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Mixed-Methods in Information Systems Research: Status Quo, Core Concepts, and Future Research Implications

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Abstract:

Mixed-methods studies are increasing in information systems research, as they deliver robust and insightful inferences combining qualitative and quantitative research. However, there is considerable divergence in conducting such studies and reporting their findings. Therefore, we aim (1) to evaluate how mixed-methods studies have developed in information systems research under the existence of heavily used guidelines and (2) to reflect on those observations in terms of potential for future research. During our review, we identified 52 mixed-methods papers and quantitatively elaborated on the adherence to the three core concepts of mixed-methods in terms of purpose, meta-inferences, and validation. Findings discover that only eight adhere to all three of them. We discuss the significance of our results for current and upcoming mixed-methods research and derive specific suggestions for authors. With our study, we contribute to mixed-methods research by showing how to leverage the insights from existing guidelines to strengthen future research and by contributing to the discussion of the legislation associated with research guidelines, in general, presenting the status quo in current literature.

Keywords: Mixed-methods, Critical Realism, Literature Review, Guidelines, Purpose, Meta-inferences, Validation.

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1 Introduction

Mixed-methods offer the opportunity to address exploratory and confirmatory questions of information systems (IS) research within the same research inquiry (Venkatesh et al., 2013). This combination of qualitative and quantitative approaches within one inquiry provides two essential advantages conducive to all IS research fields. First, mixed-methods studies deliver strong inferences and multifaceted insights into a phenomenon of interest. These are grounded in leveraging complementary strengths and non-overlapping weaknesses of qualitative and quantitative methods (Nunamaker et al., 2017) and cannot be offered when using only one of these methods individually. Second, mixed-methods enable us to include several epistemological perspectives with paradigmatic assumptions in our research as it allows for drawing different, sometimes opposing, results from the qualitative and quantitative inferences. This combination makes the derived theoretical assumptions regarding the examined phenomenon from both studies, also known as meta-inferences, more robust (Teddlie and Tashakkori, 2008).

From a theoretical perspective, mixed-methods studies can deliver insightful inferences and reliable results (Nunamaker et al., 2017). To best realize those advantages, IS research provides well-established guidelines on how to combine research paradigms with different epistemological perspectives (Venkatesh et al., 2013). While some consider those guidelines as the heavily used norm within IS research that everyone adheres to (Siponen et al., 2021; Venkatesh et al., 2016), others describe the guidelines as dense and complicated, questioning their applicability and their proven benefit (Siponen et al., 2021; Walsh, 2015; Yu & Khazanchi, 2017). Based on those tensions, we take the opportunity to examine what the current state-of-the-art in mixed-methods research looks like, if and how IS research has applied the provided guidelines, and what we can learn from that development for future mixed-methods studies. To this end, we analyze those papers integrating quantitative and qualitative research methods from the different paradigmatic assumptions in a descriptive literature review (Paré et al., 2015).

In total, we reviewed 52 papers published in the AIS Senior Scholars' Basket of Eight and examined their adherence to existing guidelines. To better compare the actual status quo in literature with the provided guidelines (Venkatesh et al., 2013), we break down the massive framework and formulate three core concepts that capture the essentials of mixed-methods, namely (1) purpose, (2) meta-inferences, and (3) inference validation. Overall, about 30 percent of the analyzed papers – mostly the more recent ones – have explicitly considered two or more of the core concepts in their research design. Disclosing this divergence between the actual and expected usage of existing guidelines provides us with the opportunity to identify potential for improvement for future mixed-methods studies. Based on our observations of the examined papers and the stimulated reflections, we offer specific advice on incorporating the core concepts into future mixed-methods studies captured in five key takeaways. With our study, we contribute to mixed-methods research by presenting the current status quo in IS research and to discussing the legislation associated with research guidelines by assessing the adherence to the deduced core concepts.

Our paper is structured as follows: First, we present the core concepts of mixed-methods based on existing guidelines. Then, we describe our literature review and present the analysis of the 52 identified papers regarding how they leverage the core concepts. We discuss how mixed-methods studies have evolved under heavily used guidelines and reflect on those observations. Last, we close with key takeaways for authors.

2 Leveraging Guidelines on Mixed-Methods

Mixed-methods allow the combination of qualitative and quantitative research studies within one inquiry and thereby overcome the barriers of purely positivist and purely constructivist paradigms (Mingers et al., 2013). Leveraging the paradigms of pragmatism or critical relativism, mixed-methods offer multiple perspectives of the same phenomenon and allow room for the existence of several ontological realities (Mingers et al., 2013; Zachariadis et al., 2013). To successfully combine paradigms, extant research provides detailed guidelines on design decisions and the structure of mixed-methods studies, especially treating the paradigmatic combination of qualitative and quantitative methods and the deduction of meta-inferences combining both (Venkatesh et al., 2013; 2016). As these guidelines are complex, and several works have tried to clarify the essential ingredients (Verhagen et al., 2015; Walsh, 2015; Yu & Khazanchi, 2017), we describe the three decisive core concepts when conducting mixed-methods (we present a glossary in the appendix).

(1) Purpose:

Stating the purpose of the mixed-methods study is crucial (Ågerfalk, 2013). Authors need to justify, clarify, and explain why more than one study is necessary to examine a particular phenomenon of interest and why the research benefits from combining quantitative and qualitative research approaches. Literature provides seven purposes for conducting mixed-methods that authors can draw upon (Venkatesh et al., 2013; Venkatesh et al., 2016): complementarity, completeness, developmental, expansion, corroboration/confirmation, compensation, and diversity.

The *complementarity* purpose aims at complementary views on the same phenomenon. The *completeness* purpose is concerned with gaining a holistic picture of a phenomenon from different perspectives. Research with a *developmental* purpose comes up with inferences about a model or hypotheses validated directly within the same study and can be used for theory building. The *expansion* purpose enables the investigation of inconclusive or surprising findings needed to expand our understanding of them. Mixed-methods studies aiming at *corroboration/confirmatio*n aim at very robust results, as one study validates the credibility of the other. *Compensation* aims at overcoming the weaknesses of one study design or method by another compensating one and *diversity* at capturing different perspectives with different populations or characteristics.

There are two key takeaways. When the envisaged study design cannot be assigned to one of the described purposes, a mixed-methods study might not be necessary. In such cases, the contribution of one study alone (e.g., either qualitative or quantitative) might already be bold enough. Furthermore, when the selection of a purpose impacts the overall study design, certain purposes require specific design decisions. Authors conducting mixed-methods can let the purpose guide the design decisions and, therefore, can follow a structured approach to derive qualitative, quantitative, and meta-inferences (Venkatesh et al., 2016).

(2) Meta-inferences:

Meta-inferences are the critical asset of mixed-methods, as they bring qualitative and quantitative inferences together. If a mixed-methods study fails to identify meta-inferences, it probably cannot fulfill the chosen purpose and is therefore obsolete or at least ineffective. Meta-inferences are theoretical statements that allow us to overcome the paradigmatic barriers of purely positivist or purely constructivist research by investigating the benefit of the combination of both research approaches. Therefore, they need to be stated clearly (Mingers et al., 2013).

Thereby, the authors identify both studies' convergent and dissonant inferences and enrich the individual inferences with convergent or complementary knowledge or the combination of both. The meta-inferences describe the knowledge one study could not have delivered without the other and, therefore, capture the actual value of mixed-methods studies (Ågerfalk, 2013).

(3) Inference validation:

Mixed-methods studies aim at delivering robust results that each of the methods individually cannot offer, by leveraging complementary strengths and non-overlapping weaknesses of qualitative and quantitative methods. Therefore, a big part of conducting mixed-methods is concerned with validation. Following the guidelines established in prior research, each type of inferences (qualitative results, quantitative results, meta-inferences) needs to be validated separately. The quality of the meta-inferences and so the quality of the theoretical assumptions drawn as a significant value from the mixed-methods study, depends decisively on the quality of the inferences delivered by the individual studies (Mingers et al., 2013). Therefore, the validation of all types of inferences has to be assured.

Having those core concepts in mind, we next evaluate how mixed-methods studies have developed in IS research under heavily used guidelines presented by Venkatesh et al. (2013) based on our literature analysis, to later reflect on those observations in terms of potential for future research.

3 Literature Review

By conducting a descriptive review (Paré et al., 2015), we overview mixed-methods research within the IS discipline. We draw on the AIS Senior Scholars' Basket of Eight[1], following recommendations in existing research that considers the AIS Senior Scholars' Basket of Eight a representative source of IS literature (Moeini et al., 2019). Further, following examples in prior research (Chipidza & Leidner, 2019), we consulted established guidelines on how to conduct a structured literature review, using techniques borrowed from grounded theory research for "rigorously reviewing literature" (Wolfswinkel et al., 2013), that consist of five steps: Define, search, select, analyze, and present.

Define. We define the scope of our research as follows: To capture all relevant articles combining quantitative and qualitative research, we searched for "mixed-methods" and "quantitative AND qualitative". We selected IS research as the scope of interest and chose the AIS Senior Scholars' Basket of Eight as an appropriate source. To evaluate current mixed-methods research, we focused on publications between 2013 (when the guidelines were published) and December 2021.

Search and Select. We searched our terms within EBSCO business source ultimate and the journal websites. We reviewed all articles within the AIS Senior Scholars' Basket of Eight that cite the original work of Venkatesh et al. (2013). Our initial research revealed 111 papers from which we excluded all papers not treating the combination of quantitative and qualitative methods. We identified one paper through a forward and backward search, resulting in a total of 57 papers (see Figure 1).

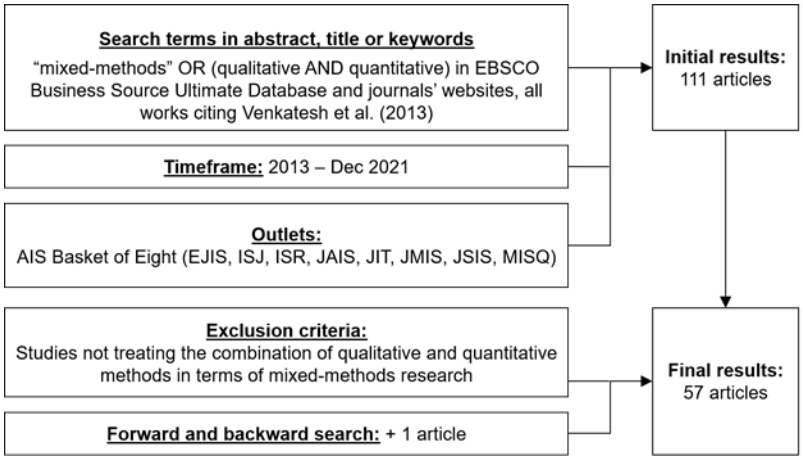

Figure 1. Search and Selection of Articles

Analyze. We analyzed our literature sample regarding the development of mixed-methods research over time and the adherence to the established guidelines extracted from existing research (Venkatesh et al., 2013). We analyzed the papers in terms of the selected purpose, the drawn meta-inferences, and the validation of the individual studies. We realized that from the analyzed papers, three had been published in 2013, and five had been published in 2014. Of these papers, only three published in 2014 cite the presented guidelines by Venkatesh et al. (2013). Since major journal publications have lengthy review times, we discussed whether those papers would have been able to incorporate the guidelines and whether integrating those results would affect our evaluation of the status quo. In line with IS research from other fields advocating for sensitivity tests (Maggetti & Levi-Faur, 2013; Mattke et al., 2022; Mattke et al., 2021), we clarified the influence of these papers on our overall evaluation. As expected, we found that the specific articles only increased the portion of papers not adhering to the guidelines by five percent, while affecting the portion of papers leveraging one, two, or all three guidelines by less than two percent. Therefore, we decided to leave those papers aside, leaving us with 52 papers to analyze.

Present. This study provides detailed records of the projects conducting mixed-methods studies within IS research regarding their adherence to the core concepts discussed above and their significant findings (details in Table 4 in the appendix). Our quantitative analyses show how the publications leveraged the

[1] The AIS Senior Scholar's Basket of Eight consists of the following journals: European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of Information Technology, Journal of MIS, Journal of Strategic Information Systems and MIS Quarterly.

core concepts of purpose, validation, and meta-inferences. Further, we present how the papers derive meta-inferences in terms of combined quantitative and qualitative results. From here, we conclude whether the established guidelines have been adopted by current research and what we can leverage from these observations for future mixed-methods studies.

4 Results

In total, we analyzed 111 papers and identified 57 papers in IS research that conduct mixed-methods in various contexts, from which 52 had the chance to be based on the established guidelines. Of these 52 papers, 42 labeled themselves as mixed-methods studies, and ten did not cite the guidelines of Venkatesh et al. (2013) (Table 4 in the appendix). Overall, we see a rising trend of mixed-methods studies in the AIS Basket of Eight (see Figure 2, dotted trend line), although the total number of papers is still limited (see Figure 2). To systematically understand the state-of-the-art in mixed-methods research, we analyzed the papers regarding the extent to which they adhere to the core concepts of mixed-methods as stated above: *(1) purpose, (2) meta-inferences, and (3) inference validation*. We structure our results accordingly and describe the analyzed papers in the light of their purpose, drawn meta-inferences, and validation of inferences.

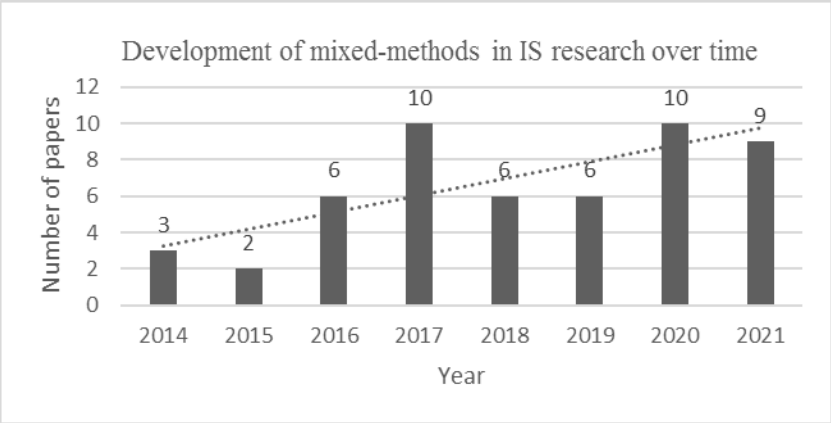

Figure 2. Development of Mixed-methods

4.1 Purposes in Mixed-Methods Research

Our analysis reveals that the selected 52 papers all follow one or more of the seven purposes presented in extant research. However, not every purpose is stated explicitly, so we also deduced implicitly stated purposes (see Figure 3 and Table 4 in the appendix). Across all studies, we identify 35 papers stating their purpose explicitly, from which 21 have selected one purpose, eleven selected two purposes, two selected three purposes, and one paper selected four purposes. Further, 17 papers implicitly stated purposes that directed the mixed-methods studies, from which 14 followed one purpose and three followed two purposes. For the 35 papers with explicitly stated purposes, the purpose did guide the research design.

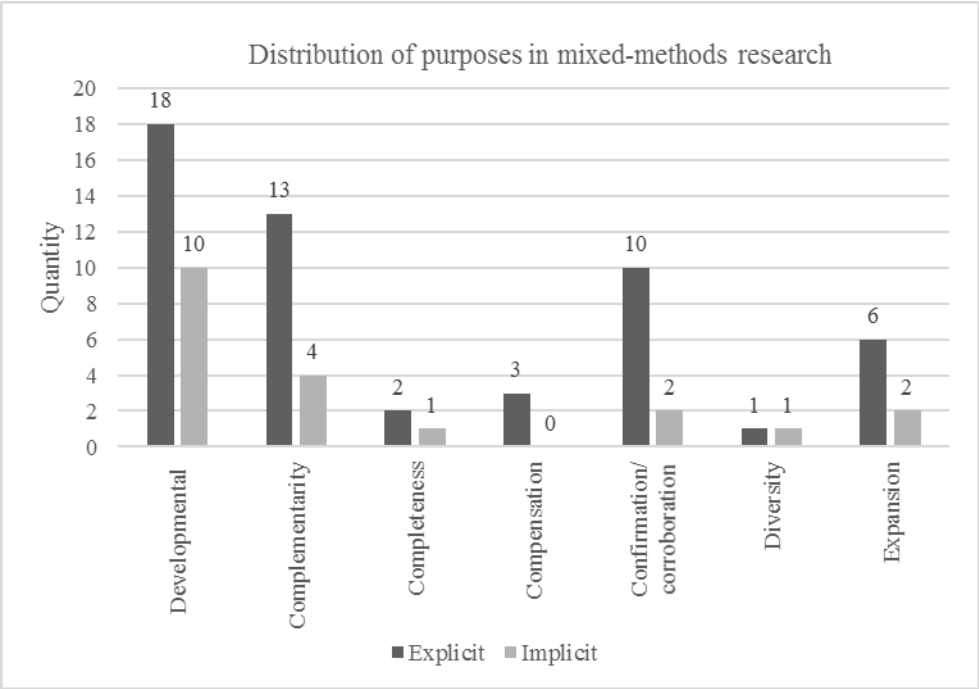

Figure 3. Distribution of Purposes in Mixed-methods Research

4.2 Meta-inferences in Mixed-methods Research

A closer look at the meta-inferences (see Figure 4 and Table 4 in the appendix) shows that only 14 papers explicitly formulate meta-inferences. Another 20 papers describe the benefits of combining quantitative and qualitative studies within one inquiry more implicitly – most in the discussion part – but did not examine complement or dissonant inferences across the combined studies. Further, 18 papers did not elaborate on the combined results, which does not mean there would be no potential to do so. However, from reading all of the selected papers, we experienced that those elaborating the meta-inferences could stress the significance of their findings more quickly and apparantly.

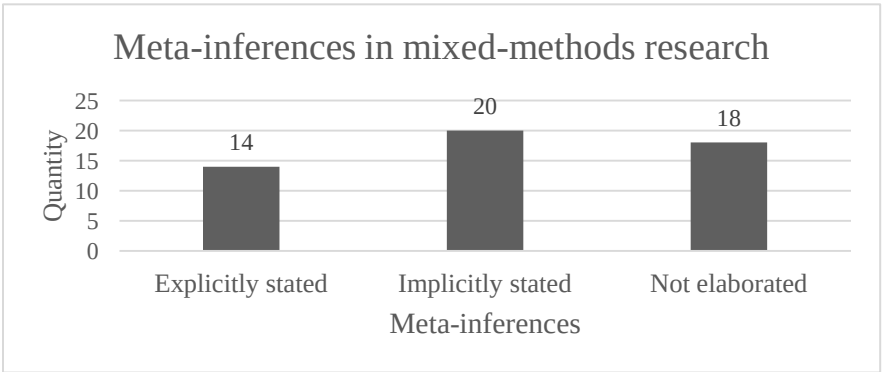

Figure 4. Drawn Meta-inferences in Mixed-methods Research

4.3 Validation of the Inferences in Mixed-methods Research

Most of the analyzed papers provide a detailed validation of their quantitative inferences or their qualitative and quantitative inferences. However, only 13 papers also validate the drawn meta-inferences (see Table 1 and Table 4 in the appendix). The central portion of papers validating just quantitative inferences grounds in the dominantly quantitative design of the papers.

Table 1. Distribution of the validation of inferences in mixed-methods research

Validation of inferences in mixed-methods research						
Qualitative	Quantitative	Meta-inferences	Qualitative+ Quantitative	Qualitative+ Meta-inferences	Quantitative+ Meta-inferences	Qualitative+ Quantitative+ Meta-inferences
2	17	0	19	0	3	11

4.4 Adherence to Core Concepts

We observe that not all papers adhere to the existing guidelines. We identified only **eight papers that explicitly adhere to two out of three** core concepts (Benthaus et al., 2016; Fox & Connolly, 2018; Sarkar et al., 2020; Sarker et al., 2018; Serrano & Karahanna, 2016; Slavova & Karanasios, 2018; Spiegel et al., 2016; Wunderlich et al., 2019), published from 2016 onwards. Further, we identified **eight papers that explicitly adhere to all three** core concepts (Califf et al., 2020; Cheng et al., 2021; Maier, Laumer, Tarafdar, et al., 2021; Mattke et al., 2020; Riemenschneider & Armstrong, 2021; Seymour et al., 2021; Srivastava & Chandra, 2018; Xiao et al., 2020) mainly published in 2020 and 2021 (see Figure 5). While this indicates a welcome trend of further maturing mixed-methods research in IS, it also shows that 36 papers have leveraged one or fewer core concepts explicitly, which do not only include those papers that do not cite or are not aware of the guidelines (see Figure 5). The good news is that if we take implicit adherence into account, 34 out of 52 papers manage to leverage at least two core concepts, which means that the potential in most papers is somehow there but can be brought to the readers' attention more explicitly.

5 Discussion, Contribution, Limitations, and Key Takeaways

We examine current mixed-methods studies in IS research with an eye toward the development of mixed-methods over the past years. Our review reveals 52 papers. About 30 percent of those papers – mostly the more recent ones – were based on two or more core concepts in their research design. In the following, we discuss the significance of our findings for current research, reflecting observations of the adoption of existing guidelines. This reflection allows us to state some improvement potentials in future mixed-methods studies.

5.1 Discussion

This study aims to evaluate how mixed-methods research has developed under the existence of mixed-methods guidelines presented by Venkatesh et al. (2013) and to reflect on those observations in terms of potential for future research. While the guidelines have been cited heavily (about 3,200 citations in June 2022), the latest IS research questions their status as a legislative golden rule due to a lack of proven benefit. It poses the question: can guidelines, used as checkboxes to test the rigor of research, prevent the publication of good research not adhering to those guidelines (Siponen et al., 2021)? From the observations in our analysis, the answer to that question is threefold. First, we see that only a fraction of papers adheres to the described guidelines and core constructs, so there are plenty of papers published that leverage the presented guidelines only partly or not. Second, if we observe the development of mixed-methods research over time, we see that the portion of papers adhering to the guidelines rises over the years, meaning that lately published mixed-methods studies in IS research increasingly leverage the deduced core concepts to the full extent (e.g., Maier, Laumer, Tarafdar, et al., 2021; Riemenschneider & Armstrong, 2021; Xiao et al., 2020). This fact does not necessarily mean that those papers provide better or more rigorous research. However, based on our analysis, we conclude that those papers adhering to the core concepts managed to present their assets, in terms of profound and many-faceted results or rigorous validation, very clearly to the reader. In contrast, those papers leveraging the core concepts only implicitly or not at all do not expose those assets as clearly. Third, we conclude that considering the core concepts can help reflect the pursued aim of research and the potential contribution of a specific study, hopefully providing the best version of a piece of research. In that light, we take the opportunity to reflect on the adherence to the core constructs in more detail and provide some guidance on how the core concepts can be integrated into future mixed-methods studies.

Concerning the role of **purpose** in future mixed-methods studies, we suggest keeping this purpose in mind for the deduction of meta-inferences and for the design decisions and using it to think through the actual possibilities of what could be achieved with this specific piece of research (for more details see Venkatesh et al., 2016). However, selecting a purpose might not be as easy as selecting one or more out

of seven. The information on selecting a purpose in established guidelines is limited to the selected research question (Venkatesh et al., 2013). Research questions are essential to most studies and are indeed essential to mixed-methods studies. There can be one or more research question(s) focusing on qualitative, quantitative, or mixed aspects of the research. They can be predefined or not, dependent or independent. These characteristics of the research question also guide the selection of an appropriate purpose, but the actual selection process remains challenging. So we clarify this process on the base of our review.

Table 2. Selection of Mixed-methods Purpose

Selection of purpose(s)						
Purpose	*Definition*	*Aim*	*Time of selection*	*Research question(s)*	*Time orientation of MM-approach*	*Example*
Developmental	Concerned with inferences in terms of a model or hypotheses that are validated directly within the same study	Theoretical model and its validation, theory building	Upfront	One or more, predefined, dependent	Sequential (qualitative, followed by quantitative)	Mattke et al. (2020) used the developmental purpose to qualitatively identify factors influencing the investment decision in bitcoin and used a qualitative study to validate their contribution to the investment decision.
Complementary	Different methods are used to get a more comprehensible, complementary understanding of a phenomenon	Overcoming paradigmatic limitations	Upfront or emergent	Not specified	Concurrent and sequential	Seymour et al. (2021) used the complementarity purpose to understand individuals' perceptions of AI at different anthropomorphic levels.
Completeness	Concerned with capturing different aspects of the truth regarding what, how, and why	Holistic understanding of a phenomenon	Upfront or emergent	Not specified	Concurrent and sequential	Sarkar et al. (2020) used the completeness purpose to clarify the influence of professional subculture on actual security policy violation behavior, what has an influence, how, and why
Compensation	One study design or method offsets the non-overlapping weaknesses of another one	Overcoming methodical weaknesses	Upfront or emergent	Not specified	Sequential and sequential	Riemenschneidr and Armstrong (2021) used quantitative methods to compensate for the subjectivity in their causal mapping regarding professional identity in IS
Confirmation/corroboration	Using two methods to validate the findings of each study	Validation of results	Upfront or emergent	Not specified	Concurrent and sequential	Srivastava and Chandra (2018) used two methods from different paradigms to validate their findings on the

Table 2. Selection of Mixed-methods Purpose

						role of social presence in virtual collaboration
Diversity	Concerned with capturing different perspectives with different populations or characteristics	Overcoming sample limitations	Upfront or emergent	Not specified	Concurrent and sequential	Deng et al. (2015) use the diversity purpose to gain insights into the perspective of business users vs. IS personnel
Expansion	Concerned with a deep dive into previously revealed inferences	Investigating inconclusive or surprising results	Emergent	At least two research questions, emergent, dependent	Sequential (quantitative followed by qualitative)	Maier, Laumer, Tarafdar, et al. (2021) used the expansion approach to investigate why a prior stated hypothesis turned out to be non-significant

The first thing to consider is whether the authors want to conduct a mixed-methods study or how they decide if the contribution of one method is enough. Our observations conclude that this depends on what authors want to achieve with their research in terms of contributions. For example, coming up with factors influencing behavior from interviews is a contribution, and if authors are satisfied with it, they can publish that paper. However, prior research has distinguished between *what*, *how*, and *why* (Whetten, 1989) when it comes to contribution. While qualitative studies are especially suited to *what* and *why*, the question of *how* often remains unanswered because we cannot deduce significance or portion of influence with purely qualitative methods. Contrary to this, quantitative research aims at identifying and confirming assumed relationships from prior research. While we can take the *what* from the literature and the *how* from the quantitative study, the *why* is often hard to explain. If authors need to enlarge their contributions, either beforehand or in their studies, mixed-methods are one possible way to achieve that. Drawing from that, the purpose followed in a mixed-methods study is not always clear from the beginning. While some studies are predefined and conceptualized as mixed-methods studies (for example, with theory building or if the authors are well aware of methodological limitations), others evolve into a mixed-methods study during the research because authors find something surprising or want to validate their results. Whether authors want to pursue one or more of the seven purposes depends on the study. However, if they select more than one purpose, each purpose needs to be visible in the study design, the results, the discussion, and the meta-inferences. Of the seven presented purposes, only the developmental and expansion purposes are sensitive to the time of selection (see Table 2). The developmental purpose aims at developing a theoretical model in an explorative approach and then validating that model with a confirmatory approach. Thus, conducting mixed-methods with a developmental goal needs to be set from the start. As a result, the research question(s) are also predefined and dependent due to the research design. However, the expansion purpose focuses on investigating inconclusive or surprising findings revealed in the first study. As we cannot foresee those results, the decision to investigate those findings in a second study or frame the research as a mixed-methods study emerges in the course of the research. When framing a mixed-methods study around an expansion purpose, we usually expect at least two research questions, which are emergent and dependent, such that the first research question motivates the actual dominant study examining the phenomenon of interest and the second research question motivates the further investigation of the surprising findings reported upfront.

With the remaining five purposes, the question would be whether the authors decide from the beginning of their research to take, for example, a complementary approach that allows them to see different aspects of a phenomenon or whether there is anything in the data or results of the undertaken study that requires or suggests a further complementary investigation. Selecting one or more purposes for mixed-methods studies can be both a structured and a fluent approach that needs to be carried out when using mixed-methods. From there, the design decisions are clear: the expansion purpose, for example, requires a sequential design where one study most likely dominates the other in terms of depth, range, sample, and contributions (see Table 2).

The selection of a purpose also informs authors about which meta-inferences to expect, as the meta-inferences fulfill the set purpose of the mixed-methods study. In other words, the meta-inferences of a developmental purpose need to treat the developed model or theory. In contrast, the meta-inferences of an expansion purpose aim at deducing theoretical statements about the phenomenon and the unexpected aspects of viewing it.

Previous research has stressed the importance of **meta-inferences** for mixed-methods research, as they enable a move between situation-specific narrating and the statistical description of a phenomenon of interest (Mingers et al., 2013; Walsh, 2015). However, only 14 out of 52 papers elaborated on the meta-inferences of the mixed-methods study. This low rate of presented meta-inferences limits the potential benefits of mixed-methods studies to researchers and practitioners. Meta-inferences offer insights into causally complex reality independent of our predefined knowledge (Mingers et al., 2013). In the spirit of critical realism, meta-inferences overcome both the reductionist threat of a traditional positivist worldview limited to what can be empirically measured and the dangers of traditional constructivism restricting knowledge generation and transfer by over-contextualizing phenomena and reducing truth to the human knowledge of it (Mingers et al., 2013). Accepting that reality might be mediated by our perceptions or pre-knowledge, through meta-inferences, we can capture multiple parts of this reality that could not have been brought to light with only one epistemological and ontological view represented through one methodological approach (Mingers et al., 2013). Therefore, we encourage upcoming mixed-methods research to take the opportunity to explicitly elaborating on the inferences that result from combining a positivist and constructivist research approach within one inquiry. Presenting not only the convergent findings but also the dissonant or complementary findings, fulfills the actual goal of mixed-methods.

Another specific strength of mixed-methods lies in providing very robust insights that are reliable enough to build on for researchers and practitioners (Mohajeri et al., 2020). This reliability is due to the strict and comprehensive **validation of all deduced inferences** throughout the mixed-methods study. A thorough validation comprises the validation of the data collection, data quality, research methods, and inference deduction. The observation that 33 papers validated more than one inference type and eight papers carried out validation processes for qualitative, quantitative, and meta-inferences supports that claim. Drawing upon what we stated about the value of meta-inferences, their contribution could be at risk when they lack validation. The underlying principles of mixed-methods, based on critical realism, believe in the compatibility of qualitative and quantitative inferences through retroduction, also known as abduction (Venkatesh et al., 2013). In essence, when examining a phenomenon of interest, we propose hypotheses informed by experiences. If they existed in the real world, we could back-inform our theoretical understanding of causal mechanisms that cause or create the phenomenon of interest (Mingers et al., 2013). In other words, we empirically observe a phenomenon and then use our knowledge assigned to the phenomenon to deduct the underlying reasons that might have created or caused the phenomenon without empirically proving that this is true, only stating that this might be one acceptable reality for explaining the phenomenon. Looking at this type of reasoning, we need positivist inferences to describe the phenomenon, constructivist inferences to capture the assigned knowledge about the phenomenon, and meta-inferences that combine the two inferences to deduce theoretical assumptions of the reality of what caused the examined phenomenon. We need to ensure that all inferences are valid and robust because otherwise, we cannot rely upon them to deliver an acceptable reality, and understanding of the phenomenon. While this might not be possible in every setting, the meta-inferences are more substantial if there is a certain validity to them and we advise future mixed-methods research to put in reasonable effort to achieve this.

5.2 Limitations

Our research aims at presenting a current state-of-the-art of mixed-methods in IS research. Therefore, in line with existing research (Moeini et al., 2019), we decided to focus on the AIS Scholar's Basket of Eight as a representative source. While we consider the AIS Scholar's Basket of Eight as an appropriate source due to the width of our topic, we acknowledge the fact that this excludes some outlets in IS and other disciplines addressing more specialized and pragmatic topics. Further, we followed the recommendations in the literature (Siponen et al., 2021), judging the guidelines presented by Venkatesh et al. (2013) as the heavily used norm and therefore considered them a baseline for our research. Consequently, we included the works citing Venkatesh et al. (2013), those works labeling themselves as mixed-methods studies, and those works combining qualitative and quantitative results. While we believe that these search terms provided us with a broad range of papers, we also acknowledge the possibility that we have missed some valuable examples. These missed examples might include papers that label themselves as multi-methods

studies (Mingers, 2001), papers combining not necessarily quantitative and qualitative studies, or papers following different mixed-methods guidelines, such as, for example, those presented by Tashakkori and Teddlie (1998) and Teddlie and Tashakkori (2008) or Zachariadis et al. (2013).

5.3 Contribution

This paper contributes to IS research and especially mixed-methods research in the following two ways. First, based on our analysis, we provide three core concepts that, to our understanding, capture the essentials of mixed-methods and highlight their significance for IS research. We, thereby, hope to encourage and support authors that may conduct more mixed-methods research in the future, leveraging the benefits of stressing assets. We provide more details on implementing the core concepts below (see Figure 5). After selecting one or more appropriate purposes, authors need to consider the appropriate research design for the selected purpose. For example, while developmental and expansion purposes require a sequential study design, completeness and compensation purposes can be achieved with a concurrent design. Then, authors need to consider the paradigmatic assumptions on which they want to base their research inquiry. It is not necessary to elaborate on these paradigmatic assumptions in detail. However, one should keep in mind how to derive knowledge and what is considered as reality in order to derive appropriate results. These paradigmatic assumptions can also help deduce meta-inferences capturing the combined knowledge of conducting two methods within one inquiry. We suggest stating those meta-inferences explicitly and discussing convergent, complementary, and dissonant inferences from both combined methods. Authors can stress the benefit and necessity of the combination of those methods. We advise authors to provide detailed validations of all inferences, including validating meta-inferences. This thorough validation ensures the robustness of the deduced inferences, the theoretical assumptions of the phenomenon, and the underlying causality we draw from them. We thereby contribute to IS research by stressing the opportunity to present assets to the reader with quality mixed-methods research that delivers robust and conclusive results and by providing condensed guidelines that authors can use to provide results that IS research benefits from the most.

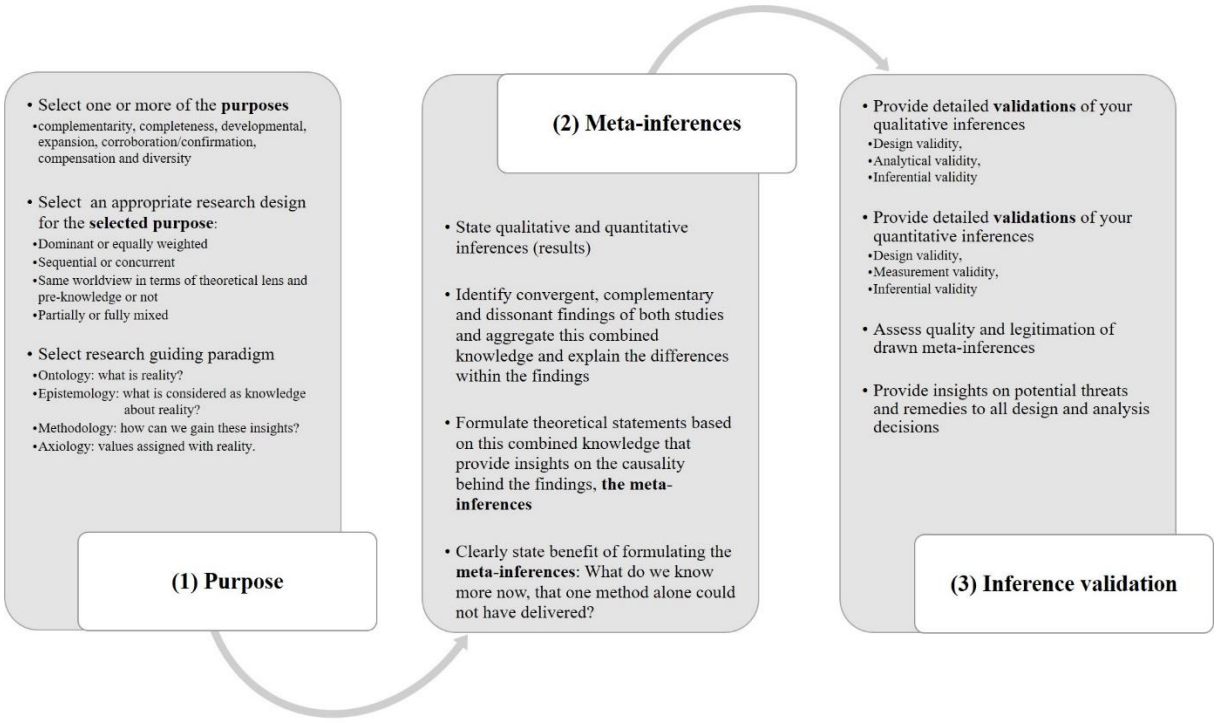

Figure 6. Mixed-methods in a Nutshell: A Guideline for Authors

Second, we offer a structured overview of mixed-methods in IS research that future research can build on and stress those works that serve as examples of using mixed-methods. We contribute by providing a structured and representative picture of mixed-methods research in IS that serves as a first orientation for

upcoming works. Additionally, we offer quantitative analyses of the selected papers that back-inform IS research on the development of mixed-methods studies in IS research in the presence of existing guidelines. These insights are especially relevant for review boards assessing received mixed-methods work. Although not all papers followed a structured mixed-methods approach, they still delivered remarkable results that contributed to IS research. In the light of our analysis and the ongoing discussion of whether research guidelines should be seen as legislative (Siponen et al., 2021), we encourage reviewers to use the insights of this study not only to recommend checking off the guidelines but also to help authors to carve out the most potent version of their mixed-methods study in terms of presenting assets. The presented core concepts and the insights on leveraging them can work as a guiding light to handle and rate mixed-methods studies in the future without preventing the publication of good research that does not check all the boxes of the existing guidelines. Our presentation of the current status quo shows that, while authors do not have to apply all core concepts, considering them and reflecting on their impact can strengthen the paper and help stress the assets it provides for IS research.

5.4 Key Takeaways

Based on a systematic analysis of 52 papers applying mixed-methods in IS research, we strongly encourage authors of upcoming mixed-methods studies to implement the provided core concepts to improve the presentation of their real assets in terms of the quality and robustness of their outcomes.

For future authors, we suggest the following:

Think about the purpose first: What do you want to achieve with combining a qualitative and quantitative study in terms of contributions?

Select a purpose-guided research design: Choose the design feature/s that best suit/s the purpose.

Do not talk too much about paradigms but capture their essentials: Try to undermine your positivist or constructivist pre-disposition and stay open to what other research paradigms have to offer. Build a combined reality out of both approaches.

State meta-inferences explicitly in a dedicated section: Meta-inferences capture the knowledge that a qualitative or quantitative study alone cannot offer. Discuss the convergent, complementary, and dissonant findings and formulate statements on the reasons behind these findings.

Validate all inferences: Provide detailed validation of all parts of your mixed-methods study: qualitative inferences, quantitative inferences, and meta-inferences! This validation comprises the validation of the data collection, data quality, research methods, and deduction of inference.

6 Conclusion

This study presents a structured literature review of 52 mixed-methods papers published in the AIS Senior Scholar's Basket of Eight. The aim of the review is (1) to evaluate how mixed-methods studies have developed in IS research under the existence of heavily used guidelines and (2) to reflect on those observations in terms of potential for future research. To that end, we quantitatively elaborated on the adherence to the three core concepts of mixed-methods in terms of purpose, meta-inferences, and validation. Our findings discover that only eight papers adhere to all three of them. While this does not necessarily mean that those papers provide better or more rigorous research, they manage to present their assets in terms of profound and many-faceted results or rigorous validation that is clear to the reader compared to those papers leveraging the core concepts only implicitly or not at all. We discuss the significance of our results for current and upcoming mixed-methods research and derive specific suggestions for authors. We contribute to mixed-methods research by showing how to leverage the insights from existing guidelines and by contributing to the discussion of the legislation associated with research guidelines in general.

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Appendix A: Glossary

Table 3. Mini-glossary on Mixed-Methods (Mertens, 2010; Mingers et al., 2013; Teddlie & Tashakkori, 2008; Venkatesh et al., 2013)

Term	Explanation
Mixed-methods	A mixed-methods study captures the usage of more than one method but from different underlying paradigms, thus qualitative AND quantitative methods.
Research inquiry	An inquiry captures the course of a research examination, including methodology and reasoning approaches.
Inferences	An inference is a result gained from a research method that has been drawn with a reasoning approach. Qualitative methods mainly use inductive reasoning, whereas quantitative studies use deductive reasoning.
Meta-inferences	Meta-inferences are the inferences one research method with one reasoning approach alone could not have delivered. Meta-inferences are theoretical statements that describe a phenomenon and its underlying causalities based on convergent, complementary, and dissonant inferences of both methods.
Paradigm	A paradigm captures the basic philosophical assumptions of what we consider as reality (ontology) or knowledge (epistemology), how we gain knowledge operatively (methodology) and how we integrate values (axiology). Primarily, researchers practicing quantitative research follow the paradigm of positivism, and researchers practicing qualitative research follow the paradigm of constructivism. Mixed-methods approaches follow paradigms defending paradigmatic pluralism, such as critical realism.
Positivism	Positivism is a view on science and knowledge that emphasizes materialism and realism. It focuses on the approximation of reality using a continued refinement of what we think we know. At the extreme, it only acknowledges the existence of what can be measured, independent of subjective interpretations. Reality is what we can prove.
Constructivism	Constructivism believes in the existence of multiple realities, shaped by the subjective perceptions and pre-experiences of the researcher. Those perceptions and pre-experiences describe reality. Reality is formed by beliefs.
Critical realism	Critical realism defends the existence of a reality independent of our knowledge. Our access to this reality is limited by our pre-knowledge and subjective perceptions. The scientific knowledge is therefore imperfect and requires multiple research methods to capture different objects of knowledge that can be combined for a better picture of reality.
Retroduction/abduction	Retroduction describes a reasoning approach to gain results from two methodologies. This approach takes a phenomenon that is empirically observed and enriches it with our pre-knowledge and subjective beliefs concerning that phenomenon to come up with assumptions about what is creating or causing that phenomenon, without the need for empirical approval. Abduction contrasts with induction in the way that a set of examples does not lead to a continuation but to see a new pattern.

Appendix B: Literature Review

Table 4. Mixed-Methods in IS Research

Paper	Journal	Labeled as mixed-methods research	Citing Venkatesh et al. 2013 or 2016	Context	Purpose	Validation			Meta-inferences	Major findings
						Qual	Quant	Meta		
Anderson et al. (2018)	ISR	No	Yes	Distributed product development projects	Developmental implicit		X		Not elaborated	Strategies to overcome time zone and language barriers
Benthaus et al. (2016)	JSIS	Yes	Yes	Social media management strategies	Complementarity		X	X	Explicit	Proof of efficacy of strategic social media marketing
Boyer O'Leary et al. (2014)	MISQ	Yes	Yes	Communication and proximity of dispersed colleagues	Expansion implicit	X	X		Implicit	Perceived proximity is a powerful tool to raise communication.
Breward et al. (2017)	ISR	No	No	Adoption of controversial IT	Developmental implicit		X		Not elaborated	Contextualized model of controversial technology adoption
Califf et al. (2020)	MISQ	Yes	Yes	Techno-eustress and distress in health IT	Developmental	X	X	X	Explicit	Technostress can have beneficial and adverse effects
Cheng et al. (2021)	EJIS	Yes	Yes	AI-enabled personal information collection on ridesharing platform	Developmental	X	X	X	Explicit	Privacy control encourages users to participate in a ridesharing platform
Cooper and Molla (2017)	ISJ	Yes	Yes	IS-environmental absorptive capacity	Developmental, confirmation/corroboration	X	X		Implicit	Antecedents and value of IS-environmental absorptive capacity
Crossler and Posey (2017)	JAIS	Yes	Yes	Privacy risks in internet security	Developmental, complementarity		X		Not elaborated	Contextualized model of technology and personal reasons
Cui et al. (2020)	JMIS	No	Yes	Managing Knowledge via Distance with the help of IT	Developmental implicit		X		Not elaborated	inter-firm knowledge exploration capability and IT-enabled inter-firm knowledge

Table 4. Mixed-Methods in IS Research

										exploitation capability can help embrace benefits
Deng et al. (2015)	ISJ	Yes	Yes	Customer service behavior	Completeness, diversity implicit	X	X		Implicit	Behavioral and contextual factors of organizational citizenship behavior
Ferguson and Soekijad (2016)	JIT	Yes	Yes	Online communities as intermediary spaces for development	Developmental, confirmation/corroboration		X		Not elaborated	Accommodates convergence and divergence of interests
Fox and Connolly (2018)	ISJ	Yes	Yes	M-health adoption	Complementarity		X	X	Explicit	Adoption model of m-health across generations
Fürstenau et al. (2019)	ISR	Yes	Yes	Embeddedness in digital infrastructures	Developmental implicit	X	X		Not elaborated	Overarching digital infrastructures requires competitive and spanning processes
Gaskin et al. (2014)	MISQ	Yes	Yes	Entanglement of human activities and digital capabilities	Complementarity	X	X		Implicit	Sequence analysis of socio-material routines
Gong et al. (2021)	ISJ	Yes	Yes	Mobile payment networks	Complementarity, confirmation corroboration		X		Not elaborated	Network effects determine consumer loyalty
Haki and Legner (2021)	JAIS	yes	Yes	Enterprise architecture principles	Complementarity, confirmation corroboration implicit	X			Implicit	Metaprinciples
Hukal et al. (2020)	MISQ	Yes	Yes	The role of platform signals in generating content	Developmental implicit		X		Not elaborated	Signals guide the generation of content in volume and diversity
Johnston et al. (2015)	MISQ	Yes	Yes	Fear appeals in information security policies	Developmental		X		Not elaborated	Enhanced fear appeal rhetorical framework
Kang et al. (2020)	JAIS	Yes	No	Smart technology attributes	Confirmation/corroboration implicit		X		Not elaborated	Attributes positively influence functionality and content

Table 4. Mixed-Methods in IS Research

										quality
Lansing et al. (2019)	JSIS	Yes	Yes	Cloud service certificates	Developmental, confirmation/corroboration	X	X		Implicit	Certificates are signals
Laumer et al. (2017)	EJIS	No	Yes	Workarounds in ECM	Developmental implicit		X		Not elaborated	Model of workaround motivations
Laumer et al. (2016)	EJIS	Yes	Yes	Work routines and resistance	Developmental	X	X		Implicit	Perceptions of work routine affect resistance
Liang et al. (2019)	MISQ	No	Yes	Emotion-focused coping with IT security threats	Expansion, confirmation/corroboration, compensation	X	X		Not elaborated	Emotion-focused coping influences problem-focused solving
Li et al. (2014)	JMIS	No	No	User-game engagement	Confirmation/ corroboration, complementarity implicit	X	X		Not elaborated	Antecedents of user-game engagement
Maier, Laumer, Tarafdar, et al. (2021)	JAIS	Yes	Yes	Challenge and hindrance stress appraisal	Expansion	X	X	X	Explicit	Challenge and hindrance stress affects routine and innovative IS use
Maier, Laumer, Thatcher, et al. (2021)	JAIS	Yes	Yes	Social network sites use resumption	Developmental implicit	X	X		Explicit	Resumptions as IS use behavior
Mattke et al. (2020)	EJIS	Yes	Yes	Bitcoin investment	Developmental	X	X	X	Explicit	Bitcoin investment is not only driven by profit but also by ideology
Moser et al. (2013)	ISJ	Yes	No	Online community engagement	Complementarity		X		Implicit	Communication motives
Najjar et al. (2021)	EJIS	No	No	IS incident recovery	Developmental implicit		X		Not elaborated	Recovery satisfaction results from both a “fix it fast and fully” perspective and a sense of effort and fairness conveyed
Ortiz de Guinea and Webster (2013)	MISQ	No	No	conceptualization of IS use patterns	Complementarity implicit	X	X		Implicit	IS use patterns as configurations of emotions, cognitions, and

Table 4. Mixed-Methods in IS Research

										behaviors
Picoto et al. (2014)	EJIS	Yes	Yes	Business value of mobile applications	Developmental, confirmation/corroboration	X	X		Implicit	Nine antecedents of mobile business usage and value
Posey et al. (2013)	MISQ	No	No	Protecting organizational information	Developmental implicit	X	X		Implicit	theory of diversity of protection motivation behavior
Power and Gruner (2017)	EJIS	Yes	Yes	Inter-organizational systems (IOS)	Complementarity	X	X		Implicit	How IOS are enabling technology decision-making processes
Riemenschneider and Armstrong (2021)	MISQ	Yes	Yes	Professional identity of IS workers	Developmental, compensation	X	X	X	Explicit	Continuous adaptation and facets of knowledge distinguish IS workers
Salo et al. (2020)	MISQ	Yes	Yes	Coping strategies	Developmental implicit	X	X		Not elaborated	Identification of different routes and sequences of coping
Sarkar et al. (2020)	ISR	yes	Yes	Influence of professional subculture on information security violations	Completeness, developmental, complementarity	X	X	X	implicit	Substantial effect of professional subculture on security violations
Sarker et al. (2018)	ISR	Yes	Yes	Work-life conflict in software development	Developmental	X	X	X	Implicit	Theoretical model of work-home conflict and its antecedents
Serrano and Karahanna (2016)	MISQ	Yes	No	Capabilities influencing task performance	Developmental	X	X		Explicit	Theoretical model of capabilities in telemedicine
Seymour et al. (2021)	JAIS	Yes	Yes	Uncanny valley	Complementarity	X	X	X	Explicit	The uncanny valley can be overcome
Slavova and Karanasios (2018)	JAIS	Yes	Yes	Hybridization of information practices	Complementarity, confirmation/ corroboration	X	X	X	Implicit	Factors that shape information practices in institutional change
Söllner et al. (2018)	JAIS	No	Yes	Technology-mediated learning (TML)	Developmental		X		Not elaborated	Theoretical model of TML
Spiegel et al. (2016)	ISJ	Yes	Yes	Social capital in internet	Complementarity		X		Explicit	follow-up funding depends on

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				start-ups						social capital
Srivastava and Chandra (2018)	MISQ	Yes	Yes	Social presence in virtual collaboration	Confirmation/ corroboration, complementarity	X	X	X	Explicit	Social presence important for trust-building
Steffen et al. (2019)	JMIS	No	No	Affordances in VR	Completeness, confirmation/ corroboration	X			Not elaborated	Model in VR context
Tarafdar and Ray (2021)	ISR	Yes	No	Role of Social Media in Social Protest Cycles	Complementarity, implicit	X	X		Implicit	Intra-actions of the social protest cycle
Thummadi and Lyytinen (2020)	JAIS	Yes	No	Methods in software design	Complementary	X	X		Implicit	Effect of method in software design is more negligible than assumed
Vaast et al. (2017)	MISQ	Yes	No	Social media and collective engagement	Complementarity, diversity, expansion, compensation		X		Implicit	Connective affordances of social media and roles
Vaghefi et al. (2017)	ISJ	Yes	Yes	IT addiction	Developmental		X		Not elaborated	Depending on the user liability type, different antecedents, behaviors, and consequences can be identified
Van Osch and Steinfield (2016)	JIT	Yes	No	Team boundary spanning in social media	Complementarity, expansion implicit	X	X		Implicit	Perceptions of enterprise social media and boundary-spanning items
Venkatesh et al. (2019)	MISQ	No	Yes	Work-home conflict and computer addiction	Expansion		X		Implicit	Influence of children's computer addiction on work of parents
Walsh (2014)	JSIS	Yes	No	User's information technology needs and culture	Complementarity, developmental implicit		X		Implicit	Strategic paths to study IT needs
Wunderlich et al. (2019)	MISQ	Yes	Yes	Sustainable technology adoption	Developmental		X	X	Explicit	Conceptual model of sustainable technology adoption
Li et al. (2020)	JAIS	Yes	Yes	Telemedicine camps in less developed	Complementary implicit	X	X		Implicit	Telemedicine can broaden healthcare

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				countries						access
Xiao et al. (2020)	MISQ	Yes	Yes	SAAS-delivered applications	Developmental	X	X	X	Explicit	Role of commitment and replacement of SAAS-delivered applications
Ye and Kankanhalli (2017)	JSIS	No	Yes	Crowdsourcing platforms	Expansion		X		Not elaborated	Antecedents of solvers' participation
Zhang (2017)	MISQ	Yes	No	Knowledge management (KM) and job performance	Confirmation/ corroboration, expansion	X	X		Implicit	Model of influence of KM tools on job performance
Zhang and Venkatesh (2017)	MISQ	Yes	Yes	Antecedents of knowledge management system use	Developmental implicit	X	X		Implicit	Model of antecedent and consequence of KM system use

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