behavior, and anticipation (and process of emergence of these qualities) |
| | Discourse analysis—examining language and style of public discourse |
| | Examined sensemaking, sense-giving, sense-breaking (Weick, Maitlis & Christianson) |
| Research design | Qualitative analysis |
| Sample | Studied different types of document for analysis press releases, dedicated blogs, substantive website updates using analysis of the policy discourse for identity building, relationship building, politics building and positioning vis a vis existing big debates (i.e., open science movement) |

**TABLE C1** (Continued)

### Cuevas Shaw (2021)

| | |
|---|---|
| Methods | Assembled a dataset of relevant documents (via NISO landing page on COVID-19). Data coded relative to questions (1) support offered/actions taken (Activity coding); (2) presentation of the organization's response—language choice, style of discourse, orientation, positionality (Discourse analysis); (3) evidence of patterns of organizational sensemaking |
| Analysis | Focus on actions, perspectives and language use (use of qualitative data analysis software)<br>NB Only a small sample of the copious amount of documents produced during this time—and no account taken of reactions to those policy statements |
| Findings (with emphasis on sensemaking methodology) | Offerings in response to the crisis—accessibility, aggregation, enhanced discoverability, free access, new collaborations, new content/products/services, research support, revision of existing business rules<br>Primary functions of the press releases—identity building, relationship-building, agenda-building, problem-solving—also categorized style of communication.<br>Organizational sensemaking: (1) to construct a distinct organizational identity and active role; (2) to make sense of the situation through action; (3) social constructed approach to collaboration and partnerships—context setting, explanation of the needs for learning, research, etc.<br>Sensegiving—setting out a vision, to demonstrate leadership<br>Sense-breaking—removing barriers, allowing multidisciplinary approaches |
| Personal reflections by review author (CU) | Careful analysis to examine how the policy statements reflect various aspects of discourse—need to bear in mind that these have been carefully crafted for impression management—do they mean what they say and do they say what they mean?<br>Might have been desirable to be a bit more explicit about the rationale for the type of discourse analysis method chosen (given that discourse analysis means different things to different disciplines). I would have liked more justification for the method given the problems of "policy discourse"—what is (really) connoted in what is denoted? I think the discourse analysis here is more about the framing of the statements, rather than the content per se (although there's a lot to be noted about use of the adjective "free" in relation to information resources). Of course—once one major publisher announces that free access will be provided, others have to make similar responses. The different time periods offered (if these were stated) suggests the "probe, sense, respond" of Snowden's sense-making for the complex domain, although likely that some publishers might consider themselves in the chaotic domain "act, sense, respond." They were already making changes toward open science and the current situation seemed to demand more of the same, but faster—more remote access, more remote learning, high demand for research information. |
| Methodology implications | The discourse analysis approach, plus the organizational sensemaking, sense-giving, sense-breaking, did help to frame the discussion on whether the collective response of scholarly publishing did exhibit some features of complex adaptive systems—fast evolution, aggregate behavior (how is the system operating as a whole) and there seemed evidence of some anticipation (awareness that the future would be different, demanding changes in some operating norms).<br>Again, interesting use of a method of discourse analysis and a method for looking at Complex Adaptive Systems with sensemaking (but there are other approaches that might have been cited). |

### Davies (2020)

| | |
|---|---|
| Identified gaps | How do staff within the organization react to campaigns aimed at external audiences? |
| Research questions | In-depth qualitative study of university marketing practices and the effects these have within an organization |
| Research framework | This article offers an in-depth exploration of university communications practice by describing and analyzing a publicity and recruitment campaign, called "Challenge Everything," carried out by the Norwegian University of Science and Technology (NTNU) in 2018. By |

(Continues)

**TABLE C1** (Continued)

| | |
|---|---|
| **Davies (2020)** | |
| | providing insight into internal sense-making around the campaign it contributes to literatures in science communication and communication management. |
| Research design | This qualitative research uses semi-structured interviews and informal organizational ethnography, mobilizing concepts of sense-making and auto-communication to guide analysis. The focus is on how organization members made sense of the Challenge Everything campaign. (Note: Bonnie cannot see the exact interview questions, although enough description text assures me the experiences were drawn out in highly contextual way). |
| Sample | 10 members of staff |
| Methods | Interviews, ethnographic research |
| Analysis | Textual analysis |
| Findings (with emphasis on sensemaking methodology) | 1/ Called out contradicting views 2/ recognize the context is changing and it is a dance (i.e., to shape and to be shaped) 3/ allow new insights to emerge 4/ not everyone needs to agree to the campaign |
| Personal reflections by review author (BC) | 1/ What is missing to me is an example of the questions being used to conduct the interviews and also to do self-ethnographic observations. 2/ from the descriptive text, I believe there is a genuine openness and honesty that the university want to understand, and willingness to hear any surprises 3/ recognizing interviewees' unique context and invite diverging voices appears to be the methodological framework behind the research 4/ I think it shows the researcher has the intention to open the space to allow topics/feedback to emerge without pre-defined assumptions |
| Methodology implications | Would be nice to see to what extent Dervin's SMM questions and timeline interviewing techniques are being used. Overall I could consider this is a piece of sense making research. |
| **Dennerlein et al. (2020)** | |
| Identified gaps | How to use affordances when doing design-based research (DBR) for workplace learning—Theory gap of understanding the sensemaking process in informal learning (claims sensemaking has not been studied in experiential learning) |
| Research questions | Research phases of contextual inquiry, concept creation, co-design scenarios and wireframes, low fidelity prototypes, co-design workplace iteration |
| Research framework | Extending DBR—domain, theory and design for workplace learning in the health sector<br>Design and appropriation of affordances—for traceable design of cognitive tools<br>Turning information into action-oriented knowledge—sensemaking (Pirolli & Card, 2005)—information foraging loop and sensemaking loop |
| Research design | Co-design development and reflection |
| Sample | General practitioner practices in the UK—used for concept creation of the informal learning (collecting "bits and pieces" in a box file) |
| Methods | Followed the phases as listed in the research questions (above). Required understanding of the domain, design problem (lack of time to support, elaborate, document and share informal learning), design iteration phases—conceptual prototype to paper prototype to functional software prototype (with evaluate loops). |
| Analysis | Analyzed which of the intended affordances were appropriated in the field, which were not, and why. Used qualitative content analysis in each co-design iteration. |
| Findings (with emphasis on sensemaking methodology) | Relates the collection of experiences (box file)—for recall and elaboration to information foraging and sensemaking loops—the design work concentrated on the latter. Referred to Eraut's differentiation between reactive and deliberate informal learning—sensemaking allows |

**TABLE C1** (Continued)

**Dennerlein et al. (2020)**

| | |
|---|---|
| | meaningful relations between past and future experiences (in two ways). Affordances—to be able to re-find notes and recall the experiences, to record experiences on the run and reflect as and when, to reflect on collected note and then annotate it, to recall reflected notes based on semantic cue retrieval, to build subset of notes for sensemaking, to visually organize collected notes, to enable hands on reflection, to collaboratively make sense of experiences (meaning making). |
| Personal reflections by review author (CU) | Interesting perspective on selecting particular affordances that were action possibilities for a sensemaking process. Continual need to recheck and return to previous use of tools—hence the emphasis on the traceability loop. |
| Methodology implications | Links perceived and "practical" affordances with sensemaking loops of foraging and sensemaking. Perhaps relevant to Rieh et al. review of searching and learning. |

**Doppler Haider et al. (2019)**

| | |
|---|---|
| Identified gaps | How do users (intelligence analysts) work with information visualizations—To make sense of criminal social network development—What are their possible sensemaking strategies? |
| Research questions | How does design influence insight generation? How is temporal development, and weighting (seriousness of crime) best presented? Research question RQ1 covers the sense-making aspect, research questions RQ2-RQ5 the aspect of utility (e.g. how well co-offender relationships represented?) |
| Research framework | Klein (2013) extended data/frame model to explain how insights can be achieved—the Triple Path Model that contains three possible ways to gain insights—Connection, Contradiction and Creative desperation (Klein, 2013). Seeing What Others Don't—The Remarkable Ways We Gain Insights. New York: Public Affairs, Perseus Book Group) |
| Research design | Qualitative (think-aloud session analysis) (13 protocols) and quantitative (completion times and swopping behavior)—done for all 31 participants |
| Sample | 13 intelligence analyst protocols examined node-link diagram and/or matrix |
| Methods | Think-aloud sessions, participants allowed to choose their favorite visualization, and then freely switch between the two |
| Analysis | Qualitative content analysis |
| Findings (with emphasis on sensemaking methodology) | Connections—mostly searched via the NL diagram and the matrix—more for Trend assessments (both the top two strategies). Another strategy—third most common strategy, Storytelling—elaborated understanding through own imagination. "They gained new knowledge using strategies such as Comparison, Creative desperation, Contradictions and Coincidental Aha's." For Elimination need to focus on specific visual analytics, for Verification—several visualizations used as a cross-check. The Comparison sensemaking category was about the middle—with less inter-coder agreement than the other categories. |
| Personal reflections by review author (CU) | Interesting analysis of sensemaking of different information visualizations. The Storytelling sensemaking category—used by some, but not all analysts—working hypotheses, looking for evidence—this seemed to act as a frame (essentially). More information either confirmed the hypothesis or else the hypothesis was abandoned. |
| Methodology implications | Coding extended the Triple Path Model of Klein—more strategies emerged. In fact, Connections was the most frequent strategy, and Contradiction and Creative Desperation the least frequently used of the 9 sense-making strategies developed. Think-aloud sessions seemed to be successful and could be coded consistently—some "technical problems"? Previous research by this team used the data/frame model of Klein to analyze transaction logs. |

(Continues)

**TABLE C1** (Continued)

| | |
|---|---|
| **Ferrara (2017)** | |
| Identified gaps | How do voluntary museum guides integrate the information obtained from training and preparation provided for exhibitions? |
| Research questions | How did the guides communicate their modes of preparation? What did they do to prepare themselves? How do they perceive the relationship between themselves and the public? |
| Research framework | Information practice, using: Dervin and Dewdney (1986) neutral questioning, Dervin (1992) sense-making of experience Talja (1999) Discourse analysis—interpretative repertoires |
| Research design | Qualitative, case study. |
| Sample | Voluntary guides at Museum of Contemporary Art, Sydney, Australia, of varying years of experience (at least 1 year). |
| Methods | Semi-structured interviews ($n = 6$)—trying to allow interviewees to reconstruct their thought processes and experience of those processes |
| Analysis | Discourse analysis—identifying patterns of consistency and variation (Talja, 1999 followed) |
| Findings (with emphasis on sensemaking methodology) | Identified the following outcomes of the sense-making processes: (1) dealing with the voice of the artist—what they learnt and what they thought should be conveyed; (2) voice of the curator; (3) embodied sensemaking—walking through their tours, mentoring, shadowing, visits to other galleries; (4) information use—deciding on likely audience response |
| Personal reflections by review author (CU) | The research attempted to take one step back—to understand why the volunteer guides might want to say what they did, in the way that they phrased their reflections. They weren't recent critical incidents, probably reflections that had been baked and then arranged, selected for presentation? They also reflect conversations with other volunteers and museum staff, and assumptions about the purpose of museums, views about contemporary art. |
| Methodology implications | An example of using a type of discourse analysis but only really possible for a small number of interviews. A different take on what we mean by "situation." |
| **Genuis and Bronstein (2017)** | |
| Identified gaps | How do people with chronic disease come to terms with a new "normal"? What constitutes "normality" with sense-making? |
| Research questions | Examining perceptions of normality from two studies of information behavior "How might the search for normality be theorized in the context of sense-making theory"? |
| Research framework | Dervin (1999) furthermore has noted that "we know little about information seeking and use in the terrains that require new connections, insightful extrapolations, and the hundreds of different strategizings humans do to bridge gaps between formal information … and the necessities of moving into the future in their material worlds (p. 741)" Also refers to Godbold (2013) study of sense-making by a group with compromised health status |
| Research design | Re-analysis of existing studies that were influenced by sense-making ideas |
| Sample | Studies were: (1) on information behavior of women around the menopause (by first author) and (2) online discussion groups of people with OCD (by second author)—both life disrupting challenges Data set one did not use SSM interviewing methods, data set two was analysis of text comments in a virtual health forum |
| Methods | Content analysis of existing qualitative data |
| Analysis | "Focused inductive coding was conducted separately on the two data sets to determine explicit and latent content pertaining to normality and to identify initial themes" —by respective authors of each data set. Aimed to keep within SSM principles on looking at processes: "emerging |

**TABLE C1** (Continued)

**Genuis and Bronstein (2017)**

|  |  |
| --- | --- |
|  | themes and supporting data from the individual studies were examined jointly and iteratively by the authors, using the metaphor of gap-bridging and sense-making as a guiding theoretical microscope" "themes and supporting data were re-examined jointly by both authors" |
| Findings (with emphasis on sensemaking methodology) | Authors note limitations that the participants in both studies perhaps more likely to voice or post comments and queries than the general population of such groups. Identified a no-illness normal, breakdown of normal, socially constructed normal and new normal. "Findings rendered an iterative model that demonstrates the search for normal as a 'journey' or process undertaken by people who are making sense of life-disrupting challenges" Note the importance of experience and dialogue in sense-making |
| Personal reflections by review author (CU) | Looking at the process of gap-bridging. Like the Naveh and Bronstein (2019) study—this does emphasize the importance of individuals making sense with others. Perhaps a type of collective sense-making? |
| Methodology implications | Neither study used SSM interviewing methods—could greater insights might have been obtained if, e.g., the health forum moderator had used full dialogic principles? But shows that some processes of gap-bridging can be identified through re-analysis of information behavior data sets. |

**Greyson (2018)**

|  |  |
| --- | --- |
| Identified gaps | Is triangulation part of everyday life practice—Using sense-making? |
| Research questions | How did young parents' health information practices emerge and develop? How do young parents assess information for potential use in their lives? |
| Research framework | Dealing with contested knowledge/construction of authority Agency and information practice (determinant of action or decision-making, relationship to self-efficacy—constraints and enablers on information use/decision making) |
| Research design | Constructivist grounded theory study |
| Sample | Young parents in the Greater Vancouver region of BC, Canada. Purposive sampling from observation sites, plus additional theoretical sampling to test and refine emergent categories/ |
| Methods | Ethnographic observation and interviews (individual)—semi-structured. Used "information world mapping," critical incident techniques to validate and triangulate data within interviews |
| Analysis | NVivo qualitative analysis |
| Findings (with emphasis on sensemaking methodology) | Observed active practices of obtaining information from multiple sources/strategies/perspectives to then assess and make sense of information to inform an action or decision. Information triangulation emerged as an active and complex practice (seeking, assessment and sense-making, iteratively) Among this community (overall socially marginalized)—degree of perceived level of authority for health professionals, cultural deference, but often critical. Verified and checked other more convenient, less authoritative information against the more authoritative—stepwise escalation. Other strategies: second opinion triangulation (when young parents felt brushed off by health professionals); expert/lay perspective triangulation—may help in explaining how to do, not just what to do; inclusive or scattershot triangulation. In practice, sometimes a bit of a mix of the four strategies. Noticed that young parents exhibited agency in the face of stigmatizing structures—but need to beware of bias—and impression management by the interviewees. |
| Personal reflections by review author (CU) | Probably need to have more information about the setting—clearly there's more information about the way health services were delivered and designed for this group that might help interpretation of the findings. Interesting that the interviewees generally took the approach of "well |

(Continues)

**TABLE C1** (Continued)

| | |
|---|---|
| **Greyson (2018)** | |
| | they would say that," putting information obtained against the likely motives and expertise (social context) of the information provider—unless, of course, they recognized a medical emergency when they sought assistance asap. |
| Methodology implications | Could compare with the collective sense-making processes in some of the educational research sensemaking studies where teachers reflected personally on their own experience, discussed with colleagues in school, and with other professional groups, as well as checking out with school principals and district groupings on the changes in practice required. |
| **Koh et al. (2019)** | |
| Identified gaps | How do learning and information behavior relate to each other in maker learning in schools? |
| Research questions | What are the processes and patterns of maker learning by high school students? |
| | What challenges do students face? |
| | What facilitates students' maker learning? |
| | What are the roles information plays in maker learning? |
| Research framework | Considers guided inquiry, uTEC model of learning in makerspace, and design thinking. Used SSM—but less to examine seeking and using information, more to examine sense-making through creating, processes of sense-unmaking. Emphasis on SMM as a process oriented and people centered research methodology |
| Research design | Mixed method |
| Sample | 20/25 students in a high school maker class agreed to be interviewed |
| | Five rounds of interviews throughout the semester |
| Methods | Individual interviews (SMM informed—inspirations, actions, emotions, challenges, helps and learning), process mapping and maker process surveys |
| | Process mapping (at end of semester) explored the entirety of the learning experience (some words on cards pre-prepared for the students drawn from student-making journals and interviews in a previous project but students free to use their own words) |
| | Maker process surveys (beginning, middle, end)—snapshot of feelings—to triangulate with other data from interviews and process mapping. |
| Analysis | Used directed qualitative content analysis—SMM offered the major constructs. |
| | Quantitative—examined trends, changes in the extent to which students felt challenges, inspirations, etc. or engaged in different activities. |
| | Looked at action-motion associations |
| Findings (with emphasis on sensemaking methodology) | Hobbies a major inspiration for student projects—actions included finding information, planning, brainstorming, exploring things, trying things out, putting things together, revising and editing. |
| | Action clusters: brainstorming and finding new information, brainstorming and choosing a topic; learning new concepts and exploring things; learning new concepts and developing skills |
| | Most common emotions: confidence, excitement, pride, anxiety, hope, sense of accomplishment |
| | Action-emotion associations (causing mixed feelings among students)—finding information, trying things out, learning new concepts, presenting, |
| | Finding information (action) co-occurred with excitement, and/or confidence. |
| | Helps—information that they found, tools/resources, teachers, etc. |
| | Adapted Dervin's sense-making Mr squiggly to show sense-making through creating, also discussed relationships with Kuhlthau ISP model—relates to zones of intervention. Students worked on individual projects—therefore little evidence of CoP development |
| | Processes in Overcoming challenges—Asking for help from people, Searching for information, Trying things out and practising, Adjusting |

**TABLE C1** (Continued)

**Koh et al. (2019)**

| | |
|---|---|
| | Proposed model—spiral making process model (brainstorming, trying things out (start positive, but also negative feelings)—revising (frustration and confusion more dominant)—gappy processes, uncertain, iterative and complex. |
| Personal reflections by review author (CU) | Interesting application of SSM—space-time, changing emotions, activities, during maker learning development. Examined "situations" during maker learning, in effect. |
| | Triangulation of findings—a highly commendable aspect of the methods. |
| Methodology implications | Interesting application of SMM to maker learning—learning as a process creating artifacts, that are personally meaningful, and contribute to a community. |
| | Used SMM but was careful to relate to Kuhlthau ISP in the discussion. |

**Lekic et al. (2020)**

| | |
|---|---|
| Identified gaps | Digital transformation of a large French telecommunications company. Authors presented the results of an empirical study on the information behavior of the top managers of telecoms network units and on the factors that influence them. |
| Research questions | What are the information activities of these leaders, what information do they need, and what strategies do they use when searching for information? Which factors influence and shape the information behavior of this population? How is the information managed and shared, and for what purpose? What impacts do digital technologies have on this group's information activity? |
| Research framework | Dervin's SMM and grounded theory |
| Research design | Qualitative, SMM interviewing method |
| Sample | 22 top managers interviewed (out of possible 27) |
| Methods | SMM interviewing (mostly) |
| Analysis | Transcripts were coded using sense-making methods. Also used grounded theory techniques to analyze interview transcripts with the support of the Nvivo software. |
| Findings (with emphasis on sensemaking methodology) | 1/ identified a set of seventy-seven sense-making situations. Each situation was linked to a precise context that was specific to a moment in time and space (Dervin, 1983) and was imbued with the company's culture, its values, its organization and procedures. The analysis allowed author to identify four categories of situations: cross-functional transversal work situations, situations related to the coordination of business activities, emergency or crisis situations, and change management situations |
| | 2/ These sense-making situations also shed light on several constraints that had an impact on the information needs of top managers and on their ability to meet these needs. The manager's constraints (total = 77) were linked to the following dimensions: information management, internal operations, technology, the human factor, the entity's structure or size, time, the regulatory and legal framework, safety, and business. |
| | 3/ eight types of information required by the top managers were identified: general information and feedback, business or technical information, governance and management information, strategic information, institutional information, contractual and legal information, security information, and commercial information. |
| | 4/ results show that top managers' emotional states, their experiences, preferences and knowledge are all important as they contribute to the sense-making process. |
| | 5/ Top managers find the information they need in different ways. One option is to look into the available sources; they can also ask individuals who have access to these sources. |
| | 6/ All of the above findings lead to a model of information behavior for top managers. This *model contributes to understanding of the information behavior and constraints of executives in work situations.* |

**TABLE C1** (Continued)

**Lekic et al. (2020)**

| | |
|---|---|
| Personal reflections by review author (BC) | 1/ I noted this statement "In addition, an organization's competitiveness depends on the ability of leaders to identify and acquire the necessary information to make the right decisions and to build an effective business strategy." This assumes sense making is the same for all leaders as long as top managers have the same information, this assumption is challenged by Dervin's SMM methodology. Is this the case? I wonder.<br><br>2/ I noted this statement "Leaders are in need of relevant, reliable and complete information to act: to make decisions, to solve problems, to define strategies and to attend to the daily activities of their entity." this assumes SMM is information (fact) driven, it makes me wonder what about the need for support, empathy and connect?<br><br>3/ As the findings were revealed, these points were being addressed subsequently in the paper. |
| Methodology implications | This paper demonstrates a human-centric approach to understand information behaviors using SMM can allow us to dig deeper and understand multiple dimensions of needs, gaps in the work context. This provides a good grounding to set information policies and/or to design the space to support top managers and their team to handle information/people connectivity |

**Lichtner and Westbrook (2019)**

| | |
|---|---|
| Identified gaps | How does "collective mindfulness" work—And did it apply when analyzing a health IT implementation. |
| Research questions | What are the main tenets of collective mindfulness?<br>How does collective mindfulness apply to health organizations?<br>Does the theory provide useful insights for implementation of IT in health organizations? |
| Research framework | Sensemaking in high reliability organizations (cites Weick & Roberts explaining that the word collective refers to individuals who act as if they are a group—inter-relate their actions<br>Examination of methods to study collective mindfulness—also considering links to distributed cognition.<br>Evaluation of the Aanestad case study to understand the implementation of an electronic health record system in Norway |
| Research design | Review, plus example case study reflection |
| Sample | Not applicable here—discussion of the evaluation of the electronic health record implementation |
| Methods | Literature review, plus reflection on a research report of IT implementation |
| Analysis | Examined dimensions of collective mindfulness, how it may be studied and measured, how sense-making is involved, and considers the extent to which collective mindfulness contributed to successful adoption of an electronic health record system |
| Findings (with emphasis on sensemaking methodology) | Working definition. (from Kathleen Sutcliffe's work with the Weick team)—"a quality of organizational attention that increases the likelihood that people will notice unique details and act upon them"—five dimensions are preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, deference to expertise.<br>Making sense of the unexpected in an IT implementation may involve agreed requirements becoming contested, unanticipated changes in workflows—resolution requires all stakeholders.<br>Review of the sensemaking challenges in the health IT project—notes that the challenges were thoroughly addressed, and in fact the one small initial change triggered a larger organizational change process. "Anticipating the unexpected"—preoccupation with constraints and preconditions, sensitive to interdependencies, upstream and downstream requirements and consequences, reluctance to premature commitment and "containing the unexpected"—commitment to avoid disruptions and seeking out appropriate mix of expertise. |
| Personal reflections by review author (CU) | Application of the theory to health care organizations and an actual implementation seemed successful—with some tweaks to the model used for high reliability organizations. Used co-design sessions, and workflow mapping (asking doctors after a meeting, to check on the |

**TABLE C1** (Continued)

| | |
|---|---|
| **Lichtner and Westbrook (2019)** | |
| | repercussions of changes). Did remind me of a case study at one hospital where doctors could order tests easier on the new system resulting in the laboratory being inundated—and then they slowed down as they couldn't cope, so nobody really benefited. |
| Methodology implications | Sense-making in health IT implementations may require level one standards at organization level with allowance for level 2 standards specific for each department. The main point is that user-centered design and sense-making needs to be aware of the inter-dependencies (workflows), consequences of small changes. |
| **Madsen and Schmeltz (2022)** | |
| Identified gaps | How are internal social media used in public sector organizations? |
| Research questions | How does sensemaking of internal social media develop over time? What are the perceived purposes of ISM? How do perceptions of perceived purpose change? |
| Research framework | Strategic communications in public sector organizations—power struggles, multiple stakeholders, complexity Possible communication areas in ISM—quiet zone, knowledge sharing, participatory Sensemaking in organizational settings—individual and collective (here thinking about interactions with team—assumed to have similar sense-making and then interactions with other departments—with possibly different or conflicting perceptions). Senior managers as sensemakers and sensegivers? Technology as a trigger of sensemaking—affordances |
| Research design | Qualitative longitudinal case study |
| Sample | Large public sector organization in Denmark Focus on managers |
| Methods | Document analysis, observations of communications on ISM, and interviews with managers—three rounds of semi-structured interviews (total $n = 27$)—prior to implementation, 3 months later and almost a year after. |
| Analysis | Qualitative content analysis—to create composite narratives—an event on the basis of a group of individuals' narratives about the same event. Identified purposes of ISM (and how their popularity waxed and waned from start to finish. |
| Findings (with emphasis on sensemaking methodology) | Shift from purposes focusing on organizational culture to much more administrative (including group of department heads sending out joint news …) So, some breaking down of silos but mostly at the top managerial levels. |
| Personal reflections by review author (CU) | Would have been useful to have gained some views from the employees as well—some reasons were purely functional/technical—not all employees tied to a computer or mobile device. Didn't check whether there were any successful employee forums (face to face, or electronic) in place in some departments prior to ISM implementation. Would findings have changed if there had been a crisis or emergency of some sort? As authors suggest some localization of the intranet might have been helpful—employees might see the point within their section, particularly if they get an immediate sense that their views are being considered. |
| Methodology implications | Shows benefits of a longitudinal approach—to show changes in sensemaking and perceptions. Composite narratives—interviews probably encouraged managers to reflect on the ISM implementation, and the sensemaking changes about its purposes. |
| **Mirbabaie et al. (2022)** | |
| Identified gaps | Rumor correction on social media—Can this work? Bad news spreads faster than good news—Is it possible to break the chain? |
| Research questions | How do rumors circulate in crisis communication on social media? |

(Continues)

**TABLE C1** (Continued)

| | |
|---|---|
| **Mirbabaie et al. (2022)** | |
| | Specifically: RQ1a: What user archetypes participate in spreading rumors? RQ1b: What behaviors in other users affect the spreading of rumors?<br><br>RQ2: How does rumor correction affect sense-breaking? |
| Research framework | Draws on previous research by the team, also brings in sense-breaking as described by Giuliani (2016), that builds on Weick (1995), Maitlis and Christianson (2014). Uses theory of connective action—"the concept, which researchers spun-off from the theory of collective action, posits that collective identity motivates individuals' engagement (Bennett & Segerberg, 2013). Refers also to Maddock's typology of user behavior in the questioning and correction. Explains that theory of collective action needs modification for social media—presents a table contrasting connective action and collective action. Also uses Vaast et al. (2017) ideas on user archetypes that develop in sustaining and amplifying information on social media. |
| Research design | Case study |
| Sample | Tweets on 2018 Chemnitz riots, case study of Twitter data set in both German and English |
| Methods | Identified rumor subsets of the Twitter data set—semi-automated process (keyword analysis—with background knowledge and fact-checking sites to identify rumors and associated keywords), and data set cleaning. Qualitative content analysis on rumor datasets (using Maddock's typology (rumor, speculation, hedge, correction, neutral/other and unrelated)—manual analysis. Coded tweets and retweets (excluding unrelated tweets), refined some of Maddock's categories.<br><br>Social network analysis—to identify top users that actively participated in communication—used the number of retweets an account received. Used Stieglitz et al. (2017) archetypes to classify the top ten users—media organizations, governmental organizations, private persons, public persons (journalists), public persons (celebrities), public persons (politicians) and public persons (other) plus "other" and "deleted" ($n = 5$ top user accounts) |
| Analysis | Used SNA to address RQ2—used centrality measures—betweenness centrality aka potential to control communication between clusters, closeness centrality—power to quickly reach other nodes, and analyzed the retweet networks for each subset to obtain information on how successfully top users spread information-correcting rumors. |
| Findings (with emphasis on sensemaking methodology) | Rumor behavior dominated communication—prestigious users exhibited it more than any other behavior. In particular, private persons commonly contribute to spreading rumors but seldom corrected them. Police account correcting misinformation had an effect (connective sense-breaking)—but this was quite factual information. Examined the sub-networks (noting echo chambers). Did find evidence that rumor spreading stopped—seems that those tweeting did encounter information elsewhere that contributed to their sense-making, but did not make the effort to clean the information space. But also a lot of general bad-mouthing about immigrants, refugees … although analysis stopped short of analyzing user's "intentions." |
| Personal reflections by review author (CU) | Builds on previous research by the team and other related research on archetypes of social media users, and behavior. Connective sense-breaking—and why it happens and doesn't happen—worth further exploration. Also need to look at the network structure—if there are sparse connections between the sub-networks (little echo chambers) difficult to allow sense-breaking to spread.<br><br>Also interesting to explore why users don't bother to engage in rumor correction—but there again, if the social media users are simply declaring prejudices and attitudes, xenophobic claims, then they won't correct? Would require some loss of face. |
| Methodology implications | For sense-making it is useful to examine the differences between connective, collective, collaborative and group sense-making—depends on the setting, and how communication occurs, presumably. |
| **Naveh and Bronstein (2019) (1)** | |
| Identified gaps | How do virtual health communities help pregnant diabetic women? Most research has focused on people with chronic disease—But pregnancy is a transitory state. |

**TABLE C1** (Continued)

**Naveh and Bronstein (2019) (1)**

| | |
|---|---|
| Research questions | How do virtual health communities help people make sense of a complex health situation that is transitory? |
| Research framework | Uses a previous model (Genuis & Bronstein, 2017) to illuminate how pregnant diabetic women negotiate their pregnancy, and presents a modified framework of the "looking for normal." |
| Research design | Analysis of posts in a forum for pregnant diabetic women from pre-pregnancy to birth. |
| Sample | 507 posts over a two-month period—50 conversations and 457 related thread messages |
| Methods | Content analysis |
| Analysis | Deductive (based on the "looking for normal" framework) and inductive analysis to identify new categories emerging from the data |
| Findings (with emphasis on sensemaking methodology) | Identified the stages of pre-pregnancy normal, the breakdown of normality as pregnancy diagnosed, socially constructed normality (finding information, planning delivery), new normal—giving birth. Examines the crises that happen during pregnancy for diabetic women managing their diabetes and pregnancy safely, and what to do—the socially constructed normality of how most pregnant diabetic women deal with pregnancy and the planning required. Experiential knowledge from other women in a similar situation was very important—the constraints could be viewed as gaps to be bridged. Information and emotional support were the bridges that the women used. Examined whether the "dialogic interface" allowed the women to talk openly about the confusions, their own specific problems, and support each other in finding a new normal. |
| Personal reflections by review author (CU) | SSM used only in the analysis as the research "subjects" were in effect doing the "sense-making" for themselves and each other, within the virtual health community. It probably helped that they knew the problems of managing their diabetes—this was an initial bond—and were aware of the problems of getting pregnant as a diabetic. Perhaps more about how the dialogic interface worked (or didn't work for some) might have helped—and how did the researchers judge? More evidence would be desirable. |
| Methodology implications | A different type of SSM-aided analysis of transitory health "crisis" situations in a virtual health community. Situation-gap-bridges (mostly) |

**Naveh and Bronstein (2019) (2)**

| | |
|---|---|
| Identified gaps | Different from former studies that women facing a problematic pregnancy rely on personal stories of pregnancy as the source of information to understand their emotions, this study used the experience of other women suffering from twin medical conditions of pregnancy and diabetes as expressed in the posts of a virtual health community to investigate how the other groups of diabetic pregnant women construct their senses of normality in their situation from the information shared in the virtual health communities. The research method is an extension of the traditional research methods such as surveys, focus groups and interviews by combining this with the theoretical framework of Dervin's sense-making. |
| Research questions | (1) How do diabetic women going through pregnancy or trying to seek informational and social support in a virtual community to make sense of their complex health condition and to reach a sense of normality? |
| Research framework | This study is based on Dervin's sense-making methodology (SMM) that has been applied in many studies to identify the information needs of people with chronic illness. In particular, the authors reviewed the corpus of SMM literature on how patients in various critical health situations make sense and get control of their gappy realities and concluded that information in magazine articles or online discussion or what they called virtual communities provide informational and social support that diabetic pregnant women need to develop their sense of normality in view of their health conditions. This study aims at analyzing 507 posts in the public Diabetes Forum from women suffering from both Type 1 and Type 2 diabetes mellitus before their pregnancies to identify the unique sense-making process that diabetic women experience when looking for normality of their illness. |
| Research design | Content analysis of public posts in a diabetes online forum |

(Continues)

**TABLE C1** (Continued)

**Naveh and Bronstein (2019) (2)**

| | |
|---|---|
| Sample | A total of 507 posts consisting of 50 conversations and 457 related thread messages were collected over a two-month period (August–September 2016) within the public Diabetes Forum for diabetic women at various stages of pregnancy and birth that is affiliated with the General Diabetes Community in the United Kingdom. |
| Methods | The study is based on the content analysis of 507 posts collected from a user-led, public virtual health community in which all content is free. |
| Analysis | The study used a hybrid approach of inductive and deductive content analysis coding. In the first phase, deductive coding was adopted to explore appropriate categories, concepts or models based on previous studies. The analysis will not stop until now new categories emerged. The authors categorized the data according to the four stages of the model proposed by Genius and Bronstein (2017). In the inductive coding stage, categories were derived from the data. Finally, the authors developed a categorization matrix after these two phases of coding. The minimum unit of analysis was a post. |
| Findings (with emphasis on sensemaking methodology) | The study identified four themes or stages diabetic pregnant women passed through in making sense of their gappy realities. Theme 1 is "pre-pregnancy normality," in which the posters conceive their fertility as an issue in their diabetic conditions and they found health advice and encouragement in the form of experiential knowledge. Theme 2 is the "breakdown of normal" when the posters were at the beginning of pregnancy. It is subdivided into two sub-themes or two questions that the posters will ask: (a) I am pregnant and diabetic—what do I need to know? (b) what do I manage crisis during pregnancy? The posters were provided with basic health information regarding the illness and the possible treatment and emotional support in the posts. Theme 3 comes to "socially constructed normal" in which the poster sought to reconstruct their social identification with women who share similar medical conditions. They were looking for normality by seeking information from basic tests to those specific complications relating to delivery as strategic for bridging their gaps in pregnancy. Theme 4 is the last stage in this sense-making process in which the posters established their "new normal" from the positive outcomes in the post in the form of successful deliveries. |
| | The authors regarded the posts in the virtual communities as personal narratives of diabetic pregnant women and thus were sources for people with similar medical conditions to look for information and support to establish their own worldviews in order to move forward in their life's time-line. The authors placed these four themes neatly into Dervin's SSM. The first stage represents the existing situation in which the posters found themselves blocked when conceiving pregnancy in diabetic condition and thus tried to look for new normal in the second and third stage from the posts in the online discussion group to find the health information and social support they need as strategies to bridge the gaps they faced in pregnancy until the final outcome, the birth of their babies, has been reached. |
| Personal reflections by review author (LL) | The authors have utilized well Dervin's SSM to provide evidence to support the argument that virtual health communities are useful sources of information and emotional support for diabetic pregnant women to look for their new normal. |
| | The data analysis method is coding in the form of content analysis which Dervin also adopted. Many of the universal verbing categories of SMM such as the situation movement state was developed by "intersecting a deductive set of framework based on Sense-Making's verbing analytic with the inductive qualities of the data" (Dervin & Frenette, 2003). The findings are all qualitative in nature. A stronger case can be made if the qualitative findings are supplemented with quantitative data in each theme to review deeper the content of the online posts. For instance, the authors can analyze from the posts which the gap-bridging strategies will be more effective in closing their gaps. There are also some duplications in theme 2b crisis management during pregnancy and socially constructed normal. A graphical model to show the similarity and differences with Dervin's SSM might also be helpful to illustrate the uniqueness of this study. |
| Methodology implications | This study is a further proof of the usefulness of Dervin's SMM in understanding the struggles of patients and their sense-making processes which is similar to the study of Schaefer and Dervin (2011) in analyzing consensus/dissensus activity in online discussion groups. Besides arguing that the sense-making process is personal, the authors also stressed that the process is also social in nature as the diabetic pregnant women interacted with other women in the virtual communities to share their common concerns and build a sense of community. The |

**TABLE C1** (Continued)

**Naveh and Bronstein (2019) (2)**

| | authors also drew very slightly on Weick's theory in this social construction of knowledge. This is a new insight seldom found in other SSM research and more studies in this direction may shed light on sense-making theories. |
|---|---|

**Oduntan and Ruthven (2017) (plus data from related documents)**

| Identified gaps | Information needs gaps for refugees and asylum seekers negotiating the processes of integration (in Scotland, UK)—The need for a situational approach to understanding information behavior and need |
|---|---|
| Research questions | What are the gaps?<br>What are the situations?<br>What are the outcomes?<br>How could integration services be improved in design and delivery? |
| Research framework | "A situational approach to information behavior during refugee integration can provide fuller perspectives to help understand the relationships between contextual factors and human in-formation behavior in situations that can be used in the actual design of services and provision. This is because information needs identified from situations put any potential person in context."<br>Socio-cognitive approach based on Dervin's sense-making methodology, using the situation-gap-outcome metaphor<br>Framework about integration—refers to Ager and Strang (2004) on markers and means (housing, education, employment, social connection, health) social connection, facilitators (language, cultural knowledge) and foundation (rights and citizenship).<br>Acknowledges influences from Savolainen's Everyday Life Information Seeking and Information Grounds—both arguably in influenced by SSM themselves. |
| Research design | Qualitative |
| Sample | Asylum-seekers ($n = 12$)<br>Refugees ($n = 8$)<br>Recruited through diversity sampling—wide number of countries, ages of individuals, reasons for migration, and route of entry. |
| Methods | Semi-structured interviews (around an hour long, $n = 20$). Data collection covered situation, gaps, bridges, outcomes. Care taken to ensure participants were comfortable and felt secure in the interview setting. Used the micro-moment time line to help design the semi-structured interview schedule.<br>"These experiences were captured through the sense-making elements situation, gaps, and bridges. At this stage, the goal was to collect data specifically to address research questions one and three. In sense-making terms, this meant the information gaps in situations, the points of discontinuity, the moments of concern, the time of question-asking, or a critical incident.<br>IQ5 Series: Describe times when you did not know? Describe times when you did not have information?<br>Probes: Did you have a time when you did not know what to do, i.e. have information?<br>Can you describe a time of fear; what are your fears?<br>At what point did you feel in need of some information?<br>Findings in this category determined the direction and success of the interview; thus the following probes were formulated for use when necessary to dig further and in preparation for the subsequent questions.<br>IQ5b Series: When was there a time when something was not right? Probes: When do you feel you don't know?<br>When was there a time when something was missing?<br>What experience since you have arrived has impacted on you? How did you know you did not know?" (from thesis, pp. 68–69)<br>Also combined with observation of case workers in refugee support |
| Analysis | Thematic analysis, examining similarities and differences in experiences—to identify information gaps. |

**TABLE C1** (Continued)

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|---|---|
| **Oduntan and Ruthven (2017) (plus data from related documents)** | |
| | "The goal was to circle out contextual information needs, relationships and information sources appearing in refugees' constructions. It has been shown how sense-making metaphors, or situation-gaps, were used to question the lived experiences of refuge-seekers as tied to specific times, places, perspectives and human conditions in the data collection guide. The data collected reflected the complexity of refugee integration, as refugee conditions were significantly different." (from thesis, p. 73) |
| Findings (with emphasis on sensemaking methodology) | "Developed an information needs matrix (the information needs matrix can be understood as a sense-making journey between sociological needs and access to societal provisions" from thesis (p. 92) Across—stages of information need according to contextual attributes, Down—differences due to particular sets of demographic attributes. Suggest a progression in the situation, and (ideally) reduction in information gaps as integration proceeds. Concludes that a focus on processes was important—situational information needs could be mapped back to social systems (to understand gaps and outcomes better) |
| Personal reflections by review author (CU) | The research illuminated the problems for refugees and asylum seekers and the findings should be useful for the agencies dealing with those groups. Politically, and socially it made sense to focus on the situation, rather than focus on the variables of demographics, (and particularly whether agencies were dealing with asylum seekers or refugees). That helped to see the big picture—and the information needs matrix that was developed. |
| Methodology implications | Authors considered both Savolainen's Everyday Life Information Seeking model and Fisher's Information Grounds—the value of complementary models in providing some "dialogue" with the use of sense-making. The development of the information needs matrix does help to include the problems of the individual, as well as the general situations in which the forced migrants find themselves as they try to work their way through the system. Authors discuss these "individual–collective information needs journeys, via situations, deconstruct the context and emphasize sense-making outcomes that honor diversity as well as human universals." |
| **Olsson (2016)** | |
| Identified gaps | Archeologists' sense-making about artifacts uncovered in an excavation and how this then relates to thinking about the site—In non-literate cultures |
| Research questions | How do objects and places become "documents"? What are the information practices of archeologists, students and volunteers while in the field—and beginning the process of sense-making |
| Research framework | Savolainen's information practice (also Gherardi, 2000; Nicolini, 2013) Social constructivism (Berger & Luckmann, 1967) Embodied information practice (Lloyd, 2007, 2010) Dervin's SSM (plus conversational approach to interviewing) |
| Research design | Qualitative research, at two sites. Ethnographic—field observations of archeologists at work, plus interviews with archeologists (short informal on site, longer interviews off site) |
| Sample | 10 (archeologists and archeology students) |
| Methods | Audio notes taken with small digital recorder on site. Interview guide influenced by Dervin's SSM. All interviews and notes transcribed. |
| Analysis | Analyzed inductively, using a constant comparison approach. Follow-up interviews and email correspondence with participants to discuss emerging findings, check potential biases and explore rival explanations—participants thus played an active role in the co-construction of findings (Dervin's view of the actor as an expert in their field) |

**TABLE C1** (Continued)

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|---|---|
| **Olsson (2016)** | |
| | "A key assumption underpinning the analysis process was that 'social reality is produced and made real through discourses, and social interactions cannot be meaningfully understood without reference to the discourses that give them meaning' (Phillips and Hardy, p. 3). Thus, our analyses focused on how the participants' statements could be understood as 'truth claims' in relation to broader discourses that governed the participants' shared domain of practice." |
| Findings (with emphasis on sensemaking methodology) | Personal expertise, Haptic analysis—multi-sensory engagement with artifacts and embodied practices, learning/mentoring with students—learning/demonstrating practical archeology, drawing as an embodied practice, recording (find and context sheets, dig diaries/blogging/social media) |
| Personal reflections by review author (CU) | The relationship between the senior archeologists and students reminiscent the Lave & Wenger's communities of practice (and like consultants' firms in hospital). And clearly the ethnographic approach deepened understanding between researcher and participants. Importance of various senses—not just sight. The professional practice of archeology—and discussions among the team at the sites, communication with other archeologists—understanding the processes of professional practice |
| Methodology implications | Advocates more use of ethnographic methods in studies that use sense-making—to understand more about how sense-making around artifacts (as "documents") evolves—for the individual and archeologists in general, in a shared domain of practice. |
| **Sirikul and Dorner (2016)** | |
| Identified gaps | What information do Thai immigrants who relocated to Auckland, New Zealand, need during the settlement process? Aim to make the process of integration less stressful. |
| Research questions | What are the settlement information needs of Thai immigrants; What sources do the immigrants use when seeking information about settlement processes seeking settlement information; What is the possible role of Auckland Libraries in the settlement process What are the main barriers and facilitators Thai immigrants encounter in meeting their information needs? |
| Research framework | Known problems about the cultural and social problems during settlement—and diversity of needs. Used Mwarigha (2002) three stages of settlement (immediate (food, clothing, shelter, help with language) intermediate (e.g. access to services) and long-term (fitting into the culture) Dervin's SSM (1998)—situation-gap-use/helps |
| Research design | Qualitative |
| Sample | Purposive sample ($n = 9$), by using maximum variation sampling to achieve a broad representation of length of stay in New Zealand, gender, educational level and occupation. |
| Methods | Used Dervin's Micro-Moment Time-Line interview approach to understand the situations experienced, what barriers were encountered and how "helps" operated or might operate. Interviews conducted in Thai and then translated for analysis. |
| Analysis | Used Situation-gaps-uses/helps |
| Findings (with emphasis on sensemaking methodology) | Situation explained the language problems and consequences Gap—frequently the difficulty of moving on to the next stage of settlement Use/helps—interpreted as bridging the gaps through family/friends, the internet, the Thai temple, public libraries |
| Personal reflections by review author (CU) | The presentation of findings limited and it is difficult to see how the use/helps fully equates with Dervin's sense-making. However, the researchers did seem to gain an understanding of the different, diverse situations of the immigrants. |

(Continues)

**TABLE C1** (Continued)

**Sirikul and Dorner (2016)**

| | |
|---|---|
| Methodology implications | In comparison to the Oduntan case study—this was a small-scale study of people who were immigrants—not forced migrants. The discussion of methodology and the sense-making implications quite limited but the stages of settlement theory complemented Dervin's SSM in focusing on situation first, not simply presuming what the information needs were likely to be. This group generally highly motivated to integrate into the prevailing culture. |

**Stieglitz et al. (2018)**

| | |
|---|---|
| Identified gaps | What's happening with sense-making on social media sites such as twitter in crisis communication situations—Good and bad |
| Research questions | RQs: (1) Does commentary-related communication in Twitter data sets reflect Integration and Trajectories of Participation and help us to identify commonalities, patterns, and processes of inter-subjective sensemaking? (2) If so, are these useful inputs to support development of crisis communication systems in the future? |
| Research framework | Used the framework of inter-subjective sense-making—joint production of "embodied agents and agents' experience" for examining social media interactions (cites Fuchs & De Jaegher, De Jaegher and di Paolo). Affordances of social media expand what is possible for individual sense-making, possibly. Also Suthers (2006) on Trajectories of Participation—are "patterns of participation over larger spans of time and collections of actors" evident and can these be used by others to build inter-subjective sense-making? |
| Research design | Case study analysis |
| Sample | Examination of three case studies (Sydney terror attack, GermanWings flight crash and Brussels terror attacks) |
| Methods | Self-developed Java based data tracking tool, data collection limited to tweets in English, accessed the search API from Twitter for data collection—so all three data sets consisted of 72 h of tweets from the initial event occurrence. To conduct the sentiment analyses, created separate text files for each topic, which included every tweet. For the social network analyses, created edges and nodes lists for identifying the Twitter user groups and their influence. |
| Analysis | Structure of the data communications (divided 1% lead users, 9% highly active, 90% less active) Sentiment analysis (used SentiStrength dictionary based program) Social network analysis of communications within user groups (Gephi tool for graph visualization) |
| Findings (with emphasis on sensemaking methodology) | Sentiment analysis provided a partial record of interaction and collaboration—and noted different distribution of positive and negative tweets among the data sets. Strong (and unexpected) differences in the commentary related communication structures Social media communications activities by different types of users (those directly impacted by and event and those who are not) need to be differentiated—if using social media for formal communication purposes by emergency services—need to filter and visualize? Notes emotion sharing communication patterns. |
| Personal reflections by review author (CU) | Difficult to see strong connections between the Suthers framework and the findings |
| Methodology implications | Contributes to ideas about embodiment in sense-making and the affordances offered by social media—enactive social cognition. |

**Tao and Tombros (2017)**

| | |
|---|---|
| Identified gaps | What is the general process through which people make sense of the task and of the encountered information together in collaborative information seeking (CIS)? |
| Research questions | What are the general patterns in which users make sense of the task and information collaboratively in a CIS task? |

**TABLE C1** (Continued)

| Tao and Tombros (2017) | |
|---|---|
| | What are the differences in the participants' sense-making behavior and strategies in the two different tasks? |
| Research framework | Previous research on CIS, influence of task on information seeking. Collaborative sensemaking—Paul and Morris (2010) work relevant as the project here used a "tool" set-up—not formal software but allowed for collaboration (Skype). |
| Research design | Re-analysis of existing data on CIS with different tasks—examined the collaborative sensemaking processes |
| Sample | 8 groups of 3 (students)—6 of the 8 groups formed themselves, 2 were formed by researchers. Different disciplines but nearly half were electronic engineering and computer science. Most had had some collaborative search experience prior to the study. |
| Methods | Took screen recordings (Camtasia) of each participant, had chat transcripts, questionnaires and post-task interview notes. |
| Analysis | Analysis of all data collected—to examine stages of the collaborative sensemaking (structuring, searching, sharing and synthesizing information into a shared representation. |
| | Used Zhang (2008) to look for evidence of task analysis, identification of gaps, information seeking (exploratory and focused for data or structure), building structure, fitting data into structures, updating knowledge and preparing task output) |
| | Content analysis of the chat logs and query logs of each group. |
| | (Coding sample—intercoder reliability checked) |
| | Authors state that the small sample size limits generalization of the findings—so they mainly focus on the behaviors where the stats showed significant differences. (?) |
| Findings (with emphasis on sensemaking methodology) | Most groups tried to identify sub-topics or subtasks to structure the task—the general process is structuring, searching for information(done individually), sharing information and synthesizing information into a shared representation. |
| | Structuring—build an overall structure that can be divided into different tasks, or identifying subtopics step by step (travel planning had an intrinsic temporal structure). Topic research generally required identification of structure gaps. Identification of data gaps more common in the travel planning (but requires coordination, correlation). |
| | Observed both exploratory search for structure, and focused search for data (travel planning 1:2 exploratory: focused; topic research more equally divided) |
| | Shared representations—web page links, snippets, and representations of subtopics. Topic research participants generally created a document to collect and organize information before sharing as a representation of their subtask. |
| | Some information sharing showed the need to keep aware of how the group was getting on. |
| | General patterns of synthesizing: |
| | Combining individual representations (by one individual) (7 groups) |
| | Writing together in a shared document (3 groups) |
| | Synthesizing shared information on the chat tool (6 groups)—and one person synthesized information into a representation. |
| | Collaborative sensemaking model of CIS—iterations of activities, structuring, sharing, synthesizing, Structure and data loop. |
| Personal reflections by review author (CU) | Setting and experience of the students probably affected findings—also a comparatively small size of group (3). Would have liked more details about the reasons one person (chosen or volunteered) to do the synthesis (mostly). |
| Methodology implications | Based on Paul and Morris findings, also relevant to Zhang & Soergel's model (and extended model?) |
| | Interesting that they might have used Klein's data/frame ideas as the initial stages of the iterative data/structure loops seem very similar to the proposal that the frame shapes the data and the data shape the frame. "The Data/Frame Theory posits a closed-loop transition sequence between |
| | • mental model formation (which is backward looking and explanatory), and |
| | • mental simulation (which is forward looking and anticipatory)." |

**TABLE C2** Table of observations Information Science.

**Stance of the researcher and outcomes (intended purpose of research/outcomes)**

Large variation—from design science in teams, and working with users through to curiosity driven research done by academic staff.

From *Analyst/Developer* (social media data sets)—*FOR Improved social media analysis tools* for conversation disentanglement, better text analysis (design science, industry/academic).

*Developer*—(tools, appropriation of affordances taking account of sensemaking and reflection for informal learning in the workplace)—FOR development of a method for supporting informal learning in the healthcare domain (Co-DAA DBR) (The research has been co-funded by the European Union's 7th Research Framework project Learning Layers (Grant agreement No. 318209; http://results.learning-layers.eu/), the European Union's Horizon 2020 research and innovation program project CEITER (Grant agreement No. 669074; http://ceiter.tlu.ee) and the Austrian COMET Program—Competence Centers for Excellent Technologies.)

*Researcher* (sense-making bridging activities to help overcome constraints and information resistance)—FOR *planning support services with/for migrants*—services that are situationally relevant, and therefore trusted by migrants (independent academic research?—no funding stated).

*Researcher* (organizational sensemaking in complex situations)—*FOR independent research (individual research grant)*—*author continues to have a role in publishing*.

*Researcher* (sensemaking strategies of intelligence analysts using information visualization tools) (funding from the European Union 7th Framework Programme FP7/2007–2013, through the VALCRI project under grant agreement no. FP7-IP-608142, awarded to B.L. William Wong, Middlesex University London, and Partners. The authors acknowledge the TU Wien Library for financial support through its Open Access Funding Program.

*Researcher*—(maker learning in school) FOR future development (IMLS funding plus other Univ based grants).

*Researcher* (how voluntary guides integrate information from training and preparation for art museum exhibitions)—*FOR* postgraduate research (independent)—probably also Greyson (funding not stated, but length of research time period suggests doctoral research, or post-doc research).

*Researcher*—(reanalysis of existing datasets using SSM inspired methods—supporting patients looking for a new normal after health disruption) (partial funding for one author stated—SKG acknowledges funders, including the Social Sciences and Humanities Research Council of Canada, the Medical Library Association, and salary support via Alberta Innovates-Health Solutions) (independent research).

*Researcher* (external academic consultant)—working on evaluation of a campaign by an organization—and commissioned for the work?

... Academic research examining digital transformation at a large telecoms company and funded by that organization.

*Researcher*—(re-analysis/review of existing case study using Weick's ideas on collective mindfulness) (funded through EU Horizon program).

*Researcher*—unclear whether study funded or not, what role the organization studied played.

*Researcher*—unclear whether study funded or not, seems an internal University research project on a learning platform?

*Researcher*—unclear funding source, possibly for postgraduate research degree.

Ditto—for study of settlement by Thai immigrants (NZ).

*Researcher*—refugee/asylum seeking integration, doctoral research funded internally by university.

*Researcher*—social media analysis (rumor correction). Funding from EU 2020 Horizons program.

– Another earlier study by one of the German team and others—no information on funding.

*Researcher*—academic staff, funding from internal university research and development grant for fieldwork.

**Questions, problems and strategies (grouped by general category of research objectives)**

*General category Analyzing conversations and comments*

Developing social media analysis tools to properly analyze messages and threads—beyond simple sentiment analysis—to disentangle conversations and analyzing purpose of the conversation: Design science with language action perspective plus Searle's speech acts (developing automated system, big data analysis.

Social media—and inter-subjective sensemaking (are there affordances with social media to expand individual sensemaking—patterns of participation and collections of actors?) Implications for crisis communication?

Social media—Rumor spreading (and dying down)—who helps, which user types provide sense-breaking—*looking at connective versus collective sensemaking—social media allows easy connective sensemaking but collective sensemaking—probably not in many cases*. Use of social network analysis methods to examine network structure (top users, sub-networks) and how connective sense-breaking achieved.

Intermediaries working with migrant communities—how is integration achieved? The problem of perceived disinformation, gaining trust—struggles and resistances (SMM)—deductive and inductive analysis. Use of Ager & Strang framework. *Situational relevance*.

**TABLE C2** (Continued)

Information needs gaps for refugees and asylum seekers—aim to inform service provision. Situation-gap-outcome metaphor. Use of Ager & Strang framework. Refugees' constructions—and individual/collective information needs journeys. *Situational relevance.*

Policies of scholarly publishers on response to the COVID-19 pandemic—critical analysis of policy statements, taking into account the complexity of the situations—how are organizations making sense of the situation—sensemaking, sensegiving, sensebreaking. Analysis of styles of communication, perceived purpose, how collaborations developed, some development of the new normal (anticipation/CAS).—*emergent views, anticipation (cf. note below on auto communication).*

Internal staff reactions to campaigns aimed at external audiences—what sort of internal sense-making developed? Do they buy into e.g. the type of values of CSR expressed? Drawing out conflicting views, informal ethnography—critically examining how campaigns might shape views, and how context shifts, and is shaped, with new insights.—*ideas about auto-communication (Autocommunication takes place whenever senders act as receivers of the messages that they are conveying. This is often the case in the context of organizations because members are senders as well as receivers of messages from their own workplace (Christensen)).*

Internal social media within organizations—are interactions within and across teams easier? Contrast individual sensemaking with collective sensemaking (within a team) and less collective/possibly conflicting sensemaking in interactions between different departments.

Integrating information from training and preparation for exhibitions—how does sense-making evolve—and, just as important, how are the reflections "baked and presented" for reflection in interviews with researcher—outcomes of the sense-making on dealing with the artist (what messages should be conveyed), dealing with the curator and their "voice," embodied sensemaking, using information to decide on likely audience response.– *how do people reflect on their sense-making and how do they consider their own views and those of the organization they're supporting?*

Dealing with contested knowledge and construction of authority—ethnographic observation, information world mapping, and critical incident techniques to provide triangulation for data collected (important when dealing with awkward situations with constraints and enablers on decision-making?)—*problems when agency is perceived as challenged by interviewees—impression management to be expected …*

*General category Supporting sense-making and informal learning, maker learning, gaining insights*

Doing design-based research for supporting workplace learning—emphasis on traceable processes. Understanding the possibilities—what happens now, what affordances might be offered, what can become "action possibilities"—perceived and practical affordances linked to information foraging and sensemaking loops.—*allowing for reflection/sense-making of personal "notes" and collaborative sensemaking.*

What are the stages of collaborative sensemaking, and what's involved for students on a group task, using Skype for collaboration. Relevant to Zhang & Soergel model of sensemaking (and Klein data frame, as well as Paul & Morris collaborative sensemaking tool.

Supporting sensemaking (cognitive) through information visualizations—how are experts using these visualizations to gain insights? Strategies of looking for/making connections, trend assessment, storytelling (having a hunch, looking for evidence to confirm, disconfirm—temporary "frame"), elimination, verification (checking across), comparison, contradiction, co-incidental A-Ha's, creative desperation.

Sensemaking in high reliability organizations in the case of health IT implementation—development of collective mindfulness—Kathleen Sutcliffe (co-researcher with Karl Weick) "a quality of organizational attention that increases the likelihood that people will notice unique details and act upon them".—*dimensions are preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, deference to expertise.*

*What might be happening in sense-making when "normality" is disrupted, or there are questions about agency and information practice*

Use of disruptive health events, looking across two data sets, using sense-making ideas of gap-bridging processes, stressing importance of experience and dialogue. Use of secondary qualitative analysis.—*using existing data sets and SSM principles to gain new insights.*

Dealing with contested knowledge and construction of authority—sense-making as triangulation.

Fieldwork for archeologists—sense-making with the artifacts of non-literate cultures—emphasis on embodied information practice—Dervin's view of the key actor as an expert in their field—archeologists making truth claims in relation to their shared domain of practice and understandings.

**Methods and groups of methods**

SMM variations—SMM informed interviews +process mapping (learning experiences) + Maker process surveys—leading to spiral making process model. *Triangulation* of findings—to examine changes over space/time. SMM process oriented and people oriented.

SMM + grounded theory—to identify sense-making situations—always a challenge to ensure that researcher assumptions about information needs do not bias the research on information behavior?

SMM + testing a previous model relevant to health disruption to check if changes required for a slightly different situation (temporary health crisis/disruption).

**TABLE C2** (Continued)

SMM + theoretical framework relevant to situation plus situation-gap-outcome metaphor + micro-moment time line interviews plus influences (Savolainen ELIS, Information Grounds) *value of complementary models in providing some dialogue with each other when planning sense-making interviewing.*

SMM aided analysis– situation–gap-bridges/helps.

SMM micro-moment timeline interviews to understand how immigrants settle into a new country (used three stages of settlement theoretical framework), analysis focused on situation-gaps-uses/helps.

Ethnographic observation of professionals and their students at work in the field-audio notes taken with small digital recorder on site. SMM interview guide.

Ethnographic observation, information world mapping, and critical incident techniques to provide *triangulation* for data collected (important when dealing with awkward situations with constraints and enablers on decision-making?)

*Organizational sensemaking, social media sense-making*

Screen recordings of participants (Camtasia), with chat transcripts, questionnaires and post-task interview notes—examined the stages of collaborative sensemaking (structuring, searching, sharing and synthesizing information into a shared representation).

Organizational sensemaking—during IT implementation—more than project management. Need for co-design sessions, workflow mapping to check consequences of changes (even small changes), interdependencies. Aiming for collective mindfulness.

Use of composite narratives—developing views of an event on the basis of a group of individuals' narratives about the same event. Changes in sensemaking about the perceptions and purposes of internal social media—longitudinal research.

Rumor correction on social media—sense-breaking occurs how? Using Twitter, semi-automated processes to identify rumor subsets (keyword analysis a tool, plus background knowledge and fact-checking sites to identify rumors and associated keywords), then data set cleaning—then manual content analysis. Some social network analysis to identify the top users and archetype list, centrality measures.

Sense-making on social media—sentiment analysis, examination of communication structures (depending on the degree of involvement of users—whether directly impacted or not), social network analysis.

**Individual sense-making/connective sense-making/collective sense-making/collaborative sense-making/team sense-making/group sense-making/collective sense-making—some definition problems apparent**

Variables affecting the sense-making process?

Space/time—Organization/department/team—setting (need for speedy action or not), crisis, high-reliability, versus shared interests or purposes, policy innovation affecting practice versus social media and use of affordances—is this a useful perspective? collaborative sensemaking over a project time period, use of collaborative sensemaking tools. (Lekic: different organizational settings: cross-functional transversal work situations, coordination of business activities, emergency or crisis situations, change management situations)

Time—collective sense-making (education/Coburn) may take place over an extended period (process of verification and modification of ideas) versus Weick (collective means that individuals are acting as if they are a group and inter-related their actions).

Greyson (triangulation processes similar to this type of collective sensemaking).

Need for unison agreement to co-ordination-allowance for some divergence of attitudes (total commitment vs. coherence).

Madsen & Schmeltz assume that individual sense-making among team members similar—but working across departments likely to bring in conflicting views?

Responsibility for sense-making—is it clear to the individual what to do? Does it matter? Freedom of action? Is inter-subjective sensemaking made easier or assumed to be easier? Enactive social cognition/embodiment …? Connective—coming together briefly with shared beliefs, attitudes, but no need for collective identity, formal organization, support.

**Personal reflections and implications for methodology**

*Discourse analysis group*

Large-scale trial to automatically do sense-making among discussion threads, social media, web forums—requiring conversation disentanglement, sorting out whether the support offered seemed emotional/social, whether one of the participants then committed to action.

The interest in this is probably less the automated text analysis system development, more the principles of operation, and examination of the purpose of the participant's messages (assertive = represents facts of the world, commissive = speaker commits to future action, expressive = speaker says something about feelings or attitudes, declarative = speaker brings about changes (pronounces, verdicts), directive = speaker gets the hearer to do something). There's a huge amount on Twitter sentiment analysis (Foolen review for example) but less work on assessing whether it is possible to assess at least some aspects of the speaker's intent.

**TABLE C2** (Continued)

Careful analysis to examine how the web policy statements reflect various aspects of discourse—need to bear in mind that these have been carefully crafted for impression management—do they mean what they say and do they say what they mean?

Might have been desirable to be a bit more explicit about the rationale for the type of discourse analysis method chosen (given that discourse analysis means different things to different disciplines). I would have liked more justification for the method given the problems of "policy discourse"—what is (really) connoted in what is denoted? I think the discourse analysis here is more about the framing of the statements, rather than the content per se (although there's a lot to be noted about use of the adjective "free" in relation to information resources). Of course—once one major publisher announces that free access will be provided, others have to make similar responses. The different time periods offered (if these were stated) suggests the "probe, sense, respond" of Snowden's sense-making for the complex domain, although likely that some publishers might consider themselves in the chaotic domain "act, sense, respond." They were already making changes toward open science and the current situation seemed to demand more of the same, but faster—more remote access, more remote learning, high demand for research information. Implications—The discourse analysis approach, plus the organizational sensemaking, sense-giving, sense-breaking, did help to frame the discussion on whether the collective response of scholarly publishing did exhibit some features of complex adaptive systems—fast evolution, aggregate behavior (how is the system operating as a whole) and there seemed evidence of some anticipation (awareness that the future would be different, demanding changes in some operating norms).

Again, interesting use of a method of discourse analysis and a method for looking at Complex Adaptive Systems with sensemaking (but there are other approaches that might have been cited).

The research attempted to take one step back—to understand why the volunteer guides might want to say what they did, in the way that they phrased their reflections. They weren't recent critical incidents, probably reflections that had been baked and then arranged, selected for presentation? They also reflect conversations with other volunteers and museum staff, and assumptions about the purpose of museums, views about contemporary art. Implications—An example of using a type of discourse analysis but only really possible for a small number of interviews. A different take on what we mean by "situation." (also compare with Dervin 2006 on interviewing mandates ...

Builds on previous research by the team and other related research on archetypes of social media users, and behavior. Connective sense-breaking—and why it happens and doesn't happen—worth further exploration. Also need to look at the network structure—if there are sparse connections between the sub-networks (little echo chambers) difficult to allow sense-breaking to spread. Also interesting to explore why users don't bother to engage in rumor correction—but there again, if the social media users are simply declaring prejudices and attitudes, xenophobic claims, then they won't correct? Would require some loss of face.

Implications—For sense-making it is useful to examine the differences between connective, collective, collaborative and group sense-making—depends on the setting, and how communication occurs, presumably.

Sentiment analysis provided a partial record of interaction and collaboration—and noted different distribution of positive and negative tweets among the data sets.

Strong (and unexpected) differences in the commentary related communication structures.

Notes emotion sharing communication patterns. Difficult to see strong connections between the Suthers framework and the findings. Implications: Contributes to ideas about embodiment in sense-making and the affordances offered by social media—enactive social cognition.

*Sense-making around migration*

Extensive literature review on theories around migration and settlement—justified choice of theoretical frameworks, and fairly novel use of Dervin's concept of information resistance. The latter worked as it avoided problems of inbuilt bias that might occur when looking specifically for information marginalization, and helped to explain why some intermediaries have to work hard to overcome distrust among migrants—to make the information situationally relevant and credible. Implications: Theoretical frameworks relevant to the situation of study, justified use, and related to existing IS frameworks (Chatman's information poverty). Helpful to think of situation constraints that may hinder sense-making, and instead of "barriers and facilitators" to think of creating situational relevance.

The research illuminated the problems for refugees and asylum seekers and the findings should be useful for the agencies dealing with those groups. Politically, and socially it made sense to focus on the situation, rather than focus on the variables of demographics, (and particularly whether agencies were dealing with asylum seekers or refugees). That helped to see the big picture—and the information needs matrix that was developed. Implications: Authors considered both Savolainen's Everyday Life Information Seeking model and Fisher's Information Grounds—the value of complementary models in providing some "dialogue" with the use of sense-making.

The development of the information needs matrix does help to include the problems of the individual, as well as the general situations in which the forced migrants find themselves as they try to work their way through the system. Authors discuss these "individual–collective information needs journeys, via situations, deconstruct the context and emphasize sense-

**TABLE C2** (Continued)

making outcomes that honor diversity as well as human universals. Implications: Authors considered both Savolainen's Everyday Life Information Seeking model and Fisher's Information Grounds—the value of complementary models in providing some "dialogue" with the use of sense-making.

The presentation of findings limited and it is difficult to see how the use/helps fully equates with Dervin's sense-making. However, the researchers did seem to gain an understanding of the different, diverse situations of the immigrants. Implications: In comparison to the Oduntan case study—this was a small-scale study of people who were immigrants—not forced migrants. The discussion of methodology and the sense-making implications quite limited but the stages of settlement theory complemented Dervin's SSM in focusing on situation first, not simply presuming what the information needs were likely to be. Implications: In comparison to the Oduntan case study—this was a small-scale study of people who were immigrants—not forced migrants. This group generally highly motivated to integrate into the prevailing culture.

*Sense-making processes*

1/ Called out contradicting views 2/ recognize the context is changing and it is a dance (i.e., to shape and to be shaped) 3/ allow new insights to emerge 4/ not everyone needs to agree to the campaign.

1/ What is missing to me is an example of the questions being used to conduct the interviews and also to do self-ethnographic observations. 2/ from the descriptive text, I believe there is a genuine openness and honesty that the university want to understand, and willingness to hear any surprises 3/ recognizing interviewees' unique context and invite diverging voices appears to be the methodological framework behind the research 4/ I think it shows the researcher has the intention to open the space to allow topics/feedback to emerge without pre-defined assumptions. Implications: Would be nice to see to what extent Dervin's SMM questions and timeline interviewing techniques are being used. Overall I could consider this is a piece of sense making research.

Interesting analysis of sensemaking of different information visualizations.

The Storytelling sensemaking category—used by some, but not all analysts—working hypotheses, looking for evidence—this seemed to act as a frame (essentially). More information either confirmed the hypothesis or else the hypothesis was abandoned. Implications: Coding extended the Triple Path Model of Klein—more strategies emerged. In fact, Connections was the most frequent strategy, and Contradiction and Creative Desperation the least frequently used of the 9 sense-making strategies developed.

Think-aloud sessions seemed to be successful and could be coded consistently—some "technical problems"? Previous research by this team used the data/frame model of Klein to analyze transaction logs.

Interesting perspective on selecting particular affordances that were action possibilities for a sensemaking process. Continual need to recheck and return to previous use of tools—hence the emphasis on the traceability loop. Implications: Links perceived and "practical" affordances with sensemaking loops of foraging and sensemaking. Perhaps relevant to Rieh et al. review of searching and learning.

Some information sharing showed the need to keep aware of how the group was getting on.

General patterns of synthesizing:

Combining individual representations (by one individual) (7 groups).

Writing together in a shared document (3 groups).

Synthesizing shared information on the chat tool (6 groups)—and one person synthesized information into a representation.

Collaborative sensemaking model of CIS—iterations of activities, structuring, sharing, synthesizing. Structure and data loop. Setting and experience of the students probably affected findings—also a comparatively small size of group (3). Would have liked more details about the reasons one person (chosen or volunteered) to do the synthesis (mostly). Implications: Links perceived and "practical" affordances with sensemaking loops of foraging and sensemaking. Perhaps relevant to Rieh et al. review of searching and learning.

Looking at the process of gap-bridging. Like the Naveh and Bronstein (2019) study—this does emphasize the importance of individuals making sense with others. Perhaps a type of collective sense-making? Implications: Neither study used SSM interviewing methods—could greater insights might have been obtained if, e.g., the health forum moderator had used full dialogic principles? But shows that some processes of gap-bridging can be identified through re-analysis of information behavior data sets.

Information triangulation emerged as an active and complex practice (seeking, assessment and sense-making, iteratively).

Among this community (overall socially marginalized)—degree of perceived level of authority for health professionals, cultural deference, but often critical. Verified and checked other more convenient, less authoritative information against the more authoritative—stepwise escalation. Other strategies: second opinion triangulation (when young parents felt brushed off by health professionals); expert/lay perspective triangulation—may help in explaining how to do, not just what to do; inclusive or scattershot triangulation. In practice, sometimes a bit of a mix of the four strategies. Noticed that young parents exhibited agency in the face of stigmatizing structures—but need to beware of bias—and impression management by the interviewees. Probably need to have more information about the setting—clearly there's more information about the way health services were delivered and designed for this group that might help interpretation of the findings. Interesting that the interviewees generally took the approach of "well they would say that," putting information obtained against

**TABLE C2** (Continued)

the likely motives and expertise (social context) of the information provider—unless, of course, they recognized a medical emergency when they sought assistance asap. Implications: Could compare with the collective sense-making processes in some of the educational research sensemaking studies where teachers reflected personally on their own experience, discussed with colleagues in school, and with other professional groups, as well as checking out with school principals and district groupings on the changes in practice required.

Identified a set of seventy-seven sense-making situations. Each situation was linked to a precise context that was specific to a moment in time and space (Dervin, 1983) and was imbued with the company's culture, its values, its organization and procedures. The analysis allowed author to identify four categories of situations: cross-functional transversal work situations, situations related to the coordination of business activities, emergency or crisis situations, and change management situations.

I noted this statement "In addition, an organization's competitiveness depends on the ability of leaders to identify and acquire the necessary information to make the right decisions and to build an effective business strategy." This assumes sense making is the same for all leaders as long as top managers have the same information, this assumption is challenged by Dervin's SMM methodology. Is this the case? I wonder.

2/ I noted this statement "Leaders are in need of relevant, reliable and complete information to act: to make decisions, to solve problems, to define strategies and to attend to the daily activities of their entity." this assumes SMM is information (fact) driven, it makes me wonder what about the need for support, empathy and connect?

3/ As the findings were revealed, these points were being addressed subsequently in the paper.

SSM used only in the analysis as the research "subjects" were in effect doing the "sense-making" for themselves and each other, within the virtual health community. It probably helped that they knew the problems of managing their diabetes—this was an initial bond—and were aware of the problems of getting pregnant as a diabetic. Perhaps more about how the dialogic interface worked (or didn't work for some) might have helped—and how did the researchers judge? More evidence would be desirable.

The authors have utilized well Dervin's SSM to provide evidence to support the argument that virtual health communities are useful sources of information and emotional support for diabetic pregnant women to look for their new normal.

The data analysis method is coding in the form of content analysis which Dervin also adopted. Many of the universal verbing categories of SMM such as the situation movement state was developed by "intersecting a deductive set of framework based on Sense-Making's verbing analytic with the inductive qualities of the data (Dervin & Frenette, 2003). The findings are all qualitative in nature. A stronger case can be made if the qualitative findings are supplemented with quantitative data in each theme to review deeper the content of the online posts. For instance, the authors can analyze from the posts which the gap-bridging strategies will be more effective in closing their gaps. There are also some duplications in theme 2b crisis management during pregnancy and socially constructed normal. A graphical model to show the similarity and differences with Dervin's SSM might also be helpful to illustrate the uniqueness of this study. Implications: Neither study used SSM interviewing methods—could greater insights might have been obtained if, e.g., the health forum moderator had used full dialogic principles? But shows that some processes of gap-bridging can be identified through re-analysis of information behavior data sets.

Working definition of collective mindfulness (from Kathleen Sutcliffe's work with the Weick team)—"a quality of organizational attention that increases the likelihood that people will notice unique details and act upon them"—five dimensions are preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, deference to expertise.

Making sense of the unexpected in an IT implementation may involve agreed requirements becoming contested, unanticipated changes in workflows—resolution requires all stakeholders.

Review of the sensemaking challenges in the health IT project—notes that the challenges were thoroughly addressed, and in fact the one small initial change triggered a larger organizational change process. "Anticipating the unexpected"—preoccupation with constraints and preconditions, sensitive to interdependencies, upstream and downstream requirements and consequences, reluctance to premature commitment and "containing the unexpected"—commitment to avoid disruptions and seeking out appropriate mix of expertise. Application of the theory to health care organizations and an actual implementation seemed successful—with some tweaks to the model used for high reliability organizations. Used co-design sessions, and workflow mapping (asking doctors after a meeting, to check on the repercussions of changes). Implications: Sense-making in health IT implementations may require level one standards at organization level with allowance for level 2 standards specific for each department. The main point is that user-centered design and sense-making needs to be aware of the inter-dependencies (workflows), consequences of small changes.

The relationship between the senior archeologists and students reminiscent of Lave & Wenger's communities of practice (and like consultants' firms in hospital). And clearly the ethnographic approach deepened understanding between researcher and participants.

Importance of various senses—not just sight. The professional practice of archeology—and discussions among the team at the sites, communication with other archeologists—understanding the processes of professional practice. Implications: Advocates more use of ethnographic methods in studies that use sense-making—to understand more about how sense-making around artifacts (as "documents") evolves—for the individual and archeologists in general, in a shared domain of practice.

*Internal social media use*

**TABLE C2**  (Continued)

Would have been useful to have gained some views from the employees as well—some reasons were purely functional/technical—not all employees tied to a computer or mobile device. Didn't check whether there were any successful employee forums (face to face, or electronic) in place in some departments prior to ISM implementation. Would findings have changed if there had been a crisis or emergency of some sort? As authors suggest some localization of the intranet might have been helpful—employees might see the point within their section, particularly if they get an immediate sense that their views are being considered. Implications: Shows benefits of a longitudinal approach—to show changes in sensemaking and perceptions. Composite narratives—interviews probably encouraged managers to reflect on the ISM implementation, and the sensemaking changes about its purposes.

*Maker learning*

Hobbies a major inspiration for student projects—actions included finding information, planning, brainstorming, exploring things, trying things out, putting things together, revising and editing.

Action clusters: brainstorming and finding new information, brainstorming and choosing a topic; learning new concepts and exploring things; learning new concepts and developing skills.

Most common emotions: confidence, excitement, pride, anxiety, hope, sense of accomplishment. Action-emotion associations (causing mixed feelings among students)—finding information, trying things out, learning new concepts, presenting.

Finding information (action) co-occurred with excitement, and/or confidence.

Helps—information that they found, tools/resources, teachers etc.

Adapted Dervin's sense-making Mr squiggly to show sense-making through creating, also discussed relationships with Kuhlthau ISP model—relates to zones of intervention. Students worked on individual projects—therefore little evidence of CoP development.

Processes in Overcoming challenges—Asking for help from people, Searching for information, Trying things out and practising, Adjusting.

Proposed model—spiral making process model (brainstorming, trying things out (start positive, but also negative feelings)—revising (frustration and confusion more dominant)—gappy processes, uncertain, iterative and complex.

Interesting application of SSM—space–time, changing emotions, activities, during maker learning development. Examined "situations" during maker learning, in effect. Used SMM but was careful to relate to Kuhlthau ISP in the discussion.

Triangulation of findings—a highly commendable aspect of the methods.

Implications: Interesting application of SMM to maker learning—learning as a process creating artifacts, that are personally meaningful, and contribute to a community.

# APPENDIX D

**TABLE D1** Case study analyses—Education research set.

| | |
|---|---|
| **Marckwordt et al. (2022): Teacher enactment of the crosscutting concepts in next generation science classrooms** | |
| Identified gaps | Most existing studies on CCCs or related "3D" ideas with NGSS are mostly concerned with implementation of units specifically designed to include CCCs and the focus is on student sensemaking. Need for a naturalistic study on teacher sensemaking around CCCs |
| Research questions | (1) What opportunities and challenges do teachers perceive in CCC enactment? and (2) What does CCC enactment look like in middle school classrooms? |
| Research framework | Drew on Odden and Russ (2019) as well as earlier education research sensemaking scholars (Marz & Kelchtermans, Ketelaar). Authors were interested in the subjective, and personal, how personal beliefs about the content, their teaching, and the local context play a part. Stressed how individual and social aspects of sensemaking should be considered—teachers using each other as resources, with informal and formal professional communities involved.<br><br>For analysis, used Rivet et al. (2016) conceptual metaphors (Lakoff & Johnson, 2003) of lens, bridge, tool, rules of the game (devised to make CCCs more accessible) |
| Research design | Naturalistic observation with complementary semi-structured interviews |
| Sample | 13 middle grade teachers in four diverse California districts (all had received some professional development on the CCCs but amount varied). |
| Methods | Two separate class-based observations, fall and spring semester<br>Interviews before and after the classroom session—interviews asked teachers to describe the observed lesson and how they saw it to be consistent with teaching NGSS. The follow-up interviews after the observation also afforded opportunities for us to ask specific questions about the lesson, particularly around CCC enactment—but only when CCC use was observed.<br>Separate mid-year and end-year interviews. These probed attitudes and intentions to use CCCs and other multiple dimensions of the CCCs, and asked about barriers and supports. |
| Analysis | Completed analytic memos after each observation, with researcher's interpretation, with sections noting when aspects of the NGSS, such as the CCCs, were present in the observation, and associated reflections and thoughts on how they were enacted.<br>Examined all the field notes, devoid of commentary, interpretations, and contextual interview data, of the larger NGSS study for all instances of teaching or discussing any of the three NGSS dimensions (i.e., SEPs, DCIs, and CCCs), and we coded the full set of data for instances of three-dimensional instruction, then focused on the CCC dimension of the NGSS. |
| Findings (with emphasis on sensemaking methodology) | Teachers often generalized about their use of CCCs beyond a single lesson … "while we asked every teacher which CCCs they were or were not able to incorporate into their instruction, not every teacher elaborated further about their decisions regarding CCCs, or how they were thinking about the CCCs, or what challenges they encountered."<br>"We became attuned to two aspects of how teachers were using the CCCs—how explicitly they were used and their roles"—notes that use often implicit.<br>Teacher thinking and sensemaking about CCCs<br>• Figuring out the CCCs (and how to use them when questioning students)<br>• CCCs challenging and abstract<br>• Transparency for the students important<br>• Students making better connections to existing knowledge<br>• Teachers being intentional in their selection of CCCs—and then presenting them transparently<br>• Some, not all had formed opinions on how CCCs should show up in the classroom |

**TABLE D1** (Continued)

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|---|---|
| **Marckwordt et al. (2022): Teacher enactment of the crosscutting concepts in next generation science classrooms** | Stressed the ongoing nature of sensemaking by teachers about CCCs |
| Personal reflections by review author (CU) | Productive use of naturalistic observation and semi-structured interviews to examine sensemaking around CCCs and the classroom trials of using CCCs in instruction. |
| | The Rivet framework was helpful in demonstrating that mostly CCCs were used as a lens—to help students focus—but other uses (bridge, tool, rules of the game) might need additional support, as less used, during the current research at least, and might need a series of classroom observations to identify properly. |
| | The empirical research was quite demanding of time and effort, and there were benefits of working as part of a research team. |
| | The published paper does not include any mention of teachers' collective sensemaking—either this did not occur, or (just as likely) most teachers were still at the early stages of figuring out themselves how to use CCCs. They may have wanted more experience before discussing their queries with colleagues. There seems a high level of uncertainty even among those who had worked out how they would use the CCCs. |
| Methodology implications | Sense-making is gradual, and may be iterative, trying out different explanations or testing possible changes to mental models. |
| | Personal sense-making may be easier to study than collective sensemaking—which demands a group of individuals within the same setting having the same or similar gap in their understanding. |
| | Sense-making approach helpful in encouraging individuals to voice and explain their uncertainties and confusions. |
| **Hodge and Stosich (2022): Accountability, alignment, and coherence: how educators made sense of complex policy environments in the Common Core era** | |
| Identified gaps | How educators cope with multiple policy changes, and how the degree of accountability and extent of policy alignment affect sensemaking and implementation of change. |
| Research questions | How did participants across two large, metropolitan districts make sense of multiple, interrelated policies, primarily concerned with the Common Core State Standards (CCSS)? |
| | In what ways did participants see these policies as complementary or contradictory? |
| | How did participants' understanding of the relationships among policies influence their actions during implementation? |
| Research framework | Draws on Weick sensemaking of reform, and organizational change. |
| | Also draws on Honig and Hatch (2004) research on coherence—how do participants make sense when the policies may seem incoherent and ill-matched? |
| | Refers to previous research such as Spillane et al. (2002) on educational policy implementation. |
| Research design | Interview protocols elicited responses on sense-making, including how individual knowledge and beliefs, prior experiences, and social contexts influenced the process of interpreting the standards' meaning and application to instruction. |
| Sample | Two case study sites: one focused on elementary school teachers and principals in a large urban district in New York and the other focused on middle school literacy teachers and instructional coaches in a large metropolitan district in Florida. Both had high accountability (using test results to identify schools with problems and teacher evaluation), but differed in policy alignment with the new standards. |
| Methods | Semi-structured interview protocols, plus other data collection methods. In one site there were 36 teacher interviews, 8 principal interviews, 17 classroom observations, 10 teacher meeting observations, and 5 half- or full-day observations of professional development. In the other there were single ethnographic interviews with 18 middle school ELA and/or reading teachers, 4 school-based literacy coaches, a district-level writing coach, and a district administrator responsible for middle school literacy, plus observations of 100 h of instruction, 10 h of professional development and team meetings, and a public hearing on the CCSS. |

**TABLE D1** (Continued)

| Hodge and Stosich (2022): Accountability, alignment, and coherence: how educators made sense of complex policy environments in the Common Core era | |
| --- | --- |
| Analysis | Coding scheme focused on segments where participants mentioned two or more of the policies together, and coding noted whether goals were complementary or contradictory. Then coded reasons why these perceptions were held. |
| Findings (with emphasis on sensemaking methodology) | Found instances where a sense of incoherence, sometimes educators just overwhelmed by number of policy changes they were dealing with. The accountability led to feelings of stress and uncertainty—and sometimes educators had problems accessing teaching materials. Assessments produced different reactions that seemed to depend on degree of policy alignment between existing assessments and the new system. Principals questioned the sequence of reforms. Discussed how coherence intersected with alignment and accountability. Makes recommendations for improving ongoing alignment and accountability. The authors conclude that coherence is "a perception that is developed and renegotiated over time as educators are confronted with new information and experiences." |
| Personal reflections by review author (CU) | Extensive use of a variety of interview, observation data, plus documentation—to check on what was happening and what support was provided. Focus on coherence was appropriate given the problems in the setting and useful (practically) to consider just how things got incoherent (contradictory policies or the feeling of responsibility for the students' test results, and implications of teacher evaluation). The researchers were also able to observe instances when teachers thought they were complying with the new standards but actually weren't. This indicated the problems of superficial change, such as not matching tasks to student capabilities, etc. This might not have been obvious without extensive observation and cross checking across the data. |
| Methodology implications | Examines some common organizational problems for sense-making I organizations where individuals, working with some degree of autonomy, have to make changes to practice, in a complex situation of change demanding making sense of contradictory policies. Situations where new information is coming in makes adjustments more difficult, particularly when initial interpretations did not cause any alarm bells. Sense-making may be associated with a sense of betrayal. Probably interesting to examine the sequencing of reforms and the reasons for the sequencing. |

| De Luca Picione et al. (2022): The Sensemaking Process of Academic Inclusion Experience: A Semiotic Research Based upon the Innovative Narrative Methodology of "upside-down-world" | |
| --- | --- |
| Identified gaps | Better understanding required of what "inclusion" means for academic education. Accommodating "special needs" is associated with provision of supports of some sort, but those "included" need to construct new meanings—With reference to circumstances, choices and context. |
| Research questions | Does a narrative methodology which includes "polarization of meanings" help understand the process of academic inclusion? |
| Research framework | Uses the notion of semantic polarities, that a meaning is expressed in relation to another that is opposed to it. Detecting difference is the basis of meaning ... Refers to the Greimas semiotic square, an abstract network of relationships illustrating opposition, contradiction and complementarity. Stresses semiotic dynamics—this is not a static, once and for all process. Refers to structural linguistics, cognitive science, psychology, biology and semiotics. |
| Research design | The use of this device (upside-down world) involved two phases as follows: a first narrative task consisting in the request to write their own experience of university inclusion and a second narrative task asks the narrator to transform and flip one's own written narrative into its opposite (also this time in written form). |
| Sample | 8 students in university in Italy. Five different story settings (1) relationship with teachers, (2) relationship with colleagues, (3) motivation that led to the choice of the degree course, (4) job expectations after the conclusion of the studies, and (5) major obstacles encountered in the course of study. Snowball sampling done by students themselves. |

(Continues)

**TABLE D1** (Continued)

**De Luca Picione et al. (2022): The Sensemaking Process of Academic Inclusion Experience: A Semiotic Research Based upon the Innovative Narrative Methodology of "upside-down-world"**

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| Methods | Instructions:<br>1. Tell me about a university inclusion experience of yours.<br>2. Turn your story into its opposite version. You are to flip your narrative into its opposite, without believing that there is an opposite objectively valid for everyone.<br>Collected 25 sets of narratives in total. |
| Analysis | Stage one. Analyzed the "positive" narratives in terms of who (was involved), times and moments, places and events/occasions in which this occurred. Stage two. "we analyzed the entire narrative corpus (obtained from the first and second task) in the following way: Every couple of narrations (the positive narrative with the negative counterpart) was analyzed by detecting the differences that emerged from their comparison. Once the semantic content of these differences was identified and collected, an abstraction and generalization was then carried out in order to allow a comparison between the different results. This process of analysis and judgment took place through the work of interpretation of three independent judges." Produced sets of "fundamental polarities" for each narration. |
| Findings (with emphasis on sensemaking methodology) | Mostly students talked about experiences in the classroom. Temporal dimensions varied—some precise, some extending for long periods. Recurrent polarities are: activity/passivity, stimulating/boring, and profitable/useless—but very varied, and some unique to the individual. "The inclusive experiences represent a positive and fertile development when the two macro-areas/trajectories of sensemaking (positioning and purpose) meet." |
| Personal reflections by review author (CU) | Rather difficult to locate the research questions but largely the aim seems to be testing out a dialogical method.<br>Reminded me a little about teaching younger children about classification, on the "look at this group of leaves from different plants," which seems the odd one out?—removing one and then carrying on with the question—which is different until the groupings are clear enough. |
| Methodology implications | Interesting way of trying to identify the binary and oppositional (semantically) processes of sensemaking. Can study the space–time aspects of sense-making well.<br>Needs advice from a linguist for the semantics/semiotics, as the literature review seemed a little vague, and lacking examples to demonstrate what the authors meant.<br>In addition, any identification of polar pairs need to be discussed and verified with at least one other researcher.<br>Also, presume that this study conducted in Italian so could be difficult to verify the actual findings about the polar pairs, given the things that get lost in translation. The range of meaning for a term in one language does not necessarily match the range of meaning in another.<br>Interesting but a different approach to finding out what matters to an individual—how they are sense-making about the meaning of inclusion, in this case. |

**Lambert et al. (2019): Qualitative exploration of the experiences of renal dietitians and how they help patients with end stage kidney disease to understand the renal diet.**

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|---|---|
| Identified gaps | It is important for renal patients to adhere to renal diet for effective management of the disease. Many studies on non-adherence focused on the perspectives of the patient and the carer.<br>Renal dietitians play a key role on educating renal patients with end stage kidney disease to adhere to renal diet, but only very few studies researched on the perspective of the dietitians. |
| Research questions | 1. What are the experiences of renal dietitians regarding the process of educating patients with end stage kidney disease?<br>2. What are the strategies renal dietitians perceiving as helpful to patients to understand the renal diet to support adherence? |
| Research framework | Drew on Dervin's sense-making methodology (SMM) and its interviewing tool to let the renal dietitians construct their movement of educating the renal patients through the time–space they select to address the gaps, identify the bridges, and use of the gap-bridging strategies to improve renal patient education. A semi-structured interview guide based on SMM was constructed to guide the interview of 27 |

**TABLE D1** (Continued)

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|---|---|
| **Lambert et al. (2019): Qualitative exploration of the experiences of renal dietitians and how they help patients with end stage kidney disease to understand the renal diet.** | renal dietitians. The analysis of the verbatim transcripts was based on the Framework method proposed by Srivastava and Thomson (2009), Smith and Firth (2011), and Swallow et al. (2003). |
| Research design | Semi-structured interviews |
| Sample | A total of 27 renal dietitians predominantly female with a mean age of 43.1 years and most had extensive dietetic and renal dietetic experience working in a variety of geographic locations in Australia. |
| Methods | A total of 27 renal dietitians were interviewed in person or via phone that lasted 30–60 min using a semi-structured interview guide based on SMM. Interviewees were asked to recall the most memorable time, good or bad, when they were teaching a patient about renal diet. The interviews were audiotaped and transcribed verbatim for analysis. No repeat interviews were conducted. |
| Analysis | After the initial line-by-line coding of the transcripts by the authors, the codes were compared and synthesized to produce the final framework that was then applied to the transcripts to identify the main themes via an iterative discussion by all authors. This is to ensure all the perspectives covered by the data were fully reflected in the analysis. |
| Findings (with emphasis on sensemaking methodology) | The study identified three main themes on Question 1 and two main themes on Question 2 in the sensemaking journey of renal dietitians. On Question 1 (experiences of providing dietary advice), the study found that the renal dietitians believe in a) establishing trust and demonstrating empathy with their patients "to help to optimize a patients' ability to effectively self-manage their renal diets." But many of them were working in b) "clinical settings with limited or adequate resources" that they did not have adequate funding, staff, time, and appropriate resources to interact with and address the patients' problems. As a result, the overwhelming emotion described by renal dietitians was c) frustration. (Note: a, b, c denote the three main themes)<br><br>On Question 2, the strategies perceived by renal dietitians to help their patients make sense of the renal diet were a) to clarify ambiguous or contradictory diet information, and b) to simplify complexity by using simple explanations during the education process, prioritizing issues for the patient, providing individualized information and practical support to the patient. ((Note: a, b denote the two main themes)<br><br>The authors found that these strategies were essential to assist patients to make sense of the renal diet advice, and "alternative approaches to patient education are warranted to help to overcome the factors which negatively impact on patient empowerment." |
| Personal reflections by review author (LL) | One of the SMM interviewing mandates are to let the participant talk about their muddles and confusion about the situation they have faced in their time-line, not what they think but what they experienced. But one of the questions asked in the semi-structured interview was "What do you think are the big questions that *patients struggle with* as a result of renal dietary advice?" This is not asking about the struggles of the interviewees, but what they think the struggles of others are.<br><br>The semi-structured interview guide also did not specify the situation, gap, bridges, outcomes of the sense-making time-line. The authors were only interested in using dialogue to explore the experience of the renal dietitians but did not make the full use of the Sense-Making Metaphor (or at least these are not reported).<br><br>The findings were also not related to the full Sense-Making Metaphor to allow the audience to compare and check the research methodology against the results of the study. |
| Methodology implications | Dervin's SMM was useful in informing the research methodology of this study whose aim was to dig out the perspective or the sense-making of renal dietitians in educating renal patients. Using SMM in full to analyze the interviews and interpret the findings—would be a great addition to the increasing evidence base of research that shows that SMM can be effectively applied in understanding the struggles of heath care workers. |
| **Chu (2022): Sensemaking of university and district stakeholders in implementing a teacher residency policy in Louisiana** | |
| Identified gaps | Little evidence on the way all stakeholders interact with each other, within and across organizational contexts, on implementation of a residency program as part of preservice teacher education. |

(Continues)

**TABLE D1** (Continued)

**Chu (2022): Sensemaking of university and district stakeholders in implementing a teacher residency policy in Louisiana**

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| Research questions | How do university and district stakeholders in one teacher residency program make sense of a state teacher residency mandate in implementing the policy? |
| Research framework | Role of teacher residency within teacher education, sensemaking in educational policy implementation (Coburn, 2001; März & Kelchtermans, 2013; Spillane et al., 2002; Weick, 1995, 2005) |
| Research design | Interviews with all types of stakeholder (resident, mentor teacher, university faculty supervisors, etc.) |
| Sample | University in Louisiana (with experience of teacher residency pilot trial), plus 3 partner school districts. 6 teacher residents included. |
| Methods | Data collected in a 2-year span (2017–2019) during the last year of the pilot and the first year of the implementation of the residency at SSU. Maximum variation principle used to select residents and mentor teachers with diverse personal and professional back-grounds. Purposeful and snowball sampling strategies were used to identify and recruit other participants based on their roles in the residency. Observations of classroom teacher planning with mentors and classroom teaching sessions. Each dyad observed 3–4 times during the residency year. Attended residency orientation and debriefing sessions. Collected relevant documentation. Two years of data collection. |
| Analysis | Interview transcripts, observation notes, and documents were imported to MAXQDA, for inductive coding. Constant comparative analysis, looking for negative evidence as well. <br> Findings, draft explanations shared with participants for verification and additions. |
| Findings (with emphasis on sensemaking methodology) | Stakeholders' knowledge and experiences about teaching and teacher learning, institutional position and responsibilities affected their sensemaking about the residency. <br> There were gaps (quite a few), although most agreed with the direction of the policy as a better way of preparing teachers. There was little or no evidence of collective sensemaking of joint enquiry (evaluating success of the program regularly). <br> Nearly all stakeholders were sensemaking individually, e.g. <br> "residents were drawing on their understandings of what constituted 'real' learning about teaching in making sense of the residency in ways of its potential for connecting university learning and classroom teaching and bridging the theory–practice gap …" <br> "Observations of resident classroom teaching also confirmed that they were deliberately experimenting with instructional strategies and activities they learned from university courses in their teaching in collaboration with their mentors." |
| Personal reflections by review author (CU) | Extensive data collection—crosschecking, transparent analysis. <br> Individual sensemaking identified. <br> Noted gaps in communication across organizations, and some conflicting assumptions—drawing partly on social/political beliefs about 'what's wrong with teacher education"—which didn't carry through to a framework for evaluating the teacher residency and proper collaboration to identify and tackle problems. Some contradictory implementation therefore occurred. |
| Methodology implications | Example of extensive observation of relevant events, classroom related activities, and documentation (including policy messages). <br> Maximum variation sampling—ensure some heterogeneity in the participants (so that problems identified were common problems) <br> Credibility of the findings strengthened by the steps taken to share interview transcripts with interviewees, and the panel of subject experts serving as auditors. <br> Mentor preparation lacking (useful to assess the training and professional development provided for any reform). |

**Manuti and Giancaspro (2021): The meaning of the organization or the organization of meaning? Metaphors as sensemaking tools to understand organizational change management**

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| Identified gaps | Part of an action research project to support HRM in an organizational change project |

**TABLE D1** (Continued)

| **Manuti and Giancaspro (2021): The meaning of the organization or the organization of meaning? Metaphors as sensemaking tools to understand organizational change management** | |
| --- | --- |
| Research questions | What were the organization metaphors used by staff when discussing what the organizational changes meant to them, how they made sense of them? |
| Research framework | Weick—but considers the focus on language use as sense-making—seeing organizations as "becoming"—characterized by many social interactions. Uses Morgan's images of organization as the framework for studying language use by staff |
| Research design | In depth individual Interviews—participants chose a metaphor and explained how they saw the company in these terms during the transition. Participants asked about their work experience, the organizational climate, and how they saw the changes, whether they thought their well-being was considered, etc. |
| Sample | 115 staff in one Italian automotive company (excluded top management) |
| Methods | "Individual interviews were audio-recorded and subsequently transcribed. The textual data collected were then analyzed adopting the paper and pencil diatextual methodology. Actually, diatextual analysis is a qualitative discursive methodology precious to penetrate 'how' did participants discursively constructed their experience with special reference to the focused topics of the study (Manuti et al., 2012; Mininni & Manuti, 2017; Mininni et al., 2014)." |
| Analysis | Metaphors reorganized under Gareth Morgan's images of organization framework<br><br>"… three main analytical categories: subjectivity, argumentation, and modality. The acronym of these categories determines the S.A.M. model, a pragmatical support of diatextual analysis allowing to approach to texts by answering to some basic questions (Who is saying that? Why does he/she say that? How does he/she say that?) and consequently to organize the results according to some specific patterns of sensemaking associated to the extreme variability of actors, contexts, and topics of talk." |
| Findings (with emphasis on sensemaking methodology) | Many positive—and some equivocal images of the transformation found—and on the roles of staff (in/out groups, parasites …)<br><br>diatextual analysis and metaphor analysis specifically could allow a 'journey' inside the sense-making processes employees use to figure out their organization. More simply the way they talk about their organization could be suggestive about the way they think about their organization and thus predictive about the way they behave. Yet, metaphors have a huge cognitive power, they contribute to shape meanings, in this case corporate identity, and consequently could differently impact on organizational behavior (Bhati et al., 2014; Cassell & Bishop, 2019; Cassell & Symon, 2006; Gummesson, 2006).<br><br>Gave HRM an idea which levers to pull when implementing changes. |
| Personal reflections by review author (CU) | Interesting approach, although difficult to assess whether all the interviewees were helpful or not—not that many data snippets in the paper.<br><br>Some more details about the approach toward the end of the paper.<br><br>Authors did not consider limitations or problems<br><br>Perhaps more details about the process of the diatextual analysis would have been useful but probably wouldn't survive the translation from Italian into English? |
| Methodology implications | A different approach to trying to analyze how staff talk about the change, how they make sense of the changes in relation to how they see their role within the organization.<br><br>The process of diatextual analysis needs further investigation, but the principles—as outlined—seem straightforward. I might also think of looking out for things the interviewees didn't talk about<br><br>Probably need to get advice from linguist expert on the 'rhetorical' structure of the arguments and justifications. |

(Continues)

**TABLE D1** (Continued)

**Hillman et al.: Educating future managers (scenario planning)**

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|---|---|
| Identified gaps | Strategic management education has been criticized for not providing significant learning experiences that equip managers with capabilities to deal with complexity, employ long term vision, think in alternatives, and have the resilience to deal with complexity. |
| Research questions | How can we educate future managers to develop resilience-related capabilities? What form of learning intervention might equip future managers with resilience-related capabilities? Could a combined learning intervention (i.e., lecture on scenario planning and case study work) be more effective than single learning intervention (i.e., case study work only) to equip managers with resilience-related capabilities to deal with complexity? |
| Research framework | Use qualitative observational study with an experimental character, i.e. case-based learning with simulation elements |
| Research design | The research team developed a specific learning intervention that combines a theoretical input in the form of a 1.5 h lecture (which provided an overview of scenario planning as a strategy framework) and a 5.5 h experiential exercise (case study with simulation elements, where the participants (in groups of 3 to 4 students) took the role of HR managers of a fictional case firm who need to develop HR strategy and strategic options to achieve company goals). The groups received no instruction on how to solve the task, and were free to apply a any strategy framework. The learning intervention was applied in an MBA course on strategic HR management and compared with another MBA course that only used the experiential exercise. |
| Sample | The research team used two parallel MBA courses on strategic HR management. The courses had the same content and differed only in terms of the applied learning intervention. "In the first course (13 students), we applied a synergetic learning intervention (theoretical input + experiential exercise). In the second course (9 students), we only applied the experiential exercise." For the experiential exercise, the research team divided the first course into four subgroups with three to four students each and the second course into three subgroups with three participants each. |
| Methods | The research team recorded the experiential exercise on video and analyzed the material in terms of the groups' processes, behavior, and developed skills. The research team included some quantitative elements to supplement the qualitative data. Data collection took place in January 2015 and involved three steps. (1) a survey was conducted in the beginning of the course to gather information about the students' individual resilience scores, self-efficacy, and team abilities. The questionnaire included 67 items that had to be answered by a 5-point Likert-type scale. (2) Recorded the groups during the experiential exercise on video, so the research team can focus more than field notes and spoken words, and can observe facial expressions, body language, and group interaction. 2314 min of video materials are collected, in addition to groups' work materials (e.g., presentations, flip charts, notes). (3) Another survey was conducted after the group work that included 59 items (5-point Likert-type scale). This allows for controlling group differences concerning group climate and group cohesion. The participants were asked about their perception of the task-related outcomes, intervention effects, and learning effects. The questionnaire for the course with the synergetic learning intervention (lecture + experiential exercise) included five additional questions on scenario planning. |
| Analysis | There are 2 stages to analyze the video data: 1/ In the first stage, the video material was analyzed using elements of grounded theory. Detailed notes were analyzed for recurring themes and identified relevant topics for in-depth analysis. 2/ In the second stage, the identified topics were used as an analysis scheme to compress the empirical data. The research team assigned relevant video sequences to "codes" and to reduce and structure the data. The research team followed a visual mapping strategy and created process flowcharts to illustrate differences in the groups' processes. *Expert Evaluation.* |

**TABLE D1** (Continued)

| **Hillman et al.: Educating future managers (scenario planning)** | |
|---|---|
| | To compare strategy processes and outcomes of the groups, the research team additionally conducted an expert evaluation. Three researchers who have a broad knowledge and practical experience in the field of strategy were chosen. |
| | We compiled a catalogue of criteria that can be used for both learning groups. Although the research team cannot exclude subjectivity as an influencing factor of the experts' rating decisions, the research team maximized the objectivity by applying a two-step evaluation process. Within a Delphi-like process, the experts were asked to rate the results individually using 5-point Likert-type scale. Next, these ratings were brought together and checked for matches. Given a high rate of matches, the nonmatched ratings were discussed by communicative validation and agreed on a consensus in-group. |
| | "In search of appropriate evaluation criteria, we draw from literature that discusses *quality of scenarios* (e.g., Mietzner & Reger, 2005; Nowack et al., 2011), *accuracy of methods* (Yokum & Armstrong, 1995), and *evaluation of business strategy* (Rumelt, 1980)." |
| Findings (with emphasis on sensemaking methodology) | Overall findings: Based on a video analysis of each group's work, the authors identify differences within the strategy processes, strategy outcomes, and resilience capabilities and derive propositions about the potential of this learning intervention to equip future managers with capabilities they need in turbulent times. |
| | Combined learning interventions are consistently superior in terms of the strategy process (structure and outcome), performance outcomes (accuracy, plausibility, creativity, and transferability), and learning outcomes. The analysis further shows a positive influence on resilience capabilities such as anticipation and sensemaking. |
| | "1/ The combined learning intervention positively influences the dynamics of the strategy development process. Specifically, it (a) creates a clear vision of aims, (b) reduces task-related intragroup conflicts, and (c) promotes interaction and a strong focus on task accomplishment. |
| | 2/ The combined learning intervention positively influences the results of the group work in terms of presented strategies. Specifically, the results show a higher degree of (a) accuracy, (b) plausibility, (c) creativity, and (d) usability/transferability. |
| | 3/ The combined learning intervention positively influences individual learning. Specifically, it facilitates (a) general learning and (b)learning from difficulties. |
| | 4/ The combined learning intervention positively influences the development of anticipation capabilities. |
| | 5/ The combined learning intervention positively influences collective sensemaking as it helps overcome the tendency of excluding negative or ambiguous developments in strategy making AND as it helps overcome the tendency to withdraw from complexity AND it enhances the individual capacity to interpret contradictory messages and transform them into a coherent overall picture." |
| Personal reflections by review author (BC) | Human sense-making is perceived as a challenging process. It creates discomfort and the process can be "disliked," even though the process yields new learning, understanding and positive outcomes. |
| | This means that the person going through sense making process needs to be disciplined and self-aware, to accept the ambiguity and unknown, and to use diverse information (in this case, strategic planning framework), insights from peers and past knowledge and experience from oneself, to find a way forward. |
| | *This also means the person going through sense making process is more reflective and tolerant of what they do not know, consider both positive and negative aspects and are more aware of what they might not have considered. As a result, they are also more critical of the outcomes they have developed.* |
| Methodology implications | Reflecting deeper on the research methodology used in this article, I cannot see how it is in line with Dervin's SMM which focuses on a dialogic and discipline process for the researcher to look through the eyes of the respondents. |
| | My conclusion is that the research methodology is expert-led, the methodology to understand the worldview of the respondents is structured by the pre-defined questions and criteria set by the experts (and therefore not dialogic and communicative in nature), and the interpretation of the respondents' experience is done by the experts. |
| | The respondents are being observed and do not have a voice outside the framework provided by the research team. |

**TABLE D2**  Table of observations EDUC.

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| Stance and research framework | Subjective and personal, personal beliefs<br>Individual and social aspects of sensemaking<br>Use of conceptual metaphors<br>Use of coherence—How do participants make sense when policies may seem incoherent and ill-matched?<br>Using "semantic polarities"—that a meaning is expressed in relation to another that is opposed to it—Detecting difference is the basis of meaning (relations opposition, contradiction, complementarity—Greimas semiotic square)<br>In some respects, sense-making by health professionals about supporting sense-making by patients in critical diet choices<br>Sense-making by all the stakeholders involved in a new program of teacher education of teacher residency, with mentor teachers<br>Focus on language as sense-making—Seeing organizations as "becoming," characterized by many social interactions<br>Case based learning (simple) with case-based learning plus scenario planning plus simulation (aim to improve capabilities in sensemaking and resilience) |
| Purpose | Teacher (as opposed to student) sensemaking about cross cutting concepts for school science education<br>Understanding how educators make sense of multiple policy changes, and the degree of accountability and extent of alignment affect sensemaking<br>Testing out a narrative methodology that includes "polarization" of meanings—to understanding the process of academic inclusion<br>Finding strategies to help patients comply with a restricted diet<br>Identifying gaps in the implementation that affected the sensemaking of the stakeholders and a better shared understanding of what the program could achieve, and was achieving.<br>What were the organization metaphors used by staff when discussing what organizational change meant to them?<br>Improving capabilities of managers to deal with complexity, thinking about alternatives |
| Methods | Naturalistic observation with complementary semi-structured interviews<br>Natural variation case study, with semi-structured interviews, observations (classroom, meetings, professional development events)<br>Narrative task (variety of story settings for inclusion)—write first the experience of inclusion, then transform and flip the narrative to write it into its opposite (without believing there is an opposite objectively valid for everyone)<br>Interviews (SMM) based with health professionals to examine approaches used to help patients with end stage kidney disease to adhere to the renal diet.<br>Extensive data collection over 2 years, interviews, observations around classroom activities, documentation with use of qualitative data analysis software.<br>Interviews, in depth, with participants chose a metaphor and explained how they saw the company in those terms during the transition.<br>Video-recording and analysis, before-after scores on students' resilience, follow-up surveys on participants' perceptions. Video-based analysis used a visual mapping technique to create process flowcharts indicating differences in the groups' processes (control group and experimental group) |
| Observations from the field | "not every teacher elaborated further about their decisions regarding CCCs, or how they were thinking about the CCCs, or what challenges they encountered"<br>"we became attuned to two aspects of ... using the CCCs—how explicitly they were used and their roles"<br>"ongoing nature of sensemaking"<br>Accountability led to feelings of stress and uncertainty among participants<br>Coherence is "a perception that is developed and negotiated over time as educators are confronted with new information and experiences"<br>"every couple of narrations (*positive with negative*) was analyzed by detecting the differences that emerged from their comparison. Once the semantic content of these differences identified and collected ... abstraction and generalization carried out ... to allow comparison between different sets of results ... *to produce* ... fundamental polarities."<br>One of the SMM interviewing mandates is to let the participant talk about the muddles and confusion they have faced in their timeline, but one of the questions asked in the study of the dieticians was "what do you think are the big questions that patients struggle with, as a result of dietary advice"—views on someone else's experiences, not the experiences of the participant.<br>"residents were drawing on their understandings of what constituted 'real' learning about teaching in making sense of the residency in ways of its potential for connecting university learning and classroom teaching and bridging the theory–practice gap ... Observations of resident classroom teaching also |

**TABLE D2** (Continued)

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| | confirmed that they were deliberately experimenting with instructional strategies and activities they learned from university courses in their teaching in collaboration with their mentors." <br><br> "diatextual analysis … approach to the texts by answering some basic questions (who is saying that, why do they say that, how do they say that) … diatextual analysis and metaphor analysis … journey inside the sense-making processes employees use to figure out their organisation." <br><br> "the combined learning intervention positively influences collective sensemaking as it helps overcome the tendency of excluding negative or ambiguous developments in strategy making, and it helps overcome the tendency to withdraw from complexity and it enhances the individual capacity to interpret contradictory messages and transform them into a coherent overall picture" |
| Personal reflections | Sensemaking research demanding of time and effort, benefits of working as part of a research team <br> Collective sensemaking may require some degree of personal sensemaking prior to discussion with colleagues, in some circumstances <br> Value of observations—to detect instances when teachers thought they were complying with the new standards (but weren't). Extensive cross checking across observations, documentation and interviews. <br> Temporal dimensions of events—some precise, some extended for long periods—space–time aspects of sense-making <br> To what extent can adaptations be made to existing sense-making methodologies—without compromising the credibility and validity of the findings? Sometimes difficult to illustrate all the methods used in a 5000 word journal article, and show the process of analysis. <br> Individual sensemaking, resulting from gaps in collaboration and evaluation mechanisms, meant that collective shared understandings of what a program could and did achieve was compromised <br> Not much detail on the process of diatextual analysis (but this may be difficult to translate meaningfully). The purpose of the research was to provide human resources staff with some ideas of how to ease the process of change, so emphasis was on what ideas were most useful. <br> Human sense-making is perceived as a challenging process. It creates discomfort and the process can be "disliked," even though the process yields new learning, understanding and positive outcomes … need for disciplined approach, self-awareness, ability to use diverse information, insights from peers, past knowledge and awareness. |
| Methodology implications | Sensemaking gradual and iterative, trying out different explanations, testing changes to mental models <br> Sense-making approaches help individuals to voice and explain their uncertainties and confusions. <br> Temporal issues when new information is coming in all the time, making adjustment difficult, particularly when initial interpretations did not cause any alarm bells. <br> Probably interesting to examine the sequencing of reforms and reasons for the sequencing. <br> Novel approach to identifying the "binary and oppositional" (semantically) processes of sensemaking. But needs the advice of structural linguists—and linguists interested in the structure of narratives. And the actual findings may be specific to one language, as the range of meaning of a word in one language does not necessarily match the range of the nearest best translation of the term in another. <br> Can be dangerous to apply "bits" of a methodology, rather than appreciating the stance, why some circumstances, and why some methods of analysis are likely to be more useful and appropriate than others. <br> Maximum variation sampling—ensure some heterogeneity in the participants (so that problems identified were likely to be common problems) <br> Credibility of the findings strengthened by the steps taken to share interview transcripts with interviewees, and the panel of subject experts serving as auditors. <br> Metaphors—useful in eliciting the ways individual employees thought about organizational change—but also have instrumental effects for leaders in "shaping" ideas. Need to be wary of over-interpreting a metaphor—"family" may have very different connotations, for example. <br> In an educational setting, the methodology (e.g., scenario planning) for encouraging sense-making may be prescriptive, using predefined questions and expert-led criteria. This not full sense-making as understood in Dervin's SMM which focuses on a dialogic and disciplined process for the researcher to look through the eyes of the respondent. |