Communications of the Association for Information Systems

Accepted Manuscript

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Please cite this article as: Reis, Lea; Maier, Christian; Weitzel, Tim: Mixed-Methods in Information Systems Research: Sta-tus Quo, Core Concepts, and Future Research Implica-tions, *Communications of the Association for Information Systems* (forthcoming), In Press.

Communications of the Association for Information Systems

Research Paper ISSN: 1529-3181

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Abstract:

Mixed-methods studies are on the rise in information systems (IS) research, as they deliver robust and insightful inferences combining qualitative and quantitative research. However, there is much divergence in conducting such studies and reporting their findings. Therefore, we aim (1) to evaluate how mixed-methods studies have developed in information systems (IS) research under the existence of heavily used guidelines presented by Venkatesh et al. (2013) and (2) to reflect on those observations in terms of potentials for future research. During our review, we identified 52 mixed-methods papers and quantitatively elaborated 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.

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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This manuscript underwent [editorial/peer] review. It was received xx/xx/20xx and was with the authors for XX months for XX revisions. [firstname lastname] served as Associate Editor.] **or** The Associate Editor chose to remain anonymous.]

1 Introduction

Mixed-methods offer the opportunity to address exploratory and confirmatory questions of information systems (IS) research within the same research inquiry (Venkatesh, Brown, & Bala, 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 infer-ences and multifaceted insights on a phenomenon of interest. These are grounded in leveraging complementary strengths and non-overlapping weaknesses of qualitative and quantitative methods (Nunamaker, Twyman, Giboney, & Briggs, 2017; Venkatesh et al., 2013) 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 into our research as it allows drawing different, sometimes opposing, results from the qualitative and quantitative inferences. This makes the derived theoretical assumptions from both studies, also known as meta-inferences, regarding the examined phenomenon more robust (Venkatesh et al. 2013).

From a theoretical perspective, studies conducting mixed-methods can deliver insightful inferences and reliable results (Nunamaker et al., 2017). To best realize those advantages, IS research pro-vides well-established guidelines on how to combine research paradigms along 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, Soliman, & Holtkamp, 2021; Venkatesh, Brown, & Sullivan, 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 how 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, Trudel, Jaana, & Kitsiou, 2015).

In total, we reviewed 52 papers from the eight journals in the AIS Senior Scholars' Basket of Eight and examined their adherence to the provided guidelines. To better compare the actual status quo in literature with the provided guidelines (Venkatesh et al., 2013), we break down the massive frame-work 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 of actual usage of guidelines versus expected norm, provides us with the opportunity to identify potentials 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 take-aways. With our study, we contribute to mixed-methods research by presenting the current status quo in IS research and to the discussion of the legislation associated with re-search 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 take-aways for authors.

2 Leveraging Guidelines on Mixed-Methods

Mixed-methods allow the combination of qualitative and quantitative research studies within one inquiry by overcoming the barriers of purely positivist and purely constructivist paradigms (Mingers, Mutch, & Willcocks, 2013). Leveraging the paradigms of pragmatism or critical relativism, mixed-methods offer multiple perspectives of the same phenomenon, giving room for the existence of several ontological realities (Mingers et al., 2013; Venkatesh et al., 2013; Zachariadis, Scott, & Barrett, 2013). To capture these 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, van

den Hooff, & Meents, 2015; Walsh, 2015; Yu & Khazanchi, 2017), we describe the three decisive core concepts when conducting mixed-methods (a glossary can be found in the appendix).

(1) Purpose:

Stating the purpose of the mixed-methods study is crucial (Venkatesh et al., 2013). Authors need to justify, clarify, and explain why more than one study is necessary to examine a certain 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 certain phenomenon with different perspectives. Research with a *developmental* purpose comes up with inferences about a model or hypotheses that are validated directly within the next study and can be used for theory building. The *expansion* purpose enables the investigation of inconclusive or surprising findings to expand our understanding of them. Mixed-methods studies aiming at *corroboration/confirmatio*n aims 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 (Venkatesh et al., 2016).

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 (Venkatesh et al., 2013). In such cases, the contribution of one study (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 (Venkatesh et al., 2016). 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 key 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 fulfil 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 and, therefore, needs to be stated clearly (Mingers et al., 2013).

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

(3) Inference validation:

As 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 (Venkatesh et al., 2013), 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) need to be validated separately, as the quality of meta-inferences, and thus the quality of the theoretical assumptions drawn as significant value from the mixed-methods study depends decisively on the quality of the inferences delivered by the individual studies (Mingers et al., 2013; Venkatesh 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 potentials 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 Basket a representative source of IS literature (Moeini, Rahrovani, & Chanc, 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, Furtmueller, & Wilderom, 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 first (Venkatesh et al. 2013), and December 2021.

Search and Select. We searched for our search 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 forward and backward search, which leaves us with 57 papers (see Figure 1).

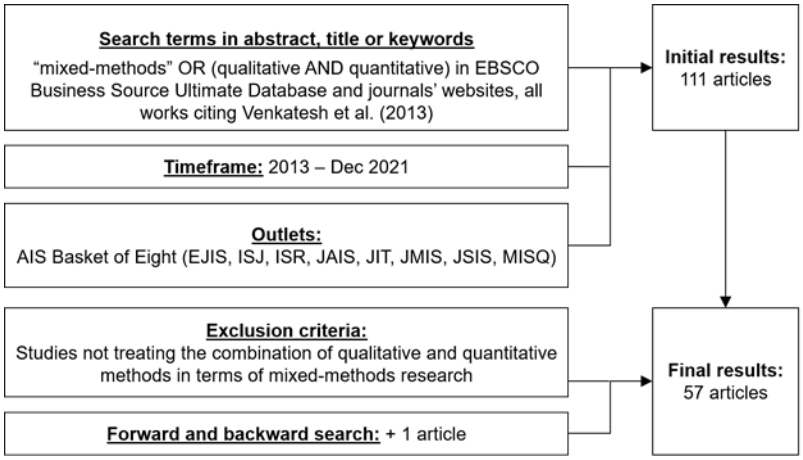

Figure 1. Search and Selection of Articles

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. From 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; Maier, Laumer, Thatcher, et al., 2021; Mattke, Maier, Weitzel, & Thatcher, 2021), we clarified the influence of these papers on our overall evaluation. We found that the specific articles only increased the portion of papers not adhering to the guidelines by five percent, as expected, 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 works conducting mixed-methods studies within IS research regarding their adherence to the core concepts discussed above and their significant findings

[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.

(details in Table 4 in the appendix). Our quantitative analyses show how the publications leveraged the 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 (Venkatesh et al. (2013) 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 conducting mixed-methods in IS research in various contexts, from which we analyzed 52, which had the chance to base on the established guidelines. From these papers, 42 labeled themselves as mixed-methods studies and ten did not cite the guidelines of Venkatesh et al. (2013) (Table 4 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.

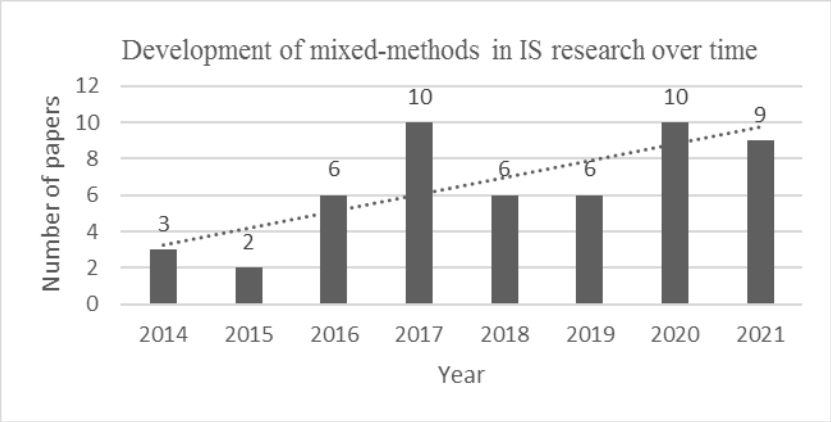

Figure 2. Development of mixed-methods

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 (Venkatesh et al., 2013). However, not every purpose is stated explicitly, so we also deduced implicitly stated purposes (see Figure 3 and Table 4 in the appendix). Over 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 followed 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, as suggested (Venkatesh et al., 2013; 2016).

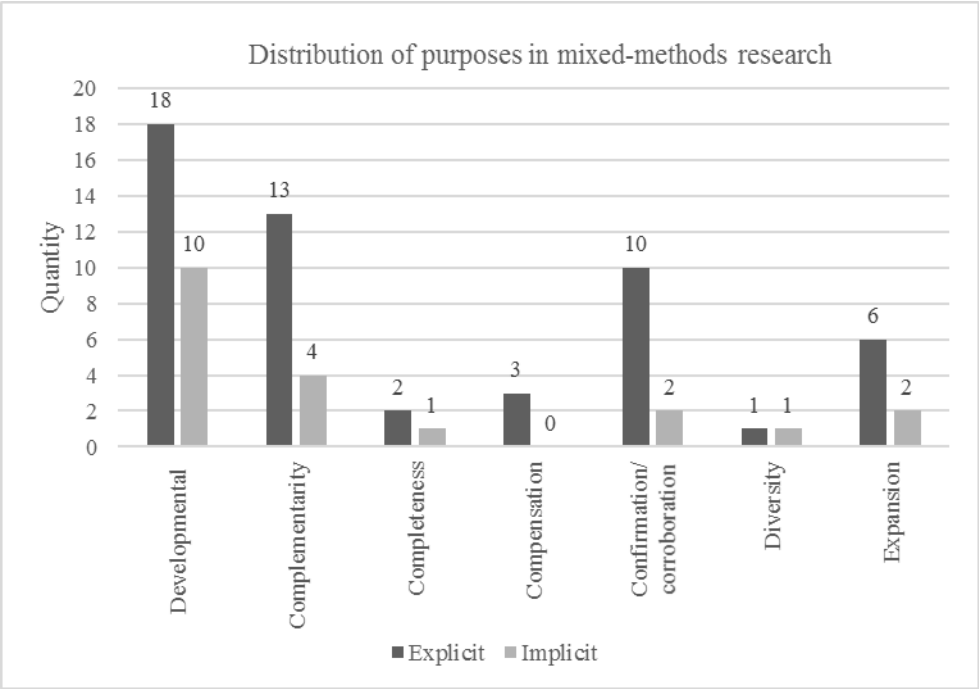

Figure 3. Distribution of purposes in mixed-methods research

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. 18 papers did not elaborate on the combined results, which does not mean that 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 easily.

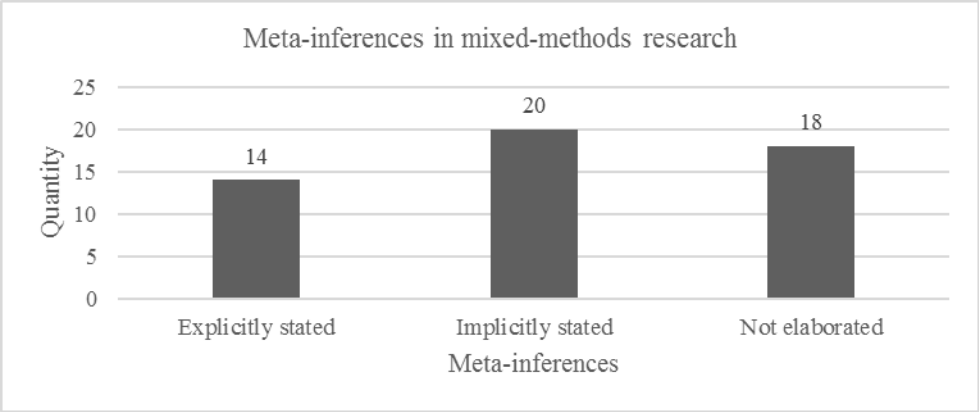

Figure 4. Drawn meta-inferences in mixed-methods research

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, but only 13 papers also validate the drawn meta-inferences (see Table 1 and Table 4 in the appendix). The major portion validating just quantitative inferences was linked to quantitative dominant 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 (Venkatesh et al. (2013; 2016). We identified only **eight papers that explicitly adhere to two out of three** core concepts (Benthaus, Risius, & Beck, 2016; Fox & Connolly, 2018; Sarkar, Vance, Ramesh, Demestihas, & Wu, 2020; Sarker, Ahuja, & Sarker, 2018; Serrano & Karahanna, 2016; Slavova & Karanasios, 2018; Spiegel et al., 2016; Wunderlich, Veit, & Sarker, 2019) published from 2016 onwards and **eight papers that explicitly adhere to all three** core concepts (Califf, Sarker, & Sarker, 2020; Cheng, Su, Luo, Benitez, & Cai, 2021; Maier, Laumer, Tarafdar, et al., 2021; Mattke, Maier, Reis, & Weitzel, 2020; Riemenschneider & Armstrong, 2021; Seymour, Yuan, Dennis, & Riemer, 2021; Srivastava & Chandra, 2018; Xiao, Sarker, Wright, Sarker, & Mariadoss, 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 are not only those papers that do not cite 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 Take-Aways

We examine current mixed-methods studies in IS research with an eye towards the development of over the past years. Our review reveals 52 papers. About 30 percent of those papers – mostly the more recent ones – have based on two or more core concepts in their research design. In the following, we discuss the significance of our findings for current research based on reflections stimulated by observations of how existing guidelines have been adopted. This 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 potentials for future research. While the guidelines have been cited heavily (about 3,000 citations in December 2021), the latest IS research questions their status as a legislative golden rule due to a lack of proven benefit and poses the question, whether clear, condensed guidelines, used as checkboxes to rigor research, prevents 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 at all. Second, if we observe the development of mixed-methods research overt time, we see that the portion of papers adhering to the guidelines rises over years, meaning that lately published mixed-methods studies in IS research increasingly leverage the deduced core concepts to full extend (e.g. Maier, Laumer, Tarafdar, et al., 2021; Riemenschneider & Armstrong, 2021; Xiao et al., 2020). While this fact does not necessarily mean that those papers provide better or more rigorous research, from our analysis, we conclude that those papers adhering to the core concepts manage to present their assets in terms of profound and many-faceted results or rigor validation, very clear to the reader, while those papers leveraging the core concepts only implicitly or not at all, do not expose those ingredients as bold assets. Third, we conclude that considering the core concepts can help reflect the pursued aim of research and potential contribution of a certain study, which will hopefully contribute to giving us the best version of a certain piece of research. In that light, we take the opportunity to reflect 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 focusing on the overall purpose of the mixed-methods studies and keeping this purpose in mind for the deduction of meta-inferences and for the design decisions, which might help 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 just selecting one or more out of seven. The provided information on selecting a purpose in established guidelines is limited to the set research question (Venkatesh et al., 2013). Research questions are essential to most studies, and so they are 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 (Venkatesh et al., 2013). 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 come up with 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 individual perceptions of AI in 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 is used	Overcoming methodical weaknesses	Upfront or emergen	Not specified	Sequential and sequential	Riemenschneider and Armstrong

	to adjust the non-overlapping weaknesses of another one		t			(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 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, Wang, and Galliers (2015) use the diversity purpose to gain insights on 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 further 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 study 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, as we cannot deduce significance or portion of influence with purely qualitative methods. Contrary, quantitative research bases on confirming assumed relationships from prior research and showing how these relationships look like. 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 more of the seven purposes, depends on the study, but 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. From the seven presented purposes, only the developmental and expansion purposes are sensitive to the time of selection (see Table 2). The developmental purpose aims to develop a theoretical model that has been stated in an explorative approach and then validated with a

confirmatory approach. Thus, conducting mixed-methods is essential upfront and the developmental goal needs to be specified from the beginning. As a result, the research question(s) are also predefined and dependent due to the research design. However, the expansion purpose focusses on the investigation of inconclusive or surprising findings revealed in the first study. As those findings cannot be foreseen, the decision to investigate those findings in a second study and 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 that are emergent and dependent, such that the first research question motivates the actual dominant study examining the phenomenon of interest, and the second 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 where the meta-inferences is heading to, 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, whereas the meta-inferences of an expansion purpose aim at deducing theoretical statements about the phenomenon and the unexpected aspects in 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 statistical description of a phenomenon of interest (Mingers et al., 2013; Walsh, 2015). However, only 14 out of 52 papers elaborated the meta-inferences of the mixed-methods study. This 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 of explicitly elaborating the inferences that result from combining a positivist and constructivist research approach within one inquiry by presenting not only the convergent findings but also the dissonant or complementary findings, as this is what mixed-methods was designed for.

Another specific strength of mixed-methods lies in providing very robust insights that are reliable to build on for researchers and practitioners (Mohajeri, Mesgari, & Lee, 2020). This reliability is due to the strict and comprehensive **validation of all deduced inferences** throughout the mixed-methods study (Venkatesh et al., 2013). This 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, basing on critical realism, believe in the compatibility of qualitative and qualitative 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 from our empirical setting. 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, but just 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 and 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 assure that all inferences are valid and robust, as otherwise, we cannot rely upon that they 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 Basket as an appropriate source due to the width of our topic focusing on research methods, we acknowledge the fact that this excludes some outlets in IS and other disciplines for more specialized and pragmatic topics. Further, we followed recommendations in 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 to include some works. This can be works that label themselves as multi-methods studies (Mingers, 2001), or 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; 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 to conduct more mixed-methods research in the future, leveraging the benefits in terms 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 think about the research design per 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 think about the paradigmatic assumptions they want to base their research inquiry on. It is not necessary to elaborate these paradigmatic assumptions in detail, but one should keep in mind how to derive knowledge and what is considered reality to derive appropriate results. These paradigmatic assumptions can also help to deduce meta-inferences capturing the combined knowledge of conducting two methods within one inquiry. We suggest stating those meta-inferences explicitly, 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 assures the robustness of the deduced inferences and 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 good quality mixed-methods research that delivers robust and conclusive results and by providing condensed guidelines authors can use to provide results that IS research benefits from the most.

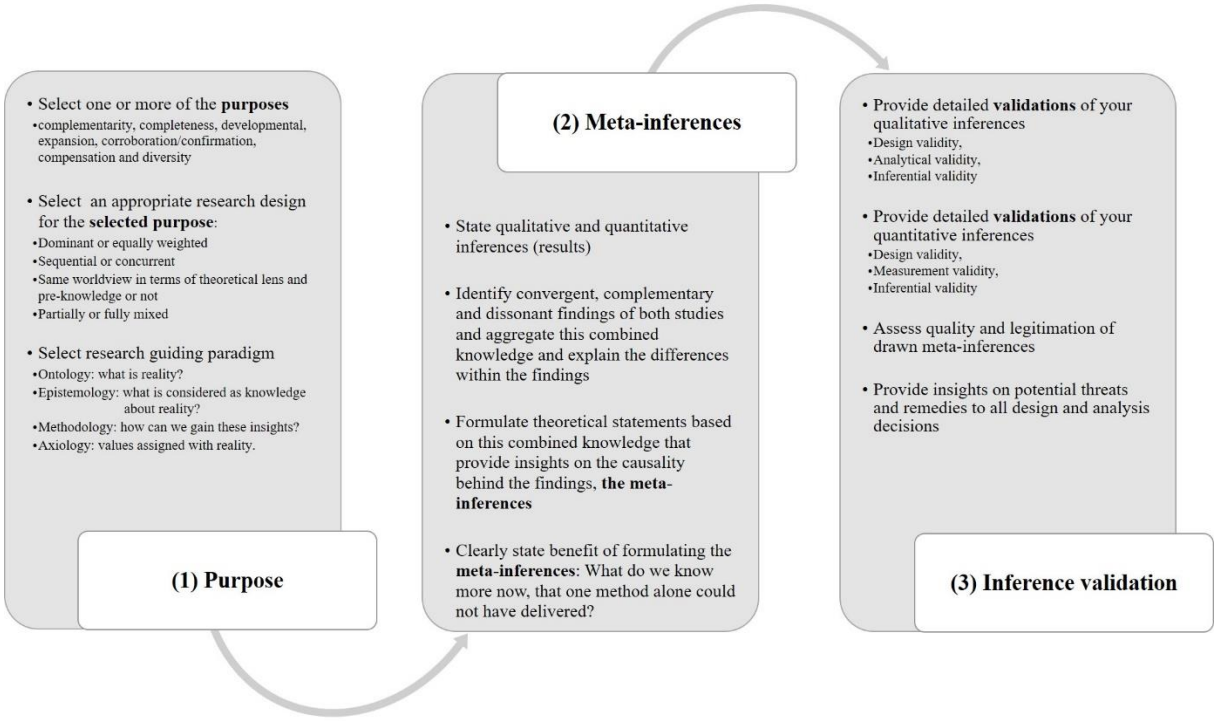

Figure 6. Mixed-methods in a nutshell: a guideline for authors

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 example studies in following 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. This is especially relevant for review boards assessing received mixed-methods work: Although not all of the papers followed a structured mixed-methods approach, they still deliver 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 check-boxing the guidelines but 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 how to leverage 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 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 to stress the assets it provides for IS research.

5.4 Key Take-Aways

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 actual assets, in terms of the quality and robustness of their outcomes. Based on our analysis, we can provide the following suggestions for future mixed-methods studies.

For authors, we suggest the following:

Think about the purpose first: What do you want to achieve with the combination of qualitative and quantitative studies 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 the insights the other research paradigm has 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, thus for qualitative inferences, quantitative inferences and meta-inferences! This 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 that review is (1) to evaluate how mixed-methods studies have developed in information systems (IS) research under the existence of heavily used guidelines presented by Venkatesh et al. (2013) and (2) to reflect on those observations in terms of potentials for future research. To that end, we quantitatively elaborated the adherence to the three core concepts of mixed-methods in terms of purpose, meta-inferences, and validation. Our findings discover that only eight 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 rigor validation, very 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. Thereby, 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 qualitative 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 mostly use deductive reasoning.
Meta-inferences	Meta-inferences are the inferences that one research method with one reasoning approach alone could not have delivered. Those are presented as theoretical statements that describe a phenomenon and its underlying causalities based on the convergent, complementary and dissonant inferences of both methods.
Paradigm	A paradigm captures the basic philosophical assumptions of what we consider as reality (ontology), what do we count as knowledge (epistemology), how we gain knowledge operatively (methodology) and how we integrate values (axiology). Mostly, researchers practicing quantitative research follow the paradigm of positivism and researchers practicing qualitative research follow the paradigm of constructivism. Mixed-methods approaches base on paradigms defending paradigmatic pluralism, such as critical realism.
Positivism	Positivism is a view of science and knowledge that emphasizes materialism and realism, which focuses on the approximation of reality with 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 beliefs in the existence of multiple realities shaped by the subjective perceptions and pre-experience of the researcher that together describe reality. Reality is formed by beliefs.
Critical realism	Critical realism defends the existence of a reality independent of our knowledge and that 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 to a better picture of reality.
Retroduction/abduction	Retroduction describes a reasoning approach to gain results from two methodologies, as it 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 to induction in that a set of examples leads not to a continuation, but to seeing 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, Chandrasekaran, Davis-Blake, and Parker (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, Wilson, and Metiu (2014)	MISQ	Yes	Yes	Communication and proximity of dispersed colleagues	Expansion implicit	X	X		Implicit	Perceived proximity is powerful tool to rise communication.
Breward, Hassanein, and Head (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 healthIT	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 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, Tong, Teo, and Li (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 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, Baiyere, and Kliewer (2019)	ISR	Yes	Yes	Embeddedness in digital infrastructures	Developmental implicit	X	X		Not elaborated	Overarching digital infrastructures requires competitive and spanning processes
Gaskin, Berente, Lyytinen, and Youngjin Yoo (2014)	MISQ	Yes	Yes	Entanglement of human activities and digital capabilities	Complementarity	X	X		Implicit	Sequence analysis of sociomaterial routines
Gong, Cheung, Liu, Zhang, and Lee (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, Henfridsson, Shaikh, and Parker (2020)	MISQ	Yes	Yes	The role of platform signals for generating content	Developmental implicit		X		Not elaborated	Signals guide generation of content in volume and diversity
Johnston, Warkentin, and Siponen (2015)	MISQ	Yes	Yes	Fear appeals in information security policies	Developmental		X		Not elaborated	Enhanced fear appeal rhetorical framework
Kang, Jiang, Peng, Sia, and Liang (2020)	JAIS	Yes	No	Smart technology attributes	Confirmation/corroboration implicit		X		Not elaborated	Attributes positively influence functionality and content quality
Lansing, Siegfried, Sunyaev, and Benlian (2019)	JSIS	Yes	Yes	Cloud service certificates	Developmental, confirmation/Corroboration	X	X		Implicit	Certificates are signals
Laumer, Maier, and Weitzel (2017)	EJIS	No	Yes	Workarounds in ECM	Developmental implicit		X		Not elaborated	Model of workaround motivations
Laumer, Maier, Eckhardt, and Weitzel (2016)	EJIS	Yes	Yes	Work routines and resistance	Developmental	X	X		Implicit	Perceptions of work routine affect resistance
Liang, Xue, Pinsonneault, and Wu (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
M. Li, Jiang, Tan, and Wei (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 site 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 not only driven by profit but also by ideology
Moser, Ganley, and Groenewegen (2013)	ISJ	Yes	No	Online community engagement	Complementarity		X		Implicit	Communication motives
Najjar, Kettinger, and Kettinger	EJIS	No	No	IS incident recovery	Developmental implicit		X		Not elaborated	Recovery satisfaction results from both

(2021)										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 behaviors
Picoto, Bélanger, and Palma-dos-Reis (2014)	EJIS	Yes	Yes	Business value of mobile applications	Developmental, confirmation/corroboration	X	X		Implicit	Nine antecedents of mobile business usage and value
Posey, Roberts, Lowry, Bennett, and Courtney (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, Makkonen, and Hekkala (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, Bitzer, Janson, and Leimeister (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 start-ups	Complementarity		X		Explicit	follow-up funding depends on 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, Gaskin, Meservy, Jenkins, and Wolman (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 smaller than assumed
Vaast, Safadi, Lapointe, and Negoita (2017)	MISQ	Yes	No	Social media and collective engagement	Complementarity, Diversity, Expansion, Compensation		X		Implicit	Connective affordances of social media and roles
Vaghefi, Lapointe, and Boudreau-Pinsonneault (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, Sykes, Chan, Thong, and Hu (2019)	MISQ	No	Yes	Work home conflict 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
X. Li, Rai, and Krishnan (2020)	JAIS	Yes	Yes	Telemedicine camps in less developed countries	Complementary implicit	X	X		Implicit	Telemedicine can broaden healthcare 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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