

Research Notes

Formulating design research questions: A framework



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This research note addresses the formulation of questions in design research. On the premise that well formulated research questions have far-reaching implications for other aspects of the development and impact of research, articulating quality research questions is an issue of the highest concern. In this note we propose a framework for the formulation of research questions, adapted from clinical research and tailored to empirical design research. The framework, RIN. AFE, pertains to criteria for effective research questions: on the substance side, Relevant, Interesting and Novel; on the methodological execution side, Appropriate, Feasible and Ethical. The application of this framework is demonstrated through an analysis of an award-winning Design Studies paper.
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Questions are fundamental to research and discovery. We open this research note with a short historical consideration of the role of questions in inquiry, in research generally, in design processes, and finally, in design research. We then briefly present a generic framework for research questions, developed in the context of clinical research and elaborate on the issue of transferring concepts, frameworks and methods from one discipline to another. Modifications to the generic framework are then introduced to adapt it to empirical design research, which are then exemplified in an analysis of a selected paper published in Design Studies. We conclude with reflections on the value of the proposed framework and its potential future extension to other types of design research.

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1 Research questions

1.1 Questions in inquiry and in research

Asking questions as a way to explore issues, probe into consequences, think of alternatives, raise new concepts — is a very ancient mode of enhancing thought and knowledge. Thanks to Plato, we have a rich documentation of the Socratic method of teaching, which has come to be known as *Socratic questioning*. In this method Socrates (c. 469 BC-399 BC) would ask questions to which his students (or other interlocutors) gave answers, and in the ensuing discussions complex issues would be resolved, and learning would take place. A dialog could develop (*Socratic dialog*) that encouraged independent, reflective and critical thinking (Edman, 1956). In the words of Paul and Elder (2007, p. 36), “Socratic questioning is disciplined questioning that can be used to pursue thought in many directions and for many purposes: to explore complex ideas, to get to the truth of things, to open up issues and problems, to uncover assumptions, to analyze concepts, to distinguish what is known from what is not known, and to follow out logical implications of thought. The key to distinguishing it from other types of questioning is that Socratic questioning is systematic, disciplined, and deep and usually focuses on foundational concepts, principles, theories, issues, or problems.”

Questions are key to learning; indeed, as put by Elder and Paul (1998, p. 297), in reference to Socratic questioning: “Thinking is driven not by answers but by questions.” They go on to state: “Had no questions been asked by those who laid the foundation for a field...the field would never have been developed in the first place. In fact, every intellectual field is born out of a cluster of questions to which answers are either needed or highly desirable. Furthermore, every field stays alive only to the extent that fresh questions are generated and taken seriously as the driving force in a process of thinking.”

It is safe to say that questions are the base on which inquiry takes place in all domains, and the Socratic mode has shaped our approach to inquiry to this day. The dominant research paradigm, which calls for one or more research questions based on identified gaps in knowledge in a certain domain, is a direct descendent of the Socratic practice.

In the Socratic tradition contemporary scientific inquiry requires that there be research questions that a research project sets out to address. In many domains research questions are translated into hypotheses, which must be confirmed by systematic and reasoned research activity, and if they are disconfirmed, the failure to confirm them necessitates sound explication.

Articulating a suitable research question is a primary condition for embarking on a successful research project, which is typically articulated at the outset of

the project. Well-formulated research questions are believed to lead to quality research (e.g., Agee, 2009; Lipowski, 2008). Contemporary research guides stipulate the research question as the starting point and stress its importance. For example, the Cornell University Library publishes ‘The seven steps of the research Process’, wherein step 1 is: “Identify and develop your topic”; it summarizes: “State your topic as a question.” (<https://olinuris.library.cornell.edu/content/seven-steps-research-process>). A large number of similar online guides list between six and ten essential research steps, the first of which is the identification of a research question. Price et al. (2015, p. 31) state: “Good research must begin with a good research question. Yet coming up with good research questions is something that novice researchers often find difficult and stressful.” While this statement was made in the context of psychological research, it is broadly applicable to most research domains. We acknowledge the fact that for certain types of scholarship, an a priori research question is not a prerequisite. These may include critiques of existing theory, historical accounts, reviews, or proposals for new research methods. Other methods, including some open-ended qualitative approaches to social inquiry, can proceed without an explicit research question, allowing ‘unmotivated’ observations (see, e.g., Bryman, 2007) to direct the shape of the investigation as it develops. However, even in such cases, questions remain fundamental to inquiry. A research contribution is always a response to a need, which can invariably be expressed as a question. However, in empirical research, on which we focus our attention in this note, research questions are the norm.

We now address research questions in design processes and in design research.

1.2 Questions in the design process and in design research

Design differs from science in major ways. It can be conceptualized as problem-solving (defined in the broadest sense possible), where problems do not necessarily precede solutions, but the two are developed concurrently (Dorst & Cross, 2001). Therefore, questions occur throughout the process of designing. Design research, however, resembles research in other domains and with the exceptions noted above, it normally commences with a research question, especially as concerns empirical research.

Cardoso et al. (2016) looked at questions asked in the course of the ideation stage of a design process in which a multidisciplinary team of students was engaged. They were interested in the influence question-asking has on the framing and reframing of design ideas. They classified the students’ questions into three categories, adopted from Eris (2004): low-level questions, and two classes of high-level questions: deep reasoning questions, and generative design questions. They found that the posing of high-level questions follows a state of dissatisfaction with the current state of affairs, and triggers a change of course, which these authors call an inflection moment. What this means is

that the level of abstraction of the design conversations changes from detailed and concrete, to a more abstract level, which allows new concrete-level directions. Inflection moments have the potential of becoming break-through moments that pave the way to a successful design solution.

In this view, important questions that shape the course of design come about in reaction to a given unsatisfactory situation, in order to facilitate a change in the direction in which the process is steered. Going up a rank in the ladder of abstraction is what allows this change, because abstractions are open to more than singular applications at more concrete levels. High-level questions are the more significant and impactful questions, but low-level questions are also necessary to make sure the process progresses and is comprehensive. To summarize, in design problem-solving, and especially during idea generation, the premise on which the process was launched is of little consequence; high-level questions that follow fixation, stuckness or another dissatisfactory state in the process, allow changes of direction that open new horizons for design.

Good design research questions do more than provide straightforward evidential answers to those questions. They draw out implications for other levels of research, e.g., for theory, for conceptualisations of phenomena, for methods of inquiry or for methodology. We bear in mind that like design practice, design research can sometimes be highly explorative in nature (Schön, 1983) and may require immersion and trial before fully formed research questions can be articulated. However, in reporting research, a research question precedes the details of the case in question, whether the methods used are quantitative or qualitative. Socratic questioning seems especially relevant to the process of forming high-level design research questions, in that often, problems must be *found* before they can be solved.

This research note unpacks some of the characteristics of research questions in design, in particular empirical design research. By this we mean evidence-based research that focuses on observed phenomena or explores hypotheses regarding design behavior in its widest sense. Often such research is experimental, but it may also rest on data collected by means other than planned experiments (e.g., ethnographic data or case studies). We take our initial point of departure from clinical research, which has proposed the FINER (Feasible, Interesting, Novel, Ethical, Relevant) framework for research questions (e.g., Fandino, 2019), and revise it for design research into RIN. AFE. RIN (Relevant, Interesting, Novel) pertains to the base requirements of a research question, while AFE (Appropriate, Feasible, Ethical) relates to the selection and execution of methods. The two are intrinsically co-dependent; together they provide a guide for articulating valuable questions in design research. Good questions frequently generate new avenues of inquiry; in this they resemble high-level questions raised in the design process (but unlike in the design process, they are not necessarily the result of dissatisfaction). We

show how carefully formulated research questions carry significant implications for several interlaced aspects of research, including its grounding in literature, its conceptualization of phenomena, its choice of methods, and its contributions.

2 Translating a framework for research questions

2.1 Transferring and adapting from other fields

One of the assets of scientific work is that despite the fact that it is (still) conducted largely within disciplinary frameworks, it is open to interdisciplinary collaborations (see [McComb & Jablokow, 2022](#)), shared methodologies, the use of concepts and theories from other disciplines, and the borrowing and adaptation of frameworks and formats. The dynamic influence that research in one discipline can have on research in another is a blessing: it permits disciplines to not ‘reinvent the wheel’, where it is needless and wasteful to do so. If a discipline can benefit from work done in another field, why not take advantage of the opportunity to do so? The mere recognition that one can utilize work done elsewhere within a discipline that can benefit from it is a creative act that requires the identification of the opportunity and the introduction of adaptations where necessary.

[Amundson \(1998\)](#) described the state of the art in the young (at the time of writing) field of operations management (OM), which is responsible, according to her, for the scarcity of theory in that field. To alleviate this deficiency, she suggested that “by learning from other disciplines, OM can exercise prudence without painfully ‘reinventing the wheel’.” (p. 341). The main field from which she recommended ‘importing’ concepts is transaction cost economics (TCE), from which she saw fit to transport the concepts of asset specificity, opportunism, integration, and efficiency. These concepts were seen as matching the needs of OM. Amundson posited that the non-exhaustive criteria for importing theory from other fields are matching issues being studied, consistent meaningful concepts; significant explanatory power, and matching underlying assumptions ([Amundson, 1998](#), p. 353).

Historically in design, the fruitful interdisciplinary cross-pollination has worked in both directions. [Frey and Dym \(2006\)](#), for example discussed validation of design methods, showing how certain validation models can be adapted from clinical studies to engineering design. Three specific areas were explored: robust design, axiomatic design, and design decision making. The authors did so by drawing analogies between clinical research, design theory and methodology, in terms of what is validated, outcomes, developers, professions involved, and standards for validation ([Frey & Dym, 2006](#), p. 48).

A notable example of successful transfer of a concept and framework from design into another field, is Christopher Alexander's theory of design patterns in architecture, that found its way into software engineering. *A Pattern Language* (Alexander & al., 1977) is a collection of some 250 patterns that can be used flexibly and intuitively to design buildings and larger built environments. The idea is that these patterns form a timeless 'language' that can be used in endless combinations to design any kind of structure or bigger edifice, wherein the patterns are adapted to the individual needs of the various cases. The idea was to allow laypeople to design homes, other structures, and communities on their own. The concept was well received but over time has not had a serious impact on the world of design, planning and construction. However, the ideas were picked up by designers in other fields and have been especially impactful in software engineering, where they are used abundantly (Gabriel, 1996). The original concepts spread further into other disciplines, e.g., communication systems (Schuler, 2008). Obviously, the patterns in software design or communication systems are different than those in architecture and planning; what has been transferred is the concept of patterns and the technique of creating and using them for a given discipline. A similar case, though less impactful, is the concept of shape grammar, originally conceived for paintings and sculptures, but developed mainly for architectural design (Stiny, 1980), which has also spread into engineering design (Cagan, 2001).

In light of the above, we are suggesting a framework for the formulation of design research questions, 'importing' an extant framework from another discipline, which we see as a profitable starting point, if the original framework is suitable. In the next sections we lay out a framework that we have adapted from clinical research.

2.2 The FINER framework in clinical research

Clinical research is a domain in which the central role of research questions is stressed: according to Riva et al. (2012) questions are so important that they account for one third of the time invested in the entire research project. Dissatisfaction with the current state of affairs is expressed by Mayo et al. (2013), who claim that three out of ten published clinical research papers would have needed a major rewording of the research questions they present. In recent years two frameworks have been presented in this domain that spell out the criteria for good clinical research questions: the first is PICOT: Population, Intervention, Comparator, Outcome and Time frame (which we shall not further comment on as it is very specific to clinical trials), and the second is FINER: Feasible, Interesting, Novel, Ethical and Relevant (Cummings et al., 2007; Fandino, 2019). This is a much more generic framework that is of particular interest to us because of its suitability to design research.

Fandino's (2019) main features of FINER criteria, as adapted from Cummings et al. (2007), are briefly described below. These criteria are equally fitting for clinical research as embedded in FINER, and for design research.

2.2.1 Feasible

Obviously, the first condition for carrying out a research project is that it be feasible. This means the allocation of suitable resources (including a budget); an adequate design of the research; available skills and access to information; and finally, a reasonable time frame. If participants are to be recruited, they must be realistically recruitable, and appropriately representative of the relevant population.

2.2.2 Interesting

No research-based publication is going to have an impact if it is not addressing a question or issue of interest, in an accessible way. A major criterion of *interesting* highlights unique dimensions with respect to the mode of presentation of the questions to be answered by the research, and the story for the research field that can be told through the study and analysis.

2.2.3 Novel

Novelty and relevance are the most necessary, if not sufficient, criteria for the success of any research project and the impact of publications based on it. Novelty can vary in scope from somewhat novel to drastically novel, which might involve inter alia challenging extant theories or underlying assumptions or postulating new ones. Novelty also relates to identifying specific gaps in the field's current understandings or approaches to the investigation of phenomena, or the application of theories or findings to new subdomains.

2.2.4 Relevant

Topics that are high on the agenda of the research community at a given time and are consequential for future lines of inquiry are inherently relevant. Relevant questions have an identifiable audience in the community, and the results of their investigation have consequences for active programs of research.

2.2.5 Ethical

It ought to go without saying that research must be ethical and therefore research questions must lead to actions that are in no way ethically conflicted. Research must be ethical regarding participants and it must be transparent regarding all aspects of the data used. Others' work must be meticulously acknowledged.

2.3 *RIN.AFE – a modification for a framework in design research*

The FINER framework is broadly suitable to design research, with necessary adaptations. We have added a sixth criterion: appropriate, as it has particular relevance to the pluralistic state of design research. The framework was reorganized and named RIN. AFE, to clearly distinguish between two types of criteria: conceptual, for research question robustness, and choice of methods and their implications, such that they best serve the investigation of the concepts. The conceptual criteria are RIN: R (relevant), I (interesting), and N (novel). The subordinate (but equally important) methods criteria that serve the conceptual ones are AFE: A (appropriate), F (feasible), and E (ethical). This distinction is made because we have encountered cases of mismatch between concepts and methods in design research. Sometimes a good research question is treated with inappropriate research methods; other times adequate methods are (mis)used to investigate a dull research question on which (for the field) very little hinges. For example, banal comparisons between manual sketching and sketching with computational tools in the ideation stage of design, using students as participants, are simple to conduct, but can seldom resolve meaningful open questions for design research. In early studies, when computational drawing and sketching applications were new, comparing their use to manual drawing was relevant and timely. Years later, such comparisons have lost their luster.

Adding to the generic properties of the FINER criteria described above, the following are specific adaptations in the new RIN. AFE framework, with an extended elaboration on the new criterion, Appropriate.

2.3.1 *Relevant*

A relevant design research question locates areas in the field that are currently underdeveloped and leave room for much new knowledge to be generated. For example, a few decades ago, when it became evident that the design methods that were rigorously developed in the 1960s and 1970s failed to achieve the expected results, research into design cognition was pioneered, after it became clear that designers' in-situ reasoning and actual behavior in the process of designing must first be understood. New design questions were then asked, for instance with respect to the role of sketching in the design process. Relevant design research must likewise lead to research that participates in theory building and current debates regarding design phenomena.

2.3.2 *Interesting*

There is a very close, and sometimes overlapping relationship between *interest*, *novelty* and *relevance* in research questions, on account of the fact that newness and relevance of the questions being investigated can make for inherently interesting studies. To be interesting, design research questions must be

grounded in current and past discourse, and they must open new lines of inquiry. This is especially important in empirical design research which is a relatively young field that must open up research avenues for PhD students and early-career researchers.

2.3.3 Novel

To be novel, a research question in design must add to the current disciplinary discourse. Obviously, not every research question can be a game changer or make a significant breakthrough in the field. However, every publication must advance a modest contribution to the state of the art that furthers the field's understanding of issues or phenomena and advances its discourse. Novelty may refer to a wide spectrum of issues, including methodological ones: introducing alternative research methods may lead to important advances in design research, as evidenced in the example in section 3 of this paper.

2.3.4 Appropriate

There is a tight coupling between the questions under investigation and the methods used to illuminate them. The 'appropriate' criterion looks critically at the fit between the concepts and relationships embedded in the research questions, and the methods, data and evidence marshalled to illuminate those questions. This must especially be the case in design research, where there is a diverging methodological plurality (Roth, 1999; Matthews & Brereton, 2014). A consensus on families of research methods for the investigation of design is increasingly unlikely. Empirical design research has used generic methods such as protocol analysis (originating in the behavioral sciences) and case studies, combined with various levels of statistical analyses. But there are also empirical studies that are entirely qualitative, using anthropological methods such as longitudinal ethnographies (Bucciarelli, 1994), or socio-linguistic approaches such as discourse analysis (Lloyd & Busby, 2001) and conversation analysis (Button & Sharrock, 2000), or sociological approaches such as grounded theory or ethnomethodology. There are also some examples of theory-driven methods that have been developed specifically for design research, such as C–K, used in engineering design (Hatchuel & Weil, 2003), or Linkography, based on protocols (Goldschmidt, 2014), which has been conceived for design research but is being used in other fields as well.

Appropriateness is predicated on choosing the most fitting methods, that is, the method that promises to best illuminate the phenomena under investigation and lead to results that are reasonable. In design research, this is particularly important, as there are very different and often incommensurable approaches to the conduct of research. For example, while most traditional or generic modes of empirical analysis rest on some form of coding practices that rely on inherent, stable and identifiable ontological distinctions between phenomena, more recent theoretical approaches used in design research

such as actor-network theory are predicated on dissolving inherited conceptual distinctions such as subject/object, social/material or nature/culture (see e.g., [Latour, 2012](#)). In such circumstances, even if two studies share a superficial interest in, e.g., ‘social’ or ‘cultural’ aspects of design activity, a set of studies under one methodological auspice cannot be glossed over or easily reconciled with others when such stark methodological differences exist. For this reason, the justification of an ‘appropriate’ research question in terms of its methodological orientation, aimed to serve the aims and ambitions of the study, is of particular importance in design research. In empirical design research, as in other empirical research, recruiting the right kind and number of participants is of utmost importance (see [Cash et al. \(2022\)](#) for a discussion on sampling in design research).

2.3.5 Feasible

For the research to be feasible, the research question must be formulated conscious of the volume of data or evidence needed to resolve the question. For instance, a sufficient number of participants must be recruited; if the generalizability of a result to a larger community is important, participants must share representative characteristics with the relevant population. For example, the general conclusions one can reach about design behavior when all participants in a study are students, are qualitatively different (and significantly attenuated) in comparison to those which can be reached from studies involving, say, experienced professional designers. The research question must a priori acknowledge limitations concerning the methods used, including issues regarding participants, demographic (or other) bias in selection, generalizability, etc.

2.3.6 Ethical

Ethical research principles, especially in empirical research involving human participants, are largely universal following from multilateral agreements such as the Helsinki Declaration. It is worth reiterating the need for obtaining informed consent from participants, transparency about the purpose of the research, and the use, storage and protection of identifiable or potentially identifiable data. Publications must make transparent how data has been worked with, collected, transcribed, organized, analyzed, coded, thematized (and by whom). Furthermore, within published work, the appropriate acknowledgement and recognition of others’ contributions is an ethical cornerstone.

[Table 1](#) is a comparison between criteria for research questions in clinical and design research, as represented by the FINER and RIN. AFE frameworks. We then provide an example of a notable design research project that, we posit, poses a research question that demonstrates the value and applicability of the RIN. AFE framework, and provides an opportunity to explicate each of the six criteria in relation to design research.

Table 1 Comparison between major FINER and RIN.AFE criteria for research question

	<i>FINER criteria</i>	<i>RIN.AFE criteria</i>
Relevant	<ul style="list-style-type: none"> • Generates new knowledge • Provides an accurate answer to a specific research question • Stimulates further research • Contributes to improve clinical practice 	<ul style="list-style-type: none"> • Locates currently underdeveloped areas of inquiry in the field • Develops current theoretical debates and conceptualizations of design phenomena
Interesting	<ul style="list-style-type: none"> • Attracts the attention of readers • Engages the interest of principal investigators • Presents a different perspective of the problem 	<ul style="list-style-type: none"> • Grounded in current and historical design research • Contributes to current discourse • Excels in presentation
Novel	<ul style="list-style-type: none"> • Resolves a gap in the existing literature • Generates new hypotheses • Improves methodological flaws of existing studies 	<ul style="list-style-type: none"> • Brings new issues to current discourse • Opens new lines of inquiry • Uses alternative methods to shed new light on design phenomena
Appropriate	—	<ul style="list-style-type: none"> • Tight coupling between the questions investigated and the methods used to illuminate them • Fit between research questions and data collected • Proof of viability for original methods
Feasible	<ul style="list-style-type: none"> • Ensures adequacy of research design • Recruits target population strategically • Aims at an achievable sample size • Accounts for clinicians’ commitment; Procures high adherence to the treatment and low rate of dropouts 	<ul style="list-style-type: none"> • Ensures adequacy of research design • Ensures access to the right type and number of participants • Recognizes limitations of available/chosen methodology
Ethical	<ul style="list-style-type: none"> • Complies with local ethical committees • Safeguards the main principles of ethical research • Guaranties safety and reversibility of side effects • Protects patients’ privacy 	<ul style="list-style-type: none"> • Complies with ethical principles and committees • Transparency with respect to data collection and handling • Acknowledges others’ work • Protects identities of subjects

3 The framework exemplified

To demonstrate the use of the RIN.AFE framework, we look at a paper published in *Design Studies* by Andy Dong (2005), one that received the *Design Studies’ Best Paper Award* for its year of publication. This paper reports empirical research, which is the kind of evidence-based research we focus on in this research note. Below we describe the paper and analyze it in terms of the RIN.AFE framework to show how it exemplifies a sound research question and judicious selection of methods to address its question.

3.1 Andy Dong: the latent semantic approach to studying design team communication

The paper lays out its central question in the first sentence of the abstract: “How does a team of designers come to construct knowledge about the artefact that they’re designing?” (Dong, 2005, p. 445). Dong claims that while various methods have been employed to explore similar questions, “the structuring of communication as scaffolds for knowledge construction has never

been measured directly.” (ibid., 445). In this paper Dong describes a way to do just that. He uses Latent Semantic Analysis (LSA) to analyze and measure verbal communication in design teams, and further shows how the values obtained correlate with the success or failure of these teams in their tasks, as independently determined by judges. With LSA he measured the co-occurrence of vocabulary, coherence of thought and the formation of a socially held representation of the designed artefact. He concludes that evolving similarity of language used by team members is decisive to their common knowledge construction, which is vital to the formation of a shared mental representation of the designed artefact, and therefore to its success.

The starting point of this study, like a host of other studies, is that verbalizations by designers while working on a design assignment are critical to the understanding of the design process, especially in teams. The acknowledgement of this criticality had led to a wide adoption of the protocol analysis method to the study of designing as of the 1970s, pioneered by Charles Eastman (1970), and utilized mainly to investigate cognitive issues related to the design process. Protocol analysis, which is labor intensive, is very useful for relatively short vignettes, but is of limited value for very long protocols, let alone big data, since to date, it has not yet been automated successfully. The limited scope of protocols analyzed this way raises criticism regarding the generalizability of findings and conclusions derived from protocol analysis studies.

Dong’s paper addresses this gap by introducing a methodology that has the advantages of protocol analysis but overcomes its limitations. LSA is a computational technique in natural language processing that uses sophisticated formal modelling that can deal with large data sets; it is presumably accessible only to specialized researchers who have sufficient algorithmic and statistical knowledge and skills. Dong is one of them. We now examine his research question in terms of the RIN. AFE framework; first RIN, which pertains to contents.

3.1.1 Relevant

Analyzing team activity in design has been a “hot” topic in design research. Understandably, knowing what the keys to successful team design efforts are, has potentially important implications for both theory and practice. It is a complex and multi-faceted topic and any advances in this domain are significant for design, for research of groups, as well as for situated cognition studies. Dong argues that LSA has the potential to deal with communication nuances in near real-time, something impossible with prior analyses. Therefore, breaking a certain deadlock reached in protocol analysis studies in design research is a highly relevant mission.

3.1.2 Interesting

Presenting a new approach to analyzing the verbal output of team design sessions is inevitably interesting – a breakthrough in the impasse described above raises much interest, and Dong’s paper directly addresses this challenge. Prior work that has sought similar objectives in the analysis of team design activity is amply reviewed in the paper. Moreover, despite the fact that sections in the paper in which the algorithms used are described will not be accessible to every reader for lack of background knowledge, the arguments and the discussion are still coherent to the average reader, who can therefore follow the text even without understanding the entirety of its intricate mathematical basis. This is possible owing to the clarity of writing, which unfolds the topic in a story-like manner.

3.1.3 Novel

It follows from the introductory text above that the research question being addressed is highly novel. To our knowledge, Dong was the first researcher to apply LSA to studies of design. Shortly before this piece, he published two papers on this topic (Dong, 2004; Dong et al., 2004), and continued to work on this topic after the current paper. The paper has been influential judging by several measures, including its subsequent citations, and that elsewhere it has been taken as an exemplar of experimental and observational studies, e.g., in Cash et al. (2012). Additionally, the approach was later picked up by other researchers as well (e.g., Casakin & Singh, 2019). The novelty of Dong’s study lies in that he took a new computational linguistics technique and applied it successfully to data documenting design conversations. The variables he analyzed were the congruence of communication and knowledge convergence, which are testable with LSA and as Dong has shown, are important indicators of successful team design. These variables, which have not been identified by other design researchers, are relevant to the topic of team effectiveness and were chosen in accordance with the method’s analytic capacity. The result is a novel, sophisticated piece of research that can be corroborated in other studies, which is evidence of a high-quality research question. Within the paper, Dong explicitly argues its novelty with respect to the (then current) lack of effective metrics for evaluating shared understandings in design.

We now turn to the second part of our proposed framework, which pertains mostly to methodological implications of the research question.

3.1.4 Appropriate

We bear in mind that there are conceivably many ways in which one might investigate knowledge construction in a design process. However, the appropriateness of LSA as a tool to do so rests on a chain of reasoning in the paper: that knowledge construction within a team happens (partially) through language; that changes in language use during the process may indicate

knowledge construction; that knowledge construction in particular may be evidenced by the development of shared understandings among the team members; that semantic convergence in language use may be taken as a proxy for shared understanding; and that because LSA can measure semantic convergence, it is a promising (and rigorous) measure that can be applied to design team data in order to investigate knowledge construction in teams. Expressed in this contracted way, there are a number of junctures through which the appropriateness of LSA as a means of answering the question must first pass, and at which points some readers may be inclined to demur. Of course, the “import” of LSA from computational linguistics was what made the study possible, and the results justified the appropriateness of the approach as they showed it possible to test the hypothesis with variables of interest that could be reliably measured based on the data that were collected and arrive at relevant findings. It is worth noting that the issue of choosing the most suitable method to investigate the potential of LSA to illuminate design activity did not present itself, as there were no alternative methods from which to choose.

3.1.5 Feasible

Dong spells out the departure point of his study: “The premise of the article is that the psychological similarity between each designer’s own mental representation and the socially held representation of the designed artefact is reflected in the semantic coherence between words in the way they co-occur in dialog and other language-based communication.” (p. 447). This premise could hardly be investigated earlier, at least not empirically with large enough data sets, for lack of a method that could handle such data. LSA was an inaugural way this became possible. LSA’s feasibility is demonstrated through its application to both new data, and two existing (and well-travelled) data sets of design activity. Similar results are obtained across all three applications. This is a notable strength of the paper.

3.1.6 Ethical

The participants in Dong’s empirical research were product design students who worked on their coursework assignments as normal. The experimental findings had no bearing on their academic assessment; the design students in the study were not subjected to any risks beyond ordinary circumstances; furthermore, no information is presented of the participants, or details of their projects, that would enable readers to identify specific individuals or teams. Therefore, there are no ethical concerns raised by the study.

Figure 1 summarizes the main merits of Dong’s research question in terms of the RIN. AFE framework.

least two challenges in doing this adequately, let alone well. One is scope: researchers must identify a specific enough issue, that a manageably concise volume of design research can be consulted to establish the currency and relevance of the question. A closely related challenge is depth: quality research questions stand on a thorough understanding of the literature they build upon, rather than resting on superficial points of difference to prior work. This is particularly evident in the RI (relevant, interesting) dimensions of the framework and analysis above.

4.2 Method

Research questions in design need to be conscious of the implications for methodological choices. A well-articulated research question must single out identifiable phenomena and relationships that are amenable to investigation. Some of the questions researchers might be very interested in investigating and definitively answering prove to be methodologically inaccessible, at least at present. The concepts that appear in a research question carry weighty implications for what must be subsequently identifiable (to both the analyst and the reader of the published research) in data and its analysis. Many assumptions are visible in researchers' decisions in this regard: their conceptualization of phenomena, adequate warrant for identification, what criteria suffice to count two instances in the data as 'the same' phenomenon (see [Matthews, 2007](#)). This is visible in the AF (appropriate, feasible) dimensions of the framework. These issues have implications for the choice of research method(s), whether adopted from other fields, or developed within the design research community.

4.3 Contribution

Ultimately, it is a conceivable possibility that even a well-grounded, well-justified, and carefully executed study, with a well-formulated research question, may yet struggle to make a significant contribution to the field. This is where the nested relationships between research questions and other aspects of a study come into clear focus. Contributions are demonstrated in many ways. A contribution might consist in changing how the field thinks about something, such as a relationship between designers' evolving use of language and the development of their shared understanding. A contribution might be in articulating a clear and new question for further study. It might be in the implications of the study for design education or design practice, or that it describes a new method that enables new kinds of research studies to be performed, or new questions to be investigated. Research questions need to be formulated in ways that do not just enable answers to be discovered through inquiry, but in ways that the answers (however they may turn out) offer benefits to the community of research. This requires more than careful and rigorous scholarship; it requires imagination. These aspects are clearest in the RN (relevant, novel) dimensions of the framework.

4.4 Narrativity

Finally, an interesting research question will lead to a compelling story in the way the research is presented. Here we return to Socratic questioning: the story must unfold logically step-by-step, leading to a climax that induces learning in the reader. This is a central aspect of the I (interest) dimension of the framework. After all, research is directed towards understanding something that had not previously been part of the field's knowledge (and skills) base.

In conclusion, we have suggested a framework of six dimensions to assess, and help formulate, constructive empirical research questions in design. We have done this with an appreciation that research questions are fundamentally related to, and have consequences for, many other elements of research, which makes their careful formulation a particularly central task. For this reason, the framework is not prescriptive, but intended to help researchers navigate, and critically assess, the fit between their question, their methods, their conceptualizations of phenomena, and ultimately their contribution to the field. To this end, we can imagine RIN. AFE may have several constructive uses for researchers: as a general set of criteria when reviewing design research submissions (alongside other yardsticks; see e.g., [Prchner and Godin \(2022\)](#), for judging the quality of RTD projects), as a prospective checklist that can be applied at different points along the evolution of the research to determine how each criterion is being addressed. We have deliberately refrained from providing straightforward guidelines as we shy away from prescriptive methods, but future work could possibly attempt ad hoc guidelines for various types of design research, empirical and beyond.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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