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A review of the nature and effects of guidance design features

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ABSTRACT

Guidance design features in information systems are used to help people in decision-making, problem solving, and task execution. Various information systems instantiate guidance design features, which have specifically been researched in the field of decision support systems for decades. However, due to the lack of a common conceptualization, it is difficult to compare the research findings on guidance design features from different literature streams. This article reviews and analyzes the work of the research streams of decisional guidance, explanations, and decision aids conducted in the last 25 years. Building on and grounded by the analyzed literature, we theorize an integrated taxonomy on guidance design features. Applying the taxonomy, we discuss existing empirical results, identify effects of different guidance design features, and propose opportunities for future research. Overall, this article contributes to research and practice. The taxonomy allows researchers to describe their work by using a set of dimensions and characteristics and to systematically compare existing research on guidance design features. From a practice-oriented perspective, we provide an overview on design features to support implementing guidance in various types of information systems.

1. Introduction

The concept of ‘guidance’ is defined as “*help or advice that tells you what to do*” [1]. Information Systems (IS) implement design features that provide guidance to support users with decision-making, problem solving, and task execution. Decision Support Systems (DSS), which represent an important class of IS, specifically aim to provide decisional advice [2] to enable faster, better, and easier decision-making. In practice, DSS are applied, for example, to medical diagnosis [3] or to supervising a nuclear power plant [4]. By implementing design features such as explanations [5] that describe to the user why the system performs a certain action, suggests a specific decision, or outputs a final result, DSS provide decisional guidance to their users [6]. Expert Systems (XPS) can likewise be viewed as another representative of IS that contains guidance design features aimed at supporting humans with their decision-making. These design features focus on emulating the decision-making ability of a human expert [7] and guide humans through complex decision problems using an integrated knowledge base (referred to as Knowledge-Based Systems (KBS)). Furthermore, DSS and XPS can include explanation-based design features [8] that describe what the system ‘knows’, how it works, and why specific actions are appropriate [9]. Given such explanations, the user is more likely to accept the decisions, suggestions, or results provided by the system [10]. Thus, decision aids aim to support users by providing decisional guidance or explanations [11]. A decision aid refers either to technical intervention such as the design features that are instantiated in a system or to a behavioral approach providing the user with guidance [12,13].

A considerable number of researchers describe various approaches or the dichotomies of functionalities to examine various forms of guidance, which “*can vary in the level of detail, technical terms and expressions, the ways things are explained or presented, and what material is included*” [14: p. 5]. Consequently, it is difficult to compare existing research and obtain a systematic overview of the current body of knowledge. A common taxonomy enables researchers to structure the existing research on guidance design features systematically, to analyze and understand the effects of guidance design features, and to prevent reinventing the wheel when designing systems that provide guidance. This taxonomy facilitates researchers describing their work and results in more detail when comparing that work with related and already-existing research. Currently, there are specific taxonomies for decisional guidance and explanations in the literature [5,6,15] but not for guidance design features in general. We integrate existing taxonomies and definitions of concepts such as decisional guidance, explanations, and decision aids into a combined guidance taxonomy incorporating further elements not considered thus far. Because all types of IS can benefit from guidance design features [6], we argue that an integrated taxonomy is required that addresses all guidance streams in IS research and

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that the IS community will benefit from such a taxonomy. Thus, we advance the guidance design features from primarily addressing DSS, XPS, and KBS to be applicable to a broader spectrum of IS that supports users in decision-making, problem solving, and task execution. Summarizing, the following research question motivated our article:

How can guidance design features be conceptualized in the form of a taxonomy to integrate existing research on decisional guidance, explanations, and decision aids?

This article makes four contributions to research and practice. First, we provide an encompassing overview of guidance design features via a conceptual literature review of the three guidance research streams. Based on our literature analysis, we theorize a taxonomy of guidance design features by aligning the different notions and concepts identified in the literature. We combine existing empirical, theoretical, and conceptual research on decisional guidance, explanations, and decision aids in our integrated taxonomy. This taxonomy enables researchers to classify and describe their research results more precisely. Consequently, researchers in the field of guidance will be able to better compare existing works, systematically analyze the body of knowledge, and identify new and potential research gaps. Second, we provide an overview on the effects and outcomes of guidance design features in terms of the corresponding dimensions of the taxonomy. This overview allows developers to design guidance systems that provide the intended outcome because the design features are grounded in existing research. Third, we demonstrate the taxonomy's applicability by comparing a selection of existing guidance systems reported in research and by identifying research gaps. Fourth, we propose opportunities for future research addressing the extension of the taxonomy and the design of guidance systems.

In the subsequent sections, we introduce the research streams on guidance design features that form the foundation of this article. Our literature review, including the description of the methodology and discussion of the descriptive results, is outlined in Section 3. Subsequently, we present the integrated taxonomy of guidance design features in Section 4. In Section 5, we demonstrate the applicability of the taxonomy by comparing existing research and discussing research opportunities. Finally, we conclude the article in Section 6.

2. Background

We believe that there is a need to consider common research streams on guidance design features and to provide a consolidated conceptualization. Davern and Parkes [16] argue that, due to their different theory types, research on explanations and decisional guidance cannot be compared with each other (based on the classification of theories [17]). According to them, Silver's [6] taxonomy of decisional guidance relates to a type IV theory, whereas the taxonomy of explanations as introduced by Gregor and Benbasat [5] refers to a type V theory. They argue that the two taxonomies cannot be combined in an integrated taxonomy [16]. However, by considering the descriptions of different theory types [17], we argue that, in general, a taxonomy is a type I theory that aims to "*describe or classify specific dimensions or characteristics* "[…] *by summarizing the commonalities found in discrete observations*" [17: p. 623]. Moreover, according to the theory type classification, a theory of type IV or type V can also be interpreted as a theory of type I [17]. Hence, we consider the two taxonomies and the research by Todd and Benbasat [18] on decision aids as type I theories. Consequently, we argue that these partially overlapping taxonomies can be merged into one integrated taxonomy of guidance design features. Subsequently, IS designers can create new guidance interventions based on our taxonomy. The resulting systems can then be evaluated to demonstrate the effects of the guidance design features, which could result in a new (design) theory. However, the dimensions of the taxonomy itself are not concrete design principles. The resulting taxonomy should, therefore, not be considered a type IV theory or even a type V theory but rather a type I theory.

For theorizing the guidance taxonomy, we decided to conduct a conceptual literature review [19,20] using a bottom-up approach with respect to the historical timeline. The main reason for this decision is the vast amount of literature on highly varying but intertwined research areas addressing questions on how to motivate, guide, or force individuals to make a certain decision, undertake an activity, or exhibit a specific behavior when using IS. Generally, much research is done in the human-computer-interaction (HCI) field studying the interactions of humans with computers in more detail and thus examining the effects of several guidance design features. Today, the research field on HCI is well established and extensively examined. More specifically, much research examines systems that provide either explicit or implicit forms of guidance. Research on decision aids, such as recommender systems [21], largely focuses on explicit forms of guidance. Researchers thus examine topics such as accuracy, trust, and the acceptance of recommendations by decision aids in various contexts such as e-commerce [22,23]. Other researchers focus more on implicit guidance and address concepts such as system restrictiveness [24], implicit coordination [25], and persuasive systems [26]. We are aware that these research streams are important and can contribute to a comprehensive conceptualization of guidance. However, because the main goal of our review is theorizing an integrated taxonomy of guidance design features rather than providing a state-of-the-art overview of existing research results, we followed a bottom-up approach to the historical timeline with respect to our taxonomy's development. There is an ongoing and contemporary debate on how to conduct literature reviews [19,20]. Consequently, we refused to search explicitly for all potentially relevant literature in these research streams. Rather, we argue that it is important to consider the baseline of the guidance concept for theorizing to have a solid grounding of our research addressing guidance design features. In doing so, we aim to incorporate the existing and important findings (independently of the research stream they refer to) rather than re-inventing the wheel by proposing new concepts that address already-existing concepts. Thus, our conceptual literature review should identify related and relevant research on guidance design features required for theorizing the taxonomy. The three seminal streams of research on decisional guidance [15], explanations [5], and decision aids [18] can be considered the foundation of the majority of guidance studies in IS and DSS research.

First, **decisional guidance** is often studied in the context of DSS. In his studies, Silver introduces decisional guidance as the design features of DSS that help users with their system use [15]. Silver subsequently demonstrates the wide range of the decisional guidance concept and discusses its applicability across different types of IS [6]. In the rephrased definition of deliberate decisional guidance, he describes guidance as "*the design features of an interactive computer-based system that have, or are intended to have, the effect of enlightening, swaying or directing its users as those users exercise the discretion the system grants them to choose among and use its functional capabilities*" [6: p. 105]. He therefore broadens the scope of guidance from a design feature for DSS to design features for IS in general. By reviewing the existing literature, he modifies his original classification [6]. Second, the stream comprising **explanations** is based on the studies of Gregor and Benbasat, who examine "*information systems with an 'intelligent'* […] *component*" [5: p. 497]. In their work, the researchers describe intelligent systems as computer-based systems that have a built-in knowledge database enabling them to provide users with explanations for system outputs. We consider this explanation provision a guidance design feature. Gregor and Benbasat mention, "*explanations serve to clarify and make something understandable, or are a declaration of the meaning of words spoken, actions, motives, etc., with a view to adjusting a misunderstanding or reconciling differences*" [5: p. 498]. The researchers thus review work on the nature and use of explanations and propose a classification of explanations according to the content type, presentation format, and provision mechanism [5]. Third, Todd and Benbasat examine the effects of **decision aids** on decision-making strategies [18], stating, "*decision aid design is generally based on one of two schools of thought*: (*i*) *decision aid as* *technological intervention should assist in the implementation of normative decision-making strategies*; *or* (*ii*) *decision aid as a behavioral approach with the aim of extending the capabilities and overcoming the limitations of decision-makers*" [12: p. 11]. From a behavioral perspective, decision aids do not restrict users by guiding them through the usage of the system; however, they support users with selecting the proper system functionalities [18]. Arnold et al. [12], however, define decision aids as mechanisms to "*integrate the expertise of one or more experts in a given decision domain*" [12: p. 2] into a relevant IS. Decision aids aim at either providing recommended solutions to a problem or at assisting with decision-making [12]. As such, we consider the notation of decision aids very similar to the decisional guidance notion of Silver [15]. In the literature, we find many types of decision aids, ranging from simple or deterministic models to DSS or intelligent systems [11]. Decision aids – considered from a technical perspective – can include entire systems, such as DSS and XPS [27], or guidance design features that are added to a system. In addition, recommender systems [21,28], and their overarching system class called intelligent systems [29], can be considered technical interventions in the form of a decision aid. As defined by Arnold et al. [12], decision aids are "*intended to provide a specific recommendation to a given problem and/or provide expert advice that assists the user in making a better decision than when unaided*" [12: p. 2]. In summary, we identified three research streams that describe the characteristics of decisional guidance [15], explanations [5], and decision aids [18].

To avoid misunderstandings, we define the following concepts explicitly for the remainder of this article: **Guidance** describes the concept of supporting users with their decision-making, problem solving, and task execution during system use by providing suggestions and information. **Guidance design features** refer to the actual implementation of the guidance concept. We thereby subsume the three research streams on decisional guidance, explanations, and decision aids (considered from a behavioral perspective) under the umbrella term 'guidance'. We consider technological interventions related to the guidance concept as design features of a system that actually provide the user with guidance. We thus subsume systems implementing guidance design features, which include decision aids (considered from a technical perspective), intelligent systems (e.g., XPS and DSS [29]), and systems with a specialized focus (e.g., recommender systems) under the term **guidance systems**. Guidance systems such as decision aids and intelligent systems provide their users with guidance, for example, in the form of decisional guidance or explanations.

3. Conceptual literature review

We decided to conduct a bottom-up approach for our literature review using the articles presented above [5,15,18] as the starting point. A conceptual literature review, also referred to as conceptual literature synthesis, aims to provide an overview on a certain topic by identifying key findings rather than providing a holistic and comprehensive overview on the literature, such as state-of-the-art reviews, meta-analysis reviews, or quantitative literature studies [20]. Next, we present the methodology before discussing the results in detail.

3.1. Methodology

We conducted the literature review following the guidelines by Webster and Watson [19] and vom Brocke et al. [20,30]. In addition, we used the taxonomy by Cooper [31] to classify our review as summarized in Table 1. We started the review with the creation of our search query based on the three research streams decisional guidance [15], explanations [5], and decision aids [18] discussed in the previous sections. The seminal work on guidance was done two decades ago at an early stage of research in this field and has since been cited frequently. The articles by Silver [15] (citation count: 189 in Google Scholar, 110 in Scopus) and by Gregor and Benbasat [5] (citation count: 311 in Google Scholar, 164 in Scopus) were published in MIS Quarterly in 1991 and 1999, respectively. The article by Todd and Benbasat (citation count: 266 in Google Scholar, 140 in Scopus) was published in Information Systems Research in 1991. Based on these articles we derived the search query. We tested and extended the query iteratively and finally adapted it to the technical specifications of the databases:

("*guidance*" *OR* "*decisional guidance*" *OR* "*explanations*" *OR* "*decision aids*") *AND* ("*decision support systems*" *OR* "*DSS*" *OR* "*expert systems*" *OR* "*intelligent systems*" *OR* "*information systems*").

Table 1
Categorization of literature review (based on Cooper [31]).

Category	Description
(1) Focus	Research outcomes of application of guidance design features in the IS research community
(2) Goal	Integrate and synthesize existing literature related to the concept of guidance and guidance design features
(3) Perspective	Objective, neutral perspective
(4) Organization	Results organized in the form of a taxonomy
(5) Coverage	Use databases of the leading economics, information systems, and computer science journals and conferences
(6) Audience	IS research community and practice

To guide our evaluation procedures during the search process, we derived explicit inclusion and exclusion criteria in accordance with our research goal, which provided additional transparency for the search and literature evaluation procedures. With respect to the time frame, we anchored our study using the articles by Silver [15] and Todd and Benbasat [18], focusing on research published between 1991 and 2015.[1] Furthermore, we considered only peer-reviewed publications written in English. We searched scientific databases containing journals and conference publications to find relevant data sources [19]. Therefore, we considered the most important databases for economics (EBSCSOhost and ProQuest), computer science (ACM Digital Library and IEEE Xplore Digital Library), and information systems (AIS Electronic Library). We selected the databases to include the IS basket of eight and the most important conference proceedings in the IS field. Nevertheless, we did not filter for specific journals or outlets to ensure that we included research from information systems, economics, and computer science, which are also relevant to our studies. Within the databases, we searched by title and abstract.

We categorized the results of the literature review according to the articles' contribution and were guided by the following question: Do the articles **conceptualize** and/or **use** guidance design features? Articles conceptualizing guidance design features either formulate new guidance design features or modify existing ones. Articles addressing the use of guidance design features instantiated them in a guidance artifact. These categories are not mutually exclusive; an article could be assigned to one or both categories. Next, we categorized the articles according to the addressed guidance streams, as introduced in the background section. In doing so, we considered the information provided in the articles, because nearly all of them provide information on the guidance stream they address. In addition, the categorization was rather straightforward because it was based on the provided references, for example, the referenced initial article(s). If an article did not provide such information, for example, articles from outside the IS community, we categorized it as "NA" (not available). When analyzing the results, we conducted a backward search to identify referenced research that was of interest to us. After the analysis, we conducted a forward search with the initial set of articles [5,15,18] to discover work that we had not yet found in the databases.

We searched for research results on guidance design features that add to the integrated taxonomy and summarized and discussed potential candidates. Subsequently, we applied the taxonomy to the identified articles and categorized them according to the taxonomy's dimensions

[1] The literature review was conducted early in 2014 and updated in early 2016.

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and characteristics. In doing so, we used the articles' information on the addressed guidance design features to derive the specific guidance characteristics. More information on this categorization process, its shortcomings, and results are reported in Section 5.

Because there is a huge amount of research on the guidance concept available, terminating the search process was difficult. Some researchers argue that a search should be terminated when a certain level of saturation is achieved, for example, when no new publications are identified [20] or when the researchers are confident of the novelty and the importance of the identified research problems [32]. We defined the level of saturation as the moment when no new guidance design feature, dimension, or taxonomy characteristic emerged [33]. Although we are aware that we might have overlooked some articles, we argue that our review has a reliable degree of comprehensiveness because we identified and included important articles and already-existing guidance design feature classifications in our taxonomy [32]. In addition, the aim of this research is to theorize an integrated taxonomy of guidance design features grounded in existing guidance research and identified in a conceptual literature review [20]. We did not aim to provide a comprehensive, detailed, or complete overview on state-of-the-art guidance design features including related research domains such as HCI or recommender systems.

3.2. Descriptive results

In total, we identified 89 articles after executing the analysis and the backward and forward search. Table 2 summarizes the number of found articles, arranged according to their guidance stream and the search phase. We found 27 papers referring to decisional guidance, 15 to decision aids, 38 to explanations, and 9 to a concept of guidance not covered by the three streams. These articles include conceptual research (e.g., [10,34,35]) and empirical research (e.g., [13,36–39]). In addition, Table 2 includes an excerpt of the identified articles by stream and search phase to provide the reader an overview of the utilized articles. Articles conceptualizing guidance are indicated with an asterisk. Due to length limitations, we are not able to provide a full list of all references identified in the review (but the list can be provided on request to the first author).

When considering the identified articles over time, we notice that until the year 2000, all three guidance streams were addressed at nearly the same rate, with explanations addressed the most. After 2000, research interest appears to focus more on explanations, given the number of identified articles in our review. A possible reason for this distribution could be the interrelationship of the three guidance concepts and how they are used in current research. The exceptional growth in the number of explanations could be due to the increasing interest in recommender systems in the IS research area. Recommender systems, or more generally, intelligent/interactive decision aids [21, 27], primarily provide a set of explanations describing why a system provides certain recommendations, or uses explanations, as a recommendation.

As the next step, we conducted a network analysis to analyze the relationship among the identified articles. Fig. 1 depicts a reduced version of the network based on a subset of the identified articles (circle diameters reflect the article citation count within the subset). The network illustrates the importance of the initial set of articles (dark grey circles) and their interrelationship to the other articles used for the subsequent theorizing of the integrated taxonomy of guidance design features. In addition, the citations of the three more recent articles [39,47,48] emphasize the relevance of the three research streams. An in-depth network analysis, based on a larger set of articles and evaluating the type of citation (e.g., as related work or theoretical foundation), is out of scope for this article and subject to future research.

4. Findings

After motivating our research and describing the review methodology in detail, we now discuss the results of the review and theorize the integrated taxonomy of guidance design features.

4.1. Integrated taxonomy of guidance design features

Building on the three research streams, we analyzed the identified literature, searched for further dimensions, and examined specific guidance characteristics. The resulting integrated taxonomy of guidance design features consists of ten dimensions: target, directivity, mode, invocation, timing, format, intention, content type, audience, and trust building. Nine of the dimensions are derived from the initial set of articles of the three guidance research streams. We supplemented these dimensions by including the dimension trust building based on our analysis and the subsequent discussion. The taxonomy of guidance design features is depicted in Fig. 2.

In the following, we describe each dimension's characteristics in more detail and provide a justification for its inclusion in the integrated taxonomy. In addition, Table 3 provides the definition and sources (if applicable) for the dimensions and characteristics of the integrated taxonomy of guidance design features.

Silver [6] discusses the category **target** in his definition of decisional guidance. In contrast to his original DSS-related definition in 1991, he generalized the two characteristics "choosing functional capabilities" and "using functional capabilities" of a system in 2006. Guidance can support users when they interact with the system and are confronted with its complexities. Furthermore, guidance helps users to choose between systems and interact with their capabilities [44]. For example, guidance can support users with their choice of a display format. By providing different forms of guidance, Mahoney et al. realized that decision-makers were more accurate and responded faster in their selection of a display format when they received appropriate guidance [44].

Silver [6] distinguishes three guidance **directivity** types. First, informative guidance "*provides pertinent information that enlightens the user's choice without suggesting or implying how to act*" [6: p. 109]. In contrast, suggestive guidance "*makes explicit recommendations to the user on how to exercise his or her discretion*" [6: p. 109]. Thus, as proposed by Arnold et al. suggestive guidance might be related to the guidance intention of specific recommendations [12]. Conversely, the intention of expert

Table 2
Results of literature review.

Analysis phase	Total	DG	EX	DA	NA
Initial set			[15]*, [5]*, [18]*		
Keyword search			**#2542**		
Title and abstract			**#108**		
Full text	**#64**	**#14** (e.g., [6]*, [36,40,41,37,42,38,43,44,45,46,47,48])	**#27** (e.g., [49]*, [50,51,34]*, [52,29]*, [5,53,54,55,56,57,58,59,14,60,61,35]*, [10]*)	**#11** (e.g., [27]*, [12]*, [62,63,64,65,13,22,39])	**#9** (e.g., [66,67,68])
Backward search	**#12**	**#6** (e.g., [69,70,71,24]*, [72])	**#4** (e.g., [73,74])	**#2** (e.g., [75])	**#0**
Forward search	**#16**	**#7** (e.g., [76,77,78]*)	**#7** (e.g., [79,80,81])	**#2** ([82,23])	**#0**
Result	**#89**	**#27**	**#38**	**#15**	**#9**

DG: decisional guidance; EX: explanations; DA: decision aids; NA: not assigned
* Article conceptualizes guidance design features.

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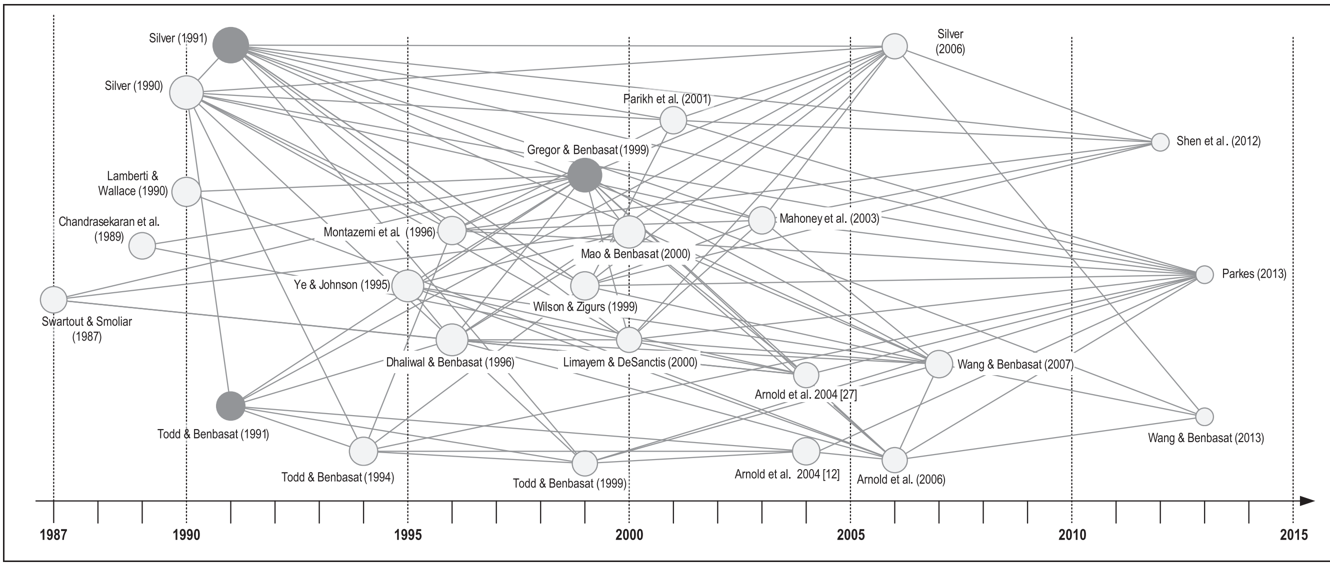

Fig. 1. Excerpt of an article network analysis.

advice could be related to informative guidance. The dimension of guidance intention is discussed below as a separate dimension. Suggestive guidance is found to enable users to perform better than does informative guidance in an experimental setting [45]. Such a guidance-based increase of performance results in higher perceived guidance satisfaction [70]. However, such effects are highly dependent upon task complexity. Researchers found that users will benefit from suggestive guidance for less complex tasks, whereas informative guidance becomes more beneficial with increasing task complexity [45]. In addition, suggestive guidance can improve the quality of decisions, increase user satisfaction, and reduce the time required for decision-making [70] because such guidance provides clear descriptions (procedural knowledge) of how to proceed. In contrast, when aiming to increase user learning, informative guidance should be favored [46] because it provides declarative, or definitional, knowledge [49] and, thus, enables an increase in the understanding of a model [38]. However, suggestive guidance can be a significant predictor of reliance and, therefore, of the provided guidance's persuasiveness [47]. Informative or even no guidance does not have such effects on users' perceived reliance. These various results of guidance directivity discussed in the literature highlight the importance of carefully considering the design of the guidance that a system offers [47]. In addition, Silver adds a mix of informative and suggestive guidance – the quasi-suggestive guidance "*that does not explicitly make a recommendation but from which one can directly infer a recommendation or direction*" [6: p. 109]. However, we could not find any studies reporting the application of a quasi-suggestive guidance or its effects on users.

Concerning the guidance **mode**, Silver proposes predefined, dynamic, and participative guidance. In contrast to the category target, he does not generalize the original DSS-related definitions [15]. Therefore, we generalize his original definition as the following: Predefined guidance is defined as guidance that is prepared, for example, by the system designer and is static in its form. Dynamic guidance is not prepared beforehand. Instead, the system "learns" from the user and generates guidance on demand. The third type, participative guidance, depends upon the user's input in the received guidance rather than in the other modes. Comparing dynamic and predefined guidance, researchers found that dynamic guidance was more effective in improving decision quality, user learning, and decision performance [37,46]. These scholars conclude that participative guidance enables an increase in task performance, particularly for highly complex tasks, because information overload can be decreased. In contrast, predefined guidance is beneficial for tasks with a low complexity, due to an increase in the task quality and performance [37]. However, if guidance aims to support user learning, participative guidance is preferable because it enables users to actively decide which information is needed and/or desired. Other modes of guidance "*may encourage passive user involvement*" [62: p. 238], which will result in the reduced acquisition of knowledge and, thus, in an inappropriate reliance on the provided guidance [62].

The guidance **invocation** style describes how guidance is initiated and delivered to the user. Gregor and Benbasat call this dimension 'provision' and mention three characteristics: user-invoked, automatic, and intelligent [5]. Silver also describes three invocation styles: on-demand, automatic, and hybrid [6]. Based on the descriptions of the

Target	Choosing		Using	
Directivity	Suggestive	Quasi-suggestive	Informative	
Mode	Predefined	Dynamic	Participative	
Invocation	Automatic	User-invoked	Intelligent	
Timing	Concurrent	Prospective	Retrospective	
Format	Text-based	Image	Animation	Audio
Intention	Clarification	Knowledge	Learning	Recommending
Content Type	Trace	Justification	Control	Terminological
Audience	Novice		Expert	
Trust-Building	Proactive		Passive	

Fig. 2. Integrated taxonomy of guidance design features.

Table 3
Dimensions and characteristics of the taxonomy.

Dimension	Definition	Source
Target	Target of guidance covers what distinct activity is enlightened. Guidance supports its users in (i) *choosing* which activity to perform or (ii) *making choices* when engaging in a given activity.	[6,15]
Directivity	Directivity of guidance covers what form of guidance is offered to the decision-maker and how it aims to influence the users' activity. Guidance can support users by (i) *suggestive guidance*, which makes judgmental recommendations, (ii) *informative guidance*, which provides pertinent information that enlightens the users' judgment without suggestions on how to act, or (iii) *quasi-suggestive guidance*, which does not explicitly provide recommendations but from which one can directly infer recommendations.	[6,15]
Mode	Mode of guidance describes how the guidance works. Guidance can be generated either (i) in a *predefined* mode, meaning the system designer prepares the provided guidance, (ii) in a *dynamic* mode, meaning an adaptive mechanism "learns" as the system is used, or (iii) in a *participative* mode, in which users participate in determining the guidance they receive.	[6,15]
Invocation	Invocation of guidance covers how the guidance is accessed. Guidance can be provided either (i) *automatically* by the system based on redefined usage events, (ii) *user-invoked* after the users' request, or (iii) *intelligently* adapting the guidance based on usage context.	[5,6,15]
Timing	Timing of guidance describes when the guidance will be provided to the user, e.g., for supporting a certain activity. Guidance can be provided either (i) *concurrently*, during the actual activity, (ii) *prospectively*, before the actual activity, or (iii) *retrospectively*, after the actual activity.	[6]
Format	Format of the guidance describes how the provided guidance is formatted. Guidance can be in the form of (i) *text*, when using primarily written words, (ii) *images*, when using pictures and depictions, (iii) *animation*, when using videos and moving pictures, or (iv) *audio*, when using speech and verbal instructions.	[5]
Intention	Intention of guidance describes the context of why guidance is provided. Guidance can be provided either as (i) *clarification*, used to illuminate a perceived anomaly, (ii) *knowledge*, used to provide additional information, (iii) *learning*, used to support learning and training, or (iv) *recommending*, used to suggest a certain decision or activity.	[12,27,29]
Content type	Content type of guidance describes the purpose of the guidance provision. Guidance can be provided either as (i) *trace*, when providing the line of reasoning, (ii) *justification*, when outlining the reasoning with an additional line of argumentation, (iii) *control*, when providing evidence for a successful strategy, or (iv) *terminological*, when providing expert knowledge on concepts of a certain domain.	[5]
Audience	Audience of guidance describes which types of users are addressed by the guidance. Guidance can be provided either to (i) *novices*, users with no or only limited knowledge and expertise of the domain of interest or (ii) *experts*, users with a (high) amount of knowledge and expertise of the domain of interest.	[5]
Trust-building	Trust building describes whether the guidance affects the user's confidence in it. Guidance can be either (i) *passive*, when the guidance is not deliberately affecting the trust of the user in it or (ii) *proactive*, when the guidance is purposefully affecting the trust of the user in it.	[35,74]

characteristics described in both articles [5,6], we condense the dimensions of the two articles into one. The descriptions of user-invoked [5] and on-demand [6] invocation are very similar, and the descriptions are related to the automatic invocation style that both describe. Silver does not provide a definition of the hybrid style, but we conclude from the differentiation of the guidance directivity that the hybrid style is a mixture of the other two invocation styles [6]. Gregor and Benbasat describe intelligent provision as providing explanations based on user behavior as monitored by the system [5]. We therefore decided to combine the two dimensions – 'invocation' [6] and 'provision' [5] – in the dimension we named invocation. Arnold et al. discuss the difference between automatic and user-invoked provision of guidance in relation to their decision aid's interface design [27]. The automatic provision of explanations requires the computer screen to be partitioned, leading to reduced space for the posing of questions and answers by their decision aid [27]. Other researchers, however, caution against the implementation of an automatic invocation of guidance, because it can lead to imperfect information and, thus, can have negative outcomes on users' decisions or task quality [79].

Silver defines three characteristics of **timing**: prospective, concurrent, and retrospective [6]. They are defined by their names: prospective guidance is provided before a certain activity, concurrent guidance is provided with the activity, and retrospective guidance is provided after an activity. Furthermore, Silver discusses the similarities between his terminology and the research on feedback and feedforward guidance [6]. Similarly, Dhaliwal and Benbasat discuss the difference between cognitive feedback and feedforward; cognitive feedback provides information that clarifies case-specific outcome feedback,

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thus improving decision-makers' understanding of a task. Feedforward is not related to the outcomes of the specific case considered but focuses on the task's input cues [34]. We agree with these findings because the formal definitions of feedback and feedforward are more than only describing the timing of guidance. Focusing on the timing of guidance, we therefore use the characteristics defined by Silver for our taxonomy [6]. To study the effects of prospective guidance, researchers conducted an experiment by providing guidance to support decision-makers' emergency management [48]. Based on the experiment, the researchers demonstrate that prospective guidance has a significantly positive effect on decision-makers' decisional accuracy, speed, and mental workload [48].

Gregor and Benbasat define two presentation **formats** in their taxonomy for explanations: text-based and multimedia [5]. The multimedia format can be realized as graphics, images, animations, and voice synthesis [5]. We modify the original definition by dividing the multimedia type to make it more precise and use the following characteristics for the presentation format of guidance: text, image, animation (including videos), and audio. These characteristics are not mutually exclusive and can be used individually or in combination. The multimodal interface community researches the combination of different media types, and we refer the interested reader to a related literature review [83]. In the current IS literature, the usage of text-based guidance is most favored. Some researchers use a text-based format for explanations and recommendations in their system [29,40]. It thus appears obvious that the length of the provided guidance text has an effect on users' acceptance of guidance and on their performance. However, findings also exist indicating that the text length and style (conveyed confidence) of the guidance have no significant effect on user decisions [29]. In contrast, combining strongly confident and long explanations is more effective with respect to user acceptance of forecasts provided by the system [29]. Text-based guidance is often used in combination with tables and graphs to support group decision-making [42]. Differentiating between spatial and symbolic tasks, researchers found "*that in tasks involving uncertainty data, the decision-makers were more accurate and responded faster when symbolic tasks were matched with tabular displays and spatial tasks were matched with graphical displays*" [44: p. 104]. By using animations (including videos) and graphics, for example, language-induced barriers can be transcended. Researchers demonstrated that providing animated guidance instead of text-based guidance led to a 50% reduction in time [76]. The audio format is specifically considered when the visual channel is heavily loaded. By using the audio format, users can avoid being distracted from other tasks, which is, for example, beneficial in the context of car navigation [61].

Arnold et al. argue that guidance can serve two **intention**s – the provision of specific recommendations and expert advice [12]. Dhaliwal and Benbasat state that it is important to distinguish between two contexts when using explanation: instructional explanations (used for learning) and working explanations (used for problem solving) [34]. These two contexts are extended by the following three intentions: clarification of a perceived anomaly, supply of extra knowledge, and facilitation of learning from the system [29]. The literature on recommender systems motivates a fourth characteristic (cf. [39]) and the suggestions offered by Arnold et al. who state that guidance could also be intended to be used for recommending decisions [12]. We combine all of these findings in the dimension intention with the following four characteristics: clarification (of a perceived anomaly), knowledge (provision), learning, and recommending. In particular, when users do not understand an advice provided by the guidance system, additional explanations increase the acceptance of this advice and guide the users [55]. When explanations are provided, the users receive extra knowledge enabling them to participate more effectively in problem-solving tasks [29]. In addition, explanations improve not only the application of guidance but also the knowledge transfer to and learning for novices [53]. Experts and novices might use explanations with different intentions; as stated by Gregor and Benbasat, "*experts will use explanations more for resolving anomalies and novices more for learning*" [5: p. 512].

The **content type**, as proposed by Gregor and Benbasat (based on [84–86]), is highly related to guidance intention [5] and is often cited by more-recent research [14,29,51]. Based on the article of Gregor and Benbasat, the content type of guidance can be differentiated into (1) trace (or line of reasoning), (2) justification (or support), (3) control (or strategic), and (4) terminological [5: p. 503]. The four types represent different intentions of the explanation use, such as justifying a specific explanation or tracing how the explanation within an XPS was derived. Furthermore, the researchers argue, "*reasoning traces, justification and control explanations are likely to be used more when the 'task' is learning rather than problem solving*" [5: p. 516]. Therefore, explanations can provide different types of knowledge. The deep (domain) knowledge could be included with any of the different explanation content types. Such deep knowledge can increase user understanding of a certain domain, resulting in improved learning [5: p. 530]. Consequently, the varying content types pursue different intentions and can be subsumed into the intention characteristics as described by Dhaliwal and Benbasat [34]. However, to provide an integrated taxonomy of guidance design features that enables researchers to describe their guidance artifacts precisely, we refrained from subsuming the content type into the intention dimension. Thus, the integrated taxonomy contains a separate dimension 'content type' with the following four characteristics: trace, justification, control, and terminological. The varying content types also have different effects on user acceptance of the provided guidance. Researchers found that users are more likely to accept justificatory knowledge that a guidance system provides. Conversely, strategic explanations appear to disappoint users [10]. Another dimension of the integrated guidance taxonomy is the **audience** of guidance, which has two characteristics: novices and experts. Gregor and Benbasat differentiate between novices and experts using the explanations provided by intelligent systems [5]. User expertise heavily influences the usage of explanations [34]. Research on problem-solving processes strongly investigates the differentiation of audience into novices and experts because both types of users vary greatly in their requirements and usage of provided support. Whereas expert users consider problems conceptually and tend to generalize them, novices examine problems syntactically by focusing on specific details and using the first method that comes to mind. Thus, experts aim to understand a problem, whereas novices simply aim to solve a problem without understanding it [63]. These differences are also observed in the context of guidance and explanations. Thus, the audience must be considered for the proper design of a guidance system. Novices, for example, need more explanations than experts [10] and will appreciate the advice of a system, whereas experts' acceptance can dwindle [56]. Given experts' and novices' varying intentions when using a guidance system, it should be designed so that novices can benefit from explanations that assist them with learning, but experts can receive information to resolve anomalies [55].

Although all of the dimensions described above are already included in the taxonomies presented in the initial set of articles, the literature review also revealed an additional dimension not considered thus far – **trust building**. We have carefully analyzed this additional dimension and incorporated it into the taxonomy. Researchers investigate the effect of explanations on trust building in the context of recommender agents [35,74]. These findings support the hypothesis that customers use explanations on how recommendations are made in their evaluations of systems' trustworthiness [36]. By providing such explanations for the results or actions, the system proactively increases user trust in the provided guidance. Trust is an especially important factor in recommender systems, or more generally in guidance systems when intending to recommend something. Silver also highlights the importance of trust by stating, "*trust in the guidance is likely to determine whether users follow the suggestions and whether they invoke guidance when it is not automatic*" [6: p. 113]. The strong relationship between trust building and users' acceptance of guidance is highlighted in one of the initial articles [5]. Here, trust is differentiated into "*three distinct and coherent dimensions of trust: predictability, dependability* (*confidence*), *and faith*" [5: p. 504]. Consequently, predictability refers to trust in certain activities (of a person or guidance system) and originates from (social) learning experiences. In contrast, dependability represents a "*shift in focus away from assessments involving specific behaviors, to an evaluation of the qualities and characteristics*" [87: p. 96]. In other words, dependability refers to trust in a person (or system) and not in specific actions. Although these two dimensions are rooted in human experiences, the third dimension 'faith' represents humans' beliefs and desires [87]. Researchers in the field of HCI found that "*apart from human relationships, trust can be relevant in human-computer relationships as well*" [58: p. 2]. Thus, we believe that guidance systems can realize at least the first two, if not all three dimensions of trust [59]. Nevertheless, to facilitate the application of our integrated taxonomy, we only make a distinction concerning whether the guidance system intends to build trust. Guidance systems that actively endeavor to increase user trust in their guidance are classified as proactive, and systems that do not try to stimulate an increase in trust are classified as passive.

4.2. Effects and outcomes of guidance design feature usage

When analyzing the research addressing guidance, we identified several effects and outcomes of guidance design features. However, clearly differentiating these effects as either positive or negative is difficult when only considering the effects of empirical research results on guidance. Table 4 provides an overview of the empirical findings organized by the investigated dependent variables. In general, guidance design features promise to increase users' **performance**, but user performance can be defined in different ways. Often, measuring the outcome quality based on the provided guidance examines a change in user performance [38,69,80]. There are findings that demonstrate a significant increase in participants' perceived decision quality if they received guidance compared with those who did not [38]. In contrast, other findings did not demonstrate such concrete results [37]. According to the researchers, the positive effect of guidance is highly influenced by the selected task type and the implemented guidance design features. The predefined guidance mode should be preferred for tasks with low complexity, whereas participative guidance should be preferred for highly complex tasks [37]. By considering the task complexity and various guidance directivities, researchers also studied the effects of guidance design features on users' performance. Rather than quality, these researchers studied accuracy as a dependent variable and concluded that suggestive guidance will result in more-accurate outcomes than will informative guidance [45]. However, when the form of the provided feedback (task information vs. cognitive information) is considered, the results vary. Although suggestive guidance still outperforms informative guidance with respect to 'task information' feedback, the effect is reversed when 'cognitive information' feedback is provided [45]. Combining suggestive guidance as directivity and dynamic guidance as mode of guidance, empirical studies also demonstrate an increase in (decision) quality [46].

In addition to performance measures, guidance design features are also often referred to as positively influencing **time** (or task execution speed). By using suggestive guidance, for example, for the matching of task requirements with the display style, decision-makers appear to be more accurate in shorter times [44,48]. Furthermore, researchers also observed such shortened decision times [38,44,76]. Conversely, other researchers found that groups receiving decisional guidance required significantly more time to complete their tasks compared with groups without guidance [42]. Thus, when considering time as a dependent variable, it appears necessary to define exactly how time is measured. In their experiment, Parikh et al. could not, at the first glance, measure significant time differences concerning varying guidance modes [46]. Rather, the researchers realized that the participants who received guidance needed more time than those who did not receive guidance. Consequently, they reanalyzed their results by splitting the measured time into decision time and time for guidance consumption. Based on the splitting of time, the researchers observed a reduction in the pure decision time (without guidance consumption time) when suggestive guidance was provided [46]. By considering different time measures, researchers observed similar results of varying effects [68]. Thus, researchers must consider whether the measured time includes the time required to process guidance.

Learning is another often-discussed variable that is influenced by guidance design features. Guidance promises to lead to better learning effects [5,6,41]. However, empirical studies fail to provide clear evidence of this effect. Rather, the results of learning are somewhat mixed, depending upon the audience and selected guidance design features. To increase user learning, informative and dynamic guidance appear to have a greater effect on user learning than does suggestive guidance [46]. The improved learning is thus traced back to providing additional explanations [53]. Mao and Benbasat, for example, found that novices can benefit from explanations that assist them with learning [55]. Furthermore, when provided with concurrent and participative guidance, people learn more effectively because they actively participate in the concepts underlying a task and work through the processes involved in the task rather than simply applying a pre-structured aid and receiving feedback from the system [62]. In another study, researchers investigate the effect of prospective (feedforward) and retrospective (feedback) guidance in the form of explanations concerning learning [27]. The researchers use the Adaptive Character Thought-Rational theory [88], which explains the different phases of understanding that guidance addresses; prospective guidance enhances the declarative phase (novice users), and retrospective guidance enhances the knowledge compilation (experienced users) and the procedural (expert user) phase. However, some empirical studies challenge these results. For example, Steinbart and Accola conclude in their work, "*Neither explanation type nor the degree of user involvement affected user learning*" [60: p. 12]. They only observed that prior knowledge had a positive correlation with user learning [60]. The sole guidance consumption can result in users attempting to decrease their effort. In particular, suggestive guidance that directs users through their work can cause users to

Table 4
Effects and outcomes of guidance design features.

Cluster	Observed variable	Exemplary sources of empirical research
Performance	Accuracy, performance, quality	[69,79,53,70,37,80,38,44,45,57,46,48,13,39,72]
	Group consensus	[38,56]
Time	Time, speed	[76,37,42,38,63,44,46,48,13,68,72]
Learning	Knowledge acquisition/transfer, learning	[49,62,53,42,38,46,60,68,73,41]
	Model/system understanding	[38,55,81]
Trust	Confidence, trust	[82,53,70,38,74,35,23,39]
Adoption and use	Acceptance	[36,52,54,38,46]
	Ease of use, intention to use, usefulness	[82,70,71,55,56,47,77,22]
	Helpfulness, value	[79,29]
	Satisfaction	[70,54,38,46,60]
Cognitive effort	Cognitive effort, information overload, mental workload	[37,48,18,64,65,39]

blindly accept the system's guidance due to its persuasiveness [47]. In addition, this externalization of relevant information could avert users' learning how to solve a task [68].

In contrast to the partially contradictory results on the effects of guidance on performance, time, and learning, more-conclusive results on the following dependent variables are observed in empirical studies. In general, when properly designed, users perceive guidance as **useful** [70] and are satisfied with the provided guidance design features [38,54]. Novices particularly benefit from guidance and perceive guidance design features as an added value [56,79]. The increased **trust** due to the guidance design features thereby has a positive effect on users' **reuse intentions** toward the guidance system [82]. Various researchers have studied the importance of user trust in the system and in the provided guidance [23,35,38,39,74]. The effect of guidance design features on users' **cognitive effort** and information overload has also been investigated [37,48]. Researchers found that guidance relieves users' working memory, which, in turn, influences their performance positively [48].

In summary, the effects of guidance design features are dependent upon the guidance's various characteristics and task complexity. Consequently, it is vitally important that researchers precisely describe the forms of guidance they provide when measuring its effects. Only when detailed information on the implemented guidance design features are provided can the effects described in empirical studies be compared and, thus, be of value for other researchers. Consequently, the derived integrated taxonomy enables researchers to define and standardize descriptions of the guidance design features they employ in their empirical studies and research. However, based on the previously discussed results, it appears reasonable to add task complexity as an additional dimension to our integrated taxonomy because it strongly influences guidance outcomes. Nevertheless, we refrained from doing so, because task complexity does not describe the provided guidance but rather the task that should be supported by using the guidance design features. Thus, task complexity is an important control variable that should be considered when comparing the effects and outcomes of guidance design features, but it is not a specific guidance design feature.

5. Taxonomy application

The following section demonstrates an example of how to use the taxonomy to compare guidance research and how to apply the taxonomy for the identification of research opportunities.

5.1. Guidance design feature research comparison

We apply our integrated taxonomy to compare selected research articles found in our literature analysis. Table 5 depicts the comparison of six articles using our integrated taxonomy. For each article, we selected the appropriate characteristics of the taxonomy's dimensions.

Arnold et al. [27] and Silver [6] also assigned the different dimensions and characteristics independently. We highlighted articles considered by their work (in particular, [55,56]) in Table 5 by using the "A" character (identified by Arnold et al. [27]) or the "S" character (identified by Silver [6]) instead of the "x" symbol. In addition, the table provides the addressed guidance research stream: decisional guidance (DG), explanations (EX), and decision aids (DA). Note that it was not possible to derive all of the characteristics for each dimension for the selected articles. When examining the comparison, several conclusions can be drawn from the table. An in-depth discussion of the research comparison lies beyond the scope of this article and could be a future project. However, we note possible conclusions concerning the conducted comparison. For example, Nah and Benbasat [56] and Montazemi et al. [45] address similar types of guidance design features in their research but address different streams (explanations and decisional guidance). Another conclusion drawn from this comparison is that all six articles use text as a guidance format. As already stated, it was not always possible to qualify the articles along all of the taxonomy's dimensions. If the author did not state the dimensions explicitly, we derived the dimensions from screenshots or descriptions in

Table 5
Comparison of research using the guidance design features taxonomy.

Guidance research stream		Al-Natuor and Benbasat [82] DG	Mao and Benbasat [55] EX	Montazemi et al. [45] DG	Nah and Benbasat [56] EX	Parkes [77] DG	Wang and Benbasat [22] DA/EX
Target	Choosing				S		
	Using						
Directivity	Suggestive	x		x	S	x	x
	Quasi-suggestive						
	Informative			x	S	x	
Mode	Predefined				x	x	x
	Dynamic		x			x	
	Participative						
Invocation	Automatic					x	
	User-invoked		A		S		
	Intelligent						
Timing	Prospective				x		
	Concurrent				x	x	x
	Retrospective		A				
Format	Text	x	A	x	x	x	x
	Image	x	A		x		
	Animation	x					
	Audio	x					
Intention	Clarification		x	x			
	Knowledge						
	Learning						
	Recommending	x			x		x
Content type	Trace		x		x		
	Justification		x				
	Control		x				
	Terminological						
Audience	Novices		x			x	
	Experts		x			x	
Trust building	Proactive						x
	Passive						

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the article. In the future, we hope that our taxonomy will facilitate the comparison of research articles by providing a common set of dimensions and characteristics for guidance design features.

5.2. Research opportunities

Another possible application of the taxonomy is the identification of opportunities for future research. Similar to the comparison, we identified taxonomy dimensions and characteristics for each article found in the literature review. Again, if not clearly stated, we tried to determine the characteristics used from contextual descriptions and screenshots. If this determination was not possible, we left the category empty. Arnold et al. [27] and Silver [6] attempted a similar effort based on their classifications. We verified their classification results with our findings and integrated them into our analysis. Fig. 3 depicts the results of our analysis.

Of the 89 articles found in this literature review, 63 classify guidance by using at least one category. The guidance characteristics are not mutually exclusive (e.g., there can be papers that simultaneously address suggestive and informative guidance). In such a case, we classified both characteristics for this article.

Based on the classification, we propose five exemplary opportunities for future research on the design of guidance systems or guidance design features:

(1) The potential of guidance systems to monitor user behavior and to provide guidance with an intelligent invocation is promising. Silver [6] also mentions user behavior as a possibility for further research. Recent advances in technologies, such as eye tracking and biofeedback devices, enable researchers to observe user behavior and react accordingly by providing appropriate guidance.

(2) A prospective and concurrent timing is rarely used, in contrast to a retrospective timing. Thus, we propose that investigating the possibilities and effects of providing users guidance concurrently or prospectively. We argue that supporting users upfront or when conducting a certain activity with the required guidance can, for example, prevent expensive mistakes and increase their knowledge. Moreover, such guidance timings can be used for interactive training for on-the-job applications.

(3) The majority of articles use a text-based or image format. We found only one article studying the effects of guidance by using animations, and only two refer to audio as a guidance format. Due to the increasing usage of multimedia channels, we propose investigating such types of guidance formats and their effects.

(4) Although we are aware that guidance is primarily helpful for novices, more research on empowering experts by providing appropriate guidance could be interesting, particularly when considering that novices can become expert users over time. This possibility can be investigated in the context of training on-the-job applications. Another aspect is the support or detection of experts conducting failures due to wrong knowledge.

(5) Finally, more research on trust in guidance is required, as already proposed by Silver [6]. For example, what means are effective to proactively stimulate an increase in trust, and to what extent do users need or actually want information about the guidance they receive? Is addressing trust in guidance less important in an organizational context than for consumer online shopping? How can user trust in the provided guidance be increased?

(6) These research opportunities are only an excerpt of potential future research areas that can increase the body of knowledge on the design and effects of guidance design features. In addition to these design-oriented suggestions for future research, we propose suggestions for future research addressing the extension and the application of the guidance taxonomy.

(7) Researchers can conduct a systematic state-of-the-art literature review on guidance design features in IS research and related research areas. The taxonomy can serve as a baseline for classifying and coding the existing guidance literature. Based on the analysis, they can extend the research gap analysis and propose further opportunities for future research addressing the design of guidance systems. Moreover, researchers can analyze their findings with respect to the historical development of guidance research streams.

(8) Because we focus primarily on guidance design features in IS research, future research can compare the proposed integrated taxonomy with existing taxonomies of more specialized systems and research results outside the IS community, such as recommender systems, or related work by the HCI community. If possible, the identified theories, classifications, and taxonomies can be combined with our integrated taxonomy to form a more generalized taxonomy of guidance design features.

(9) Researchers can utilize the integrated taxonomy of guidance design features as a baseline for conceptualizing and designing new guidance artifacts. Depending upon the addressed research context, the taxonomy and the list of effects and outcomes of guidance design features can serve as a starting point for designing a guidance system. Researchers can use the taxonomy for the design of the guidance system and justify the completeness of the design based on the taxonomy.

6. Conclusion

This article presents the theorizing of an integrated taxonomy of guidance design features based on a conceptual literature review of the present work on guidance. We introduced three concepts of guidance, namely decisional guidance, explanations, and decision aids, and discussed their interrelationships.

Our research makes four contributions to research and practice. First, the conducted conceptual literature review provides an overview of more than 25 years of guidance research. We present important

Target (32)	Choosing (13)		Using (21)	
Directivity (39)	Suggestive (31)	Quasi-suggestive (0)	Informative (22)	
Mode (31)	Predefined (23)	Dynamic (8)	Participative (5)	
Invocation (36)	Automatic (18)	User-invoked (19)	Intelligent (1)	
Timing (32)	Concurrent (12)	Prospective (9)	Retrospective (20)	
Format (45)	Text-based (41)	Image (17)	Animation (1)	Audio (2)
Intention (34)	Clarification (4)	Knowledge (17)	Learning (7)	Recommending (13)
Content Type (23)	Trace (16)	Justification (19)	Control (8)	Terminological (2)
Audience (16)	Novice (16)		Expert (8)	
Trust-Building (5)	Proactive (5)		Passive (0)	

Fig. 3. Distribution of guidance design features.

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research results on the conceptualization and usage of guidance design features. Based on the findings of the conducted literature review, we theorize the integrated taxonomy of guidance design features. To date, there are only distinct taxonomies or classifications of various guidance concepts. We combined and extended existing knowledge, in the form of existing theories and research, into new knowledge by proposing an integrated taxonomy of guidance design features. Researchers and practitioners can use the taxonomy of guidance, a type I theory, to formulate, compare, and classify guidance design features with a common set of dimensions and characteristics. Additionally, researchers and practitioners can use the taxonomy to justify their design of guidance systems and their completeness with respect to the guidance dimensions. Second, we discuss several effects of guidance design features by summarizing empirical research findings. Practitioners and researchers can use this summary for the identification of certain guidance design features, resulting in the desired outcome, for example, for the development of a guidance system enabling users to learn certain content. Third, we demonstrate how to apply the taxonomy to compare and classify existing guidance systems reported in research. When conducting a systematic review, the classification can be redone based on an increased set of articles. Fourth, we propose several opportunities for future research addressing the extension of the taxonomy and more research on the actual design of guidance design features.

We are aware that our work has limitations. Although our literature review was conducted according to the established guidelines, rigorously executed, and comprehensively documented, there might be work on guidance design features not included in this review. The integrated taxonomy of guidance is rooted in the explored literature, but it could be biased due to missing articles. The task of categorizing the identified literature using our taxonomy was rather difficult due to authors omitting information on the included guidance design features. If not stated explicitly, we derived the applied guidance design features from the information provided in the articles. This approach could have led to a false categorization of the analyzed work. However, we consider the inability to clearly identify the characteristics of various guidance systems presented in the literature a strong indicator of the need for a taxonomy of guidance design features and a motivation for researchers to use our taxonomy in the future. Researchers could use the taxonomy to describe the applied guidance design features with our predefined, common terms. This approach will enable other researchers to understand and compare their guidance with related work and potentially further improve our taxonomy. Moreover, future research could conduct a systematic literature review to provide an overview on existing guidance research, use the taxonomy to categorize the existing research results, and identify additional opportunities for future work. Using the initial set of articles as the baseline for our research might be another limitation that must be considered. When building the search query, we refrained from including additional research articles, because we simply aimed at providing an overview of guidance and at providing a method to describe various guidance design features, rather than at providing an overview of the state-of-the-art in all of the related research areas. Another limitation might be the focus on guidance design features specifically on IS/DSS research. Much important research addresses guidance outside these communities, e.g., in the field of HCI. We acknowledge these important research streams by including selected findings in the integrated taxonomy. However, the main contribution of this article is the presentation and discussion of the foundations of guidance design features in IS research and theorizing the integrated taxonomy. Finally, the exhaustive nature of each literature review is questionable. The aim of a literature review is to provide an overview of the existing research addressing a specific topic. During the search phase, it is difficult to determine the point of saturation and terminate the search process. With respect to our review of guidance design features in IS research and the theorized taxonomy, we argue that the current review is saturated and sufficiently complete because we could not find additional articles related to our search string when performing a backward and forward search. Nevertheless, because this field of research is ongoing, our taxonomy and the overview of guidance research can be extended in future research. We invite researchers and practitioners to apply our integrated taxonomy on guidance and to address the proposed opportunities for future research.

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