Say Hello to Your New Automated Tutor – A Structured Literature Review on Pedagogical Conversational Agents

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Abstract. In this paper, we present the current state of the art of using conversational agents for educational purposes. These so-called pedagogical conversational agents are a specialized type of e-learning and intelligent tutoring systems. The main difference to traditional e-learning and intelligent tutoring systems is that they interact with learners using natural language dialogs, e.g. in the form of chatbots. For the sake of our research project, we analyzed current trends in the research stream as well as research gaps. Our results show for instance that (1) there is a trend towards using mobile conversational agents in education, (2) a proper generalization of existing research results (e.g. design knowledge) is missing, and (3) there is a need for comprehensive in-depth evaluation studies and corresponding process models. Based on our results, we outline a research agenda for future research studies.

Keywords: pedagogical conversational agent, intelligent tutoring system, technology-enhance learning, chatbot, natural language processing.

1 Introduction

Intelligent learning systems can be used in educational contexts to improve learning processes [1]. In traditional learning settings (like in university lectures or in seminars in vocational trainings) it is challenging to provide individualized learning support to learners or to respond to every personal demand of learners individually. This challenge is targeted by intelligent tutoring systems [2]. They promise to provide individualized and personalized learning support regardless of the number of learners.

Due to the increasing spread and media attention of artificial systems as well as machine learning applications, the demand of learners and teachers for intelligent learning systems rises. The availability of intelligent dialog-based systems like Facebook Messenger bots increases the demands further. This results in a growing research interest *in pedagogical conversational agents* as part of the research stream of intelligent tutoring systems [3]. Research projects targeting pedagogical conversational agents deal with the question of how to provide proper learning support to learners via natural language interfaces. Thus, these research interests combine the pedagogical view on individualization of learning processes with promising technologies like

artificial intelligence and natural language processing to provide easy to use learning systems.

The use of natural language user interfaces for learning systems seems especially promising as learners already use messenger-like systems in private life commonly. According to recent representative surveys in Germany, over 90 % of those questioned use messenger services – over 75 % of them on a daily bases [4]. Thus, using chat-based systems including chatbots (i.e. conversational agents for non-educational use cases like FAQ bots [5]) are common. So, it is to expect that learners need (almost) no time to get used to natural language-based learning systems.

Even though the use of pedagogical conversational agents seems to be promising, the success of such systems should not be pledged early. In fact, researchers should carefully analyze whether the demand of users towards using the technology is just because of the current rise of artificial intelligence in general or whether it really enables improvements in learning processes. As a first step to consolidate the existing research interest and to provide a structured guidance towards a research agenda for design-oriented research, we outline the results of a structured literature review targeting text-based pedagogical conversational agents in this research paper. Thus, we ask the following research questions to describe our research targets:

> RQ1: What is the current state of the art of using pedagogical conversational agents in education?
>
> RQ2: Which design-oriented research gaps exist in the current research on pedagogical conversational agents?

To answer these research questions, the remainder of this paper is structured as follows: First, we briefly describe the term *pedagogical conversational agent* and outline related concepts like *intelligent tutoring systems*. Based on these basic terms, we describe the research approach of our literature review process in section 3. Following, we present our results focusing on four main perspectives (time, technical, didactical and methodical perspectives) in section 4 and discuss them in section 5 to outline a future research agenda. Finally, we briefly summarize the findings in the conclusion.

2 Basic Terms

Pedagogical conversational agents can be defined as a special form of learning applications that interact with learners individually [6]. The conversation of those agents usually takes place using natural language [2]. From a technical perspective, there exist two common types of pedagogical conversational agents:

1. *Messenger-like agents* that use common chat interfaces (e.g. known from WhatsApp or similar chat interfaces),
2. *Embodied conversational agents* (like game characters or avatars) that consist of a (virtual) representation of a person in virtual environments and communicate either via text-based or voice-based language.

Whereas in the past embodied agents were common, nowadays especially messenger-like agents (a.k.a. chatbots) are widespread. The reason is that messenger

apps are considered to be easy to use, because "interaction takes place through messaging applications to which students are already very keen on" [7].

To enable a language-based communication, pedagogical conversational agents usually combine technical methods from natural language processing and machine learning. Thus, pedagogical conversation agents have the possibility to act in different human roles like tutors, students or colleagues [2]. Because of this stream in research, pedagogical conversational agents have similarities and intersections with intelligent tutoring systems [3, 8]. Both software systems are learning applications that aim at providing (individualized) assistance to learners [6, 8]. The combination of both definitions is also known as "conversational intelligent tutoring system" [3].

3 Literature Review Process

To answer the research questions raised in section 1, we conducted a systematic literature review. We followed established methodical approaches in performing literature analyses including those of *Cooper* [9], *Webster/Watson* [10] and *Fettke* [11]. Furthermore, we especially took the work of *vom Brocke et al.* [12, 13] into account that outlines recommendations on how to deal with the existing "literature overload" [12]. By adopting the *Framework for literature reviewing* [13], we apply the proposed five consecutive research steps that we briefly describe in the following. During the whole literature review process, we documented all process steps in a search protocol as proposed by [12]. To ensure the traceability of our research process, we attached a condensed version of the search protocol including our list of reviewing criteria at https://publikationen.as.wiwi.uni-goettingen.de/getfile?DateiID=739.

3.1 Definition of Review Scope

As we intend to identify the current state of the art of using pedagogical conversational agents for supporting learners especially in higher education as well as in workplace learning, we primarily focus our literature review on the research outcomes as well as on applications of published research papers. In this literature review, our goal is to identify central aspects on a conceptual level. As we intend to share the results not only with specialized scholars but also with interested practitioners, we synthesize the outcomes to highlight important results. Table 1 summarized the characteristics of the review by adapting the taxonomy of [9].

Table 1. Definition of review scope (adapted from [9])

Focus	Outcomes	Methods	Theories		Applications
Organization	Historical	Conceptual		Methodological	
Perspective	Neutral representation		Espousal of position		
Coverage	Exhaustive (in analyzed sources)	Representative		Central or Pivotal	
Audience	Specialized scholar	General scholars	Practitioners		General public

3.2 Conceptualization of the Topic

As a basis for the conceptualization of the topic of pedagogical conversational agents in the context of this paper, we rely on the definitions outlined in section 2. Using those definitions as a starting point as well as the works of [14, 15], we derive the following systematization that we use to classify the corpus.

First, we conceptualize the relevant papers based on technical considerations (see Table 2). In particular, we focus on the *type* of pedagogical conversational agents that are examined in the paper corpus: (1) Messenger-like conversational agents that provide user-interfaces in forms of text-based chats. (2) Embodied conversational agents that include visualizations of the agent like an animated virtual avatar. We also take the target *platform* of the considered conversational agents into account: (1) Mobile-first agents that focus mainly on smartphones (and tablet computers). (2) Web-based agents that are usable on any platform but do not follow a mobile-first approach. (3) Others, like standalone applications, that are limited to specific desktop operating systems.

Table 2. Criteria for conceptualizing the literature review (1/2)

Type	Messenger-like conversational agent		Embodied conversational agent
Platform	Mobile-first	Web-based	Standalone/Others

In addition to the classification based on technical aspects, we distinguish the analyzed papers by the targeted *learning settings*. In this category, we differ between formal learning settings (like using a pedagogical conversational agent at a university during seminar sessions) and non-formal learning settings (like using an agent at home for self-study). Even though there exist more sophisticated forms of distinguishing learning settings, this seems sufficient for the given view on the literature. Furthermore, we categorize the articles by *learning form* and distinguish the following types: isolated, collective, situated and collaborative learning (see [14, 15] for detailed explanations of the learning forms). Finally, we consider the *content* view of the papers in which we differ single-topic learning content or multi-topic learning content. We distinguish both because pedagogical conversational agents (1) can be built for just a single purpose (e.g. training a special situation in language learning; single-topic) or (2) can be used to assist learners during a series of lectures or seminars (multi-topic). Table 3 summarizes the conceptualization that is a basis for the conduction of the literature review.

Table 3. Criteria for conceptualizing the literature review (2/2) based on [14, 15]

Learning setting	Formal learning settings (e.g. at a university while attending a seminar)		Non-formal learning settings (e.g. self-study at home)	
Learning form	Isolated learning	Collective learning	Situated learning	Collaborative learning
Content	Single-topic learning content		Multiple-topic learning content	

3.3 Literature Search

To identify relevant publications according to the review scope (see Table 1 above), we conducted a keyword search in bibliographic databases in June 2018. As the focus of the literature review can be assigned to the field of technology-enhanced learning, we selected databases that have at least partly a technology-oriented view. We further broadened the search scope by including all eight journals of the AIS Senior Scholars' Basket of Journals [16]. In doing so, we included in the following sources:

Table 4. Selection of searched sources

Journals	Scientific databases
– European Journal of Information Systems	– AIS Electronic Library
– Information Systems Journal	– ACM Digital Library
– Information Systems Research	– IEEE Xplore Digitial Library
– Journal of AIS	– ScienceDirect
– Journal of Information Technology	– EBSCOhost Business Source Complete
– Journal of MIS	
– Journal of Strategic Information Systems	
– MIS Quarterly	

To perform the literature search, we used the search terms listed in Table 5 in all selected databases and journal sources. In doing so, we included articles that match our research target directly (search term #1) as well as articles that cover most likely closely related topics (search terms #2 and #3). In total, we obtained approx. 550 papers.

To evaluate the search results for relevance, we defined criteria for inclusion as well as exclusion in accordance with [12]. Using those criteria, we reviewed titles and abstracts of all search results in a first step. Based on the resulting corpus, we reviewed the full text to the best of our knowledge and came up with a total number of 41 papers that represent original findings as the final corpus.

Table 5. Overview over search terms

Search terms	
#1	"pedagogical conversational agent"
#2	"smart teaching assistant" OR "AI teaching assistant" OR "artificial intelligence teaching assistant" OR "virtual teaching assistant"
#3	(chatbot OR chatterbot OR talkbot OR "interactive agent" OR "dialog system" OR "conversational agent") AND (learning OR teaching)

3.4 Literature Analysis and Synthesis and Proposition of Research Agenda

In the next two phases of the literature review process, we first analyze and synthesize the final corpus of relevant articles. We first examine the corpus using a time perspective before we analyzed its content in full depth by focusing on technical, didactical and methodical aspects (see section 4). Second, we discuss trends and

research gaps in the corpus in order to derive a research agenda that is shown in section 5.

4 Results

In the following, we outline the results of our literature review using four perspectives. First, we focus on the time perspective of the paper corpus. Afterward, we examine the technical foundation, before we take a didactical perspective. Finally, we switch to a methodical perspective and outline how the researchers of the identified relevant papers conducted their research.

4.1 Time Perspective

A first descriptive analysis of the corpus regarding the distribution of publications per year shows an increasing interest in recent years. In 2017, the number of relevant publications reached an all-time high in the considered timeframe. Furthermore, the number of papers published in the first month of 2018 already reached the second highest number of publications. After interpolating the publications for 2018 based on the first six months (see Figure 1), we expect that the number of relevant publications in 2018 will exceed the current high. Thus, we conclude that there is an increasing interest apparent.
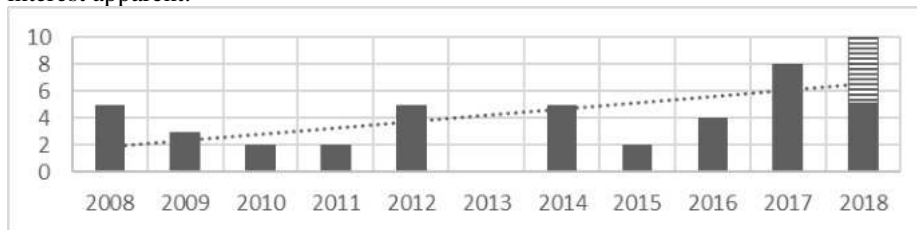

Figure 1. Distribution per year (grey shaded: 2018 interpolated based on June 2018)

4.2 Technical Perspective

As the first step of the content analysis, we categorized our final paper corpus by looking at the different technical types of agents as well as on their target platforms.

Agent Type. First, the distribution outlined in Figure 2 shows that the number of messenger-like conversational agents is more than twice the number of articles targeting at embodied conversational agents.

| 1. Messenger-like Conversational Agent | 28 |
| 2. Embodied Conversational Agent | 11 |

Figure 2. Distribution of articles per conversational agent type

Furthermore, the average publication date of all articles targeting messenger-like conversational agents (MCA: 2013.2) is approx. one year newer compared to the average of all embodied conversational agent papers (ECA: 2012.2). Thus, there is a trend present to use messenger-like conversational agents instead of embodied conversational agents. Even though the difference seems not to be huge, the trends become apparent when looking at the time lines and trend lines in Figure 3.
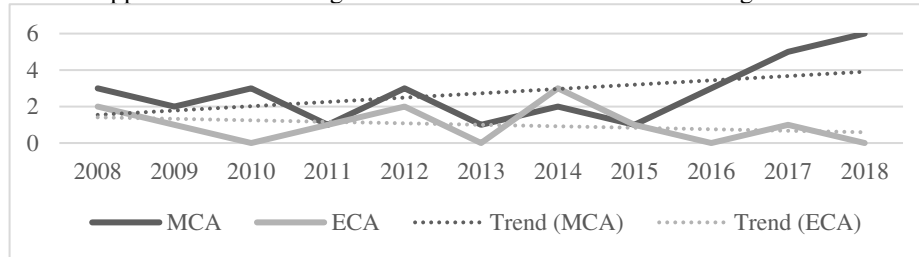
Figure 3. Trends per conversational agent type (year 2018 interpolated based on June 2018)

Target Platform. By analyzing the technical foundations of the identified conversational agents independently of the type, we could identify a trend towards implementing conversational agents for mobile platforms. Whereas mobile conversational agents are targeted in the paper corpus since 2016 with an increasing amount, the number of web-based or standalone conversational agents is decreasing. This is also reflected in the average publication date: Mobile agents have been published in average in 2017. In contrast to that, papers in both other categories have an average publication date of approx. 2012. However, it needs to be remarked that some web-based conversational agents are implemented responsively (e.g. [17]), i.e. they can be used on smartphones as well. However, if the primary focus of such prototypes is a desktop computer, we did not count them as mobile-first approaches.

Technical system architectures. Focusing on the technical system architectures of pedagogical conversational agents, we could identify that there is a large variety of system architectures present. Nevertheless, most implementations are based on a client-server architecture where natural language processing is done on the server side (e.g. [18]). However, the language processing steps vary in the different implementations from simple command-based matching approaches to the application of advanced machine learning based toolkits. Concerning the storage of data, some authors store, for instance, predefined question and answer tuples in relational databases, whereas others use AIML-files to store patterns and related answering templates (e.g. [19]). In some cases, answers are based on learning objects or learning paths (e.g. [20]). On the client side, user interfaces differ as well: Some agents are implemented as standalone clients (e.g. [21]) whereas others are integrated into third-party messaging platforms (e.g. [7]) or learning systems (e.g. [19]).

Summary. We conclude that the current research mainly focuses on messenger-like interfaces in mobile settings. On the one hand, the trend towards researching messenger-like agents seems like a reduction of complexity as the user interfaces get simpler. However, on the other hand, we could not identify a reduction in complexity in the system design as we could not identify a uniform architecture approach.

4.3 Didactical Perspective

Whereas the technical perspective focuses on the underlying software of conversational agents, we use the didactical perspective to analyze the educational application scenarios and the learning settings of pedagogical conversational agents.

Learning Setting. First, we categorized the papers of the corpus into formal or non-formal learning settings. As a result, we can conclude that only approx. 25 % of the papers that we could categorize[1] focus on formal learning settings. An exemplary paper is [22] in which the authors developed a virtual embodied avatar that can be used to simulate a virtual patient. Medical students can interview the embodied avatar to train diagnosing the avatar's diseases. The learning situation can be categorized as formal learning setting as the virtual embodied avatar is used by the students in a laboratory and not in a non-formal situation (e.g. at home). Another example of a mostly formal setting is presented by [23]. In this case, a pedagogical agent is used in an online tutoring task to guide the learners. As the learners need to communicate with the agents as a homework task, we categorized it as a formal learning setting.

Even though some papers cover formal learning settings, according to our analysis most pedagogical conversational agents target non-formal settings and provide communication possibilities to learners independently of a specific location, time or learning environment (e.g. course or lecture). However, in many cases the learning setting depends on the concrete use: In many cases, learners can interact with the agent location independent whenever they want using a smartphone or a desktop computer. But if the use of the pedagogical agent is integrated into the curriculum (like homework; see e.g. [23]), the transition to formal settings is smooth. Selected examples of non-formal learning settings are the prototypes *Oskar* [8] that can be used by learners for training the use of the database language SQL via an intelligent tutoring system and *Charlie* [19], which is a natural language user interface to the *INtelligent Educational System (INES)*.

Learning Form. The large number of papers covering non-formal learning settings is also reflected in the learning forms. As many conversational agents can be used by learners in any location independent of the user's environment, the learning often (approx. 66 %) takes place in an isolated way (i.e. learners interact with the conversational agent without any interaction with other learners, human tutors or lecturers). The remaining learning forms (collective, situated and collaborated learning) only take place in approx. 14 %, 3 %, and 17 % respectively.

Topic Focus. According to our statistics, the pedagogical conversational agents that have been researched in the paper corpus are almost equally distributed among single-topic agents or multi-topic agents. In many cases, the authors of the papers state that the agents are intended to support a specific learning scenario (e.g. the agent *Dr. Roland* [24] focuses on supporting learners to solve math problems; [25] is able to ask very specific questions and give hints about a special simulation). In other cases, the described agents can be used in almost any learning scenario, because teachers or lecturers are able to edit the learning content or add additional content via control

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[1] In some cases, we could not categorize the papers, because too few information was available.
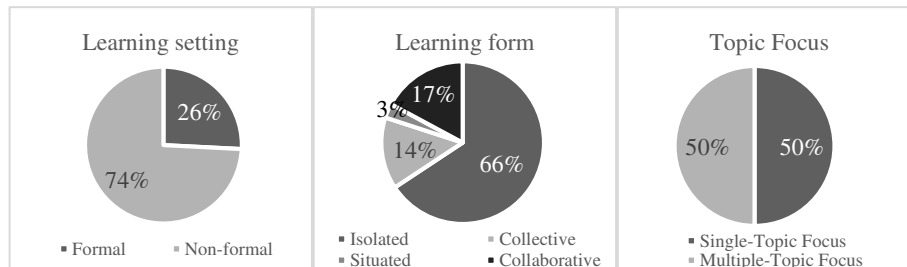
Figure 4. Summary of the didactical perspective on the paper corpus

panels. Exemplary systems that we identified are *MentorChat* (see e.g. [26]) or the agent by [27] that provides a so-called *Learning Objects Authoring Interfaces*.

Summary. Based on these results of taking an didactical perspective on pedagogical conversational agents (see Figure 4), we conclude that most available agents target non-formal learning situations in which learners interact with the agents alone (in an isolated way). However, it has not yet been conclusively investigated whether these use cases are beneficial over use cases in formal learning settings. Nevertheless, it needs to be remarked that this observation does not imply that such pedagogical conversational agents just support simple learning cases as known from simple mobile learning applications (like vocabulary training). On the contrary, pedagogical conversational agents are able to provide interactive, natural language-based opportunities to convey learning content in a way that was previously only possible in human-to-human training settings (like in classroom training or individual tutoring). Consequently, the isolated learning form as we used it in our classification only means that the learner uses the agent alone without any interaction with other learners. Nevertheless, the learners are not really isolated as they interact with an automated, virtual, but natural language-based chat partner.

We could not determine any trend regarding the topic focus of agents. On the one hand, agents that allow an administrator to configure and provide multiple topics seem useful. On the other hand, many researchers focus on single-topic agents that are specialized to fulfill a given learning task.

4.4 Methodical Perspective

In addition to the analysis of the content of the papers, we also examined the applied methods. Thus, we aim at identifying how researchers in the domain of pedagogical conversational agents are conducting their research.

First, we need to acknowledge that the methods that are described in the papers differ because the research field of pedagogical conversational agents is interdisciplinary: Researchers from the domains of computer science, information systems, pedagogy, and psychology are participating. This makes it difficult to classify the methods, as they differ depending on the discipline or the individual research background. For this reason, we have opted to an aggregated, qualitative view. Two aspects are particularly noteworthy: Prototype development and evaluations.

Prototype Development. In a majority of the papers, the authors based their research on implemented software prototypes (including *Charlie* [19], *Oskar* [8], *MentorChat (e.g. [26])*, *Dr. Roland* [24], *Ville* [28], *DEAL* [28], *AutoTutor* [29], *WrenchTalker* [30], *CiboPoli Bot* [31] and many unnamed more). From a methodical view, it is difficult to classify the methods as often there are not enough details available, but they seem to belong to the methods of design science research. However, to our knowledge, none of the research projects covers the whole design science research cycle starting with the problem identification phase and continuing with the definition of objectives, design, implementation, demonstration, evaluation and communication [32].

Evaluation. Focusing on the evaluation step, we identified two major directions: On the one hand multiple researchers chose Wizard-of-Oz experiments as an option to evaluate the potentials of pedagogical conversational agents in a simulated experiment. On the other hand, field studies were conducted to observe the operability, acceptance and beneficial value of the pedagogical conversational agents. However, there is no uniform evaluation method approach.

Summary. Based on the methodical view of the paper corpus, we conclude that the applied methods are quite heterogeneous. Only in the evaluation of pedagogical conversational agents, we can observe a trend towards using Wizard-of-Oz experiments as well as field studies. Considering the other steps of typical design science research cycles, we cannot identify a consolidation towards using specific methods. In many cases, only parts of the design science cycle are covered. Often the authors focus either on a technical view (covering conceptualization and implementation) or on a pedagogical view (covering learning scenario and evaluation). Comprehensive approaches are usually missing. In particular, it needs to be noted that neither generalizable requirements nor design theories are presented.

5 Discussion of Trends and Future Research Agenda

The first research goal (RQ1) of our study was to identify the current state of the art of using conversational agents for educational purposes. For this reason, we conducted a structured literature review and analyzed the resulting final paper corpus from four perspectives: From analyzing the time perspective, we determined that there is an increasing interest in research about pedagogical conversational agents. This becomes apparent as the total number of relevant papers reaches an all-time high in 2017 and we expect an even increasing number of publications by the end of 2018.

The technical perspective outlines that both, messenger-like conversational agents as well as embodied conversational agents, are objects of research. However, we can observe an upward trend in the number of publications focusing on messenger-like conversational agents whereas the number of embodied conversational agents seems to be decreasing. We explain this mainly with the increasing popularity of messenger apps in private life [4]. Additionally, an increasing number of messenger platforms and social networks started to provide APIs that can be used for developing chatbots (e.g. Slack, Facebook or Telegram). This resulted in a growing number of chatbot

applications. In addition to that, an increasing interest of researchers and practitioners to adapt methods known from the machine learning or artificial intelligent domain can be observed (e.g., complex natural language understanding and generation algorithms). Due to this, intelligent chatbots receive more attention in research.

Our analysis of the didactical perspective shows that pedagogical conversational agents are most often designed for non-formal learning settings. Thus, learners can use the agents anywhere and anytime because of the common mobile or web-based implementation. For this reason, learning often takes place isolated from other learners but in interaction with a conversational agent. Regarding the topic focus, we could not identify a trend either towards single-topic or multiple-topic agents. However, we argue that the quite large number of single-topic agents is especially related to that fact that it is easier for researchers to limit the complexity of the software to a single topic, as this is often sufficient for conducting an evaluation. In some cases, we assume that the software artifacts are even capable of supporting multiple-topic scenarios, but the authors did not state this explicitly in the written papers. Thus, we argue that there is a trend towards multiple-topic agents when the focus is on actually using them in real settings and not only in laboratory experiments.

Finally, the methodical perspective shows the presence of a heterogeneous method mix. This represents the fact that the field of pedagogical conversational agents is quite interdisciplinary. As information system researchers, we must admit that complete design science research cycles and especially generalizable results in almost all design science research steps are missing.

Trending Characteristics. Based on our literature review and our interpretation of the results in the discussion above, we summarize the trends for pedagogical conversational agents in the following Table 6.

Table 6. Trending characteristics of pedagogical conversational agents

Type	Messenger-like conversational agent		Embodied conversational agent	
Content	Mobile-first	Web-based		Other
Learning setting	Formal learning settings (e.g. at a university while attending a seminar)		Non-formal learning settings (e.g. self-study)	
Learning form	Isolated learning	Collective learning	Situated learning	Collaborative learning
Content	Single-topic learning content		Multiple-topic learning content	

Future Research Agenda. With these results, we state the following research gaps and research opportunities:

(1) Need for generalized design knowledge. As most publications in the field focus on specific implementations of pedagogical conversational agents and miss to provide in-depth transferable insights, we propose that researchers should focus especially on the generalization of their design results. We are aware that it might be difficult to propose requirements that are generalized but also meaningful. Nevertheless, proposing generalizable system architectures for pedagogical conversational agents that can be transferred for different learning settings will be useful for researchers and

practitioners. As information system researchers, we propose to conduct multiple design science research cycles as a proper method to achieve this.

(2) Need for comprehensive in-depth evaluations. In the paper corpus, we identified many evaluations of pedagogical conversational agents. However, those papers often focus on very specific evaluation targets. Comprehensive evaluations covering multiple aspects (like learning success, technology acceptance, software quality, algorithmic quality, suitability of application scenarios) are missing. Even though an in-depth analysis of the evaluation methods was not in the focus of this article, we recognized that this needs to be addressed in the future. In particular, it would be meaningful to provide researchers with a detailed overview of suited evaluation methods. This is especially important for conducting comprehensive evaluations in research studies focusing on pedagogical conversational agents as the research field is interdisciplinary.

(3) Need for process models. Currently, the range of approaches on how to conduct research in the interdisciplinary field of pedagogical conversation agents is huge, because there is no uniform procedure. We assume that a common understanding of (a) how to develop and use pedagogical conversational agents in practice-oriented projects and (b) how to evaluate those agents comprehensively would advance the research field. For this reason, we propose that future research studies should focus on providing process models that cover both, design steps and evaluation methods. In particular, it would be helpful for design-oriented researchers as well as for practitioners to obtain a guideline that describes at which stage of the development process which evaluation methods are useful (e.g. conducting Wizard-of-Oz experiments seem especially useful in an early stage of the design process whereas field experiments are more useful after a functional prototype is available).

6   Conclusion

In this research study, we evaluated prior research papers in the interdisciplinary research stream of pedagogical conversational agents by taking time, technical, didactical and methodical perspectives on the literature base. Using this approach, we identified the state of the art and outlined trends that are present in research projects targeting at pedagogical conversational agents. Additionally, we proposed a research agenda. Possible limitations of this study lie in the selection and interpretation process of the analyzed papers. We are aware that these steps are dependent on the judgment of the individual researchers. Through a systematic literature analysis approach in which we defined inclusion and exclusion criteria, we tried to minimize the subjective influence as much as possible. Our results can contribute to both, research and practice: Researchers can base future projects on our research agenda to develop the field further. Additionally, our research might be helpful for practitioners. Especially developers of chatbot applications might use our results as a starting point to inform themselves about current trends in the field of pedagogical conversational agents.

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