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Level-Up your Learning – Introducing a Framework for Gamified Educational Conversational Agents

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Abstract. Driven by circumstances like the global pandemic many learners and educators realize the importance and value of self-regulated digital learning. To better support self-regulated learning, conversational agents have become more relevant. Conversational agents can act as tutor or as learning mate for learners. Although conversational agents have potential to better support self-regulated learning processes, challenges exist requiring implications about how to make these interactions more engaging and supportive. This study discusses the value of gamified conversational learning chatbots that use game elements to engage learners to guide researchers and practitioners to design conversational agents that effectively motivate learners and provide self-regulated learning at the same time. Therefore, we propose a systematically developed framework for gamifying educational conversational agents and contribute to theory by consolidating several theories about games, digital learning, and conversational agents and support practitioners by providing implications about what to care about when gamifying conversational agents.

Keywords: Gamification, Education, Framework, Conversational Agents

1 Introduction

The pandemic has demonstrated to us the importance of self-regulated online learning. In today's online environments, it is becoming more and more relevant to assist learners in their learning process and to keep them engaged [1]. Self-regulated learning abilities are important, because learners have to organize and regulate their own learning progress, they need to be capable of working at tasks on their own and are required to train their skills on different levels which is challenging from a cognitive perspective [2]. In such an online setting outside the classroom, learners are oftentimes not assisted or guided by a teacher, resulting in questions that can remain unanswered [3].

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Consequently, motivating learners in their self-regulated learning process has become significantly more important.

A solution to support a more regular and guided learner interaction is to work with so-called conversational agents (CA) [4]. CAs interact with learners and support them in their learning process and at the same time contribute to learner engagement and motivation [1, 5]. CAs can offer a textual interaction between a human and a what we typically call „chatbot“ [6–8]. Furthermore, CAs are available 24/7 and can be individually adapted to a learning process and the needs of learners [4, 9, 10]. However, CAs are not a one size fits all solution without fault as the design and development of CAs still faces difficulties. Studies confirm that conversational agents are not universally accepted and many users (over 50%) do not like to interact with agents in general; further, many users (over 70%) also simply do not enjoy the interaction [11]. Recent research further confirms these findings and highlights that users can become demotivated because of a bad design of and interactions with conversational agents [12] resulting in unsatisfactory experiences [13], and bad performance (e.g., academic success) [14]. Consequently, advancements in CA design are required to ensure motivation and make these interactions more enjoyable. A solution to create a more motivating CA, and at the same time to support user performance, is to implement gamification. Gamification is used in in non-entertaining contexts to support user engagement by displaying game-like elements such as badges, points, or levels [15, 16]. Gamification in learning has already been proven to work in education (e.g., [17]) where researchers acknowledge the potential of gamified conversational agents [18], especially their ability to engage and motivate learners.

However, so far, research still struggles with how to use gamification in combination with CAs [19]. While there are attempts to gamify CAs, there is still a noticeable lack of feasible theoretical grounding and knowledge on this topic. Especially the theoretical component of gamifying CAs i.e., what theories are relevant seems to be a blind spot in current research. This translates into a lack of practical knowledge and tools practitioners can rely on for gamified CAs (e.g., frameworks, guidelines). These attempts are oftentimes not developed as true gamified CAs, instead they most often resemble “conversational UIs” with a gamification layer (e.g., [20]) and others a more game-like presentation (e.g., [21]). Moreover, these attempts also oftentimes use an approach without relying on a sound theoretical fundament (i.e., theories, frameworks), or focus on selective aspects like player types [22]. While these selective aspects are important, it limits the scope of the application and thus disregards a wider theoretical background. Such an approach can lead to undesired effects because important aspects and theoretical fundamentals are not accounted for. An example for this is the inclusion of competitive game design elements that may have adverse effects based on the setting and target audience [23].

Therefore, it is interesting to discuss what theories, factors and designs can be used when developing a conversational educational agent. With our study, we aim to cover a wider array of highly relevant criteria for developing gamified CAs in general and the educational context of our study. With our study, we want to analyze how gamification and it’s theoretical background has been used in combination with CAs in digital

learning settings, as educational CAs are becoming more relevant in improving learning outcomes [5]. With our study, we answer two research questions (RQ):

RQ1: What is the state-of-the-art of gamifying CAs in digital education?

RQ2: How can we support practitioners in gamifying educational CAs?

To answer our research questions, we present the results of a systematic literature review and propose a developed framework based on our review. We aligned the framework with the revised learning goal taxonomy of Bloom (1956) [24] by Anderson et al. (2001) [25], and the theory of learner goal orientation by Ames (1992) [26]. We consolidate the results of our literature review and consider relevant theories, to develop our framework that can be of assistance for practitioners. To demonstrate the usefulness of our framework, we present a case-based approach in training how we created *Micromate* – a gamified educational CA by using our own framework. With our work we support theory by clarifying about how to design and gamify CAs in digital learning. We demonstrate to practitioners how our developed framework can be used to guide the construction of a gamified CA in digital learning.

2 Theoretical Background

2.1 Gamified Conversational Agents

For our work, two terms are relevant: CAs, and gamification. The term CAs, here text-based CAs, refers to advanced programs that use natural language and artificial intelligence to interact and converse with humans [6, 8]. Moreover, CAs offer an around the clock availability, human-like experience and interaction [27] which makes them a popular choice for many digital applications including digital learning [28]. The underlying idea behind CAs is a technology-based approach to fulfill tasks and to provide assistance for humans [27], for example in the case of learning [9, 29]. In this study, we rely only on text-based CAs, not on speech-based ones such as Alexa, although these also exist. We make this choice as we see text-based CAs as a more practical approach for standardized digital education applications that build upon learning management systems, text-based apps and existing tools (e.g., Microsoft Teams) which have become widespread in our current digital education environment. We explain the specificalities of text-based CAs with regard to gamification below.

Gamification has been developed with the intention to motivate and engage users in working on their activities and is widely applied in the field of information system (IS) as well as digital education. In other words, gamification is well-known method to increase user motivation by using game design elements in non-entertaining-based context [15]. Typically, gamification and its elements are implemented in IS applications with one of the most prominent examples being the ever so popular Nike+ sports app. Connecting them to conversational educational CAs makes the tutor the one that rewards a user. In classroom settings, teachers are typically the ones that motivate their students. If we collaborate with such a CA, the agent has the intention to motivate his learners to keep interacting with him. To achieve such motivating effects, different

elements can be used. ***Table 1*** provides an overview about existing elements based on the taxonomy of Schöbel et al. (2020) [30].

Element Name	Description
Points	A numerical unit that is obtained for completing an activity.
Badges	A visual icon that signifies an achievement a user accomplishes while working on an activity.
Virtual Goods	Assets with a perceived value that can be purchased or traded (e.g., coins).
Level	Shows a user's progress in working on system activities and displays their experience through different (increasing) level positions.
Ranking	A user can compare their own performance with the performance of other users.
Progress Bar	A progress bar is used to indicate the user's progress when working on activities.
Feedback / Information	Feedback provides users with information about how well they have performed and helps to keep them aware of progress and failure when working on activities.
Avatar	Avatars are either used as tutors or as user representation and can visualize in different forms (e.g., with a human or animal shape).
Goals	Goals are achievable steps that users can accomplish while working on activities.
Time Pressure	Time pressure is applied regarding the completion of certain activities using e.g., a counter or an hourglass.
Narratives	Narratives are used to tell a story and generally embed every activity.
Reminder	A reminder is used to visualize the user's past behavior by presenting them with a history of their actions.

Table 1: Elements and their Description based on Schöbel et al. (2020) [30]

In our study, we identify in each of the papers, which element was used and how it was designed for the context of digital learning. Looking at the elements and their functionalities indicates that not each element could be suitable to combine it with CAs – we marked the cells in grey and explain our reasoning as follows.

Time pressure has been proven to be not effective in the context of digital learning, it rather increases pressure and cognitive stress of learners, thus potentially decreasing their learning performance and success [31]. Ranking would require a connection to other learners and their results which could be difficult to realize if an agent is just interacting with an individual learner. Moreover, ranking is targeted towards more competitive personalities or players who search for direct comparison and contest. Nevertheless, we will include these game design elements in our research to provide a complete overview on what and how game elements are used in literature. In the context of learner goal orientation these competitive personalities reflect the learner goal orientation of performance, where the focus is to be better than the competition, with less effort and better results in direct comparison [26]. While this may work in sports or games for enjoyment, it may put unnecessary stress on learners who do not have such a strongly competitive mindset, potentially demotivating them. This becomes especially problematic with weaker or disadvantaged learners who won't be able to compete with the higher performing students, thus are more likely to disengage from using such a system [23]. Whereas more competitive learners with performance orientation may prove more difficult to design learning experiences for, mastery-oriented learners are much easier as they focus on their own learning success driven by the intrinsic motivation to get better.

2.2 Cognitive Learning Goal Dimensions and Learner Goal Orientation

Designing a learning experience or lesson – whether digital or analog in class – starts with the definition of learning goals as the learning goals and the cognitive dimensions define what knowledge is expected to be attained and what learning outcome is targeted [32]. Therefore, CAs that are used in the context of digital learning, need to consider the purpose of a training and what is being taught to a learner (e.g., language learning [33]). After defining the learning outcomes goals and dimensions in the first step, all following characteristics can be defined. For example, it is different if we taught basic facts to a learner or if we try to support training complex problem solving skills [34].

To understand how we can design CAs aligned to the purpose of learning and teaching, we can refer to the work done by Anderson et al. (2001) [25]. This cognitive learning goal dimensions taxonomy considers the difficulty of learning tasks on various levels. On the ground level, we have the dimension of *remembering* that is about recalling facts and basic concepts [24, 25]. In such a setting, an agent can follow a simple question and answer dialogue asking learners about how to define specific aspects. In an upper level, *understanding* is about explaining ideas and concepts [24, 25]. Here, an agent can try to let learners classify something of interest. The dimension of *applying* asks for using information in new situations [24, 25]. A conversational tutor could present a case to a learner letting him decide about the solution to a given, new problem. Once *analyzing*, learners are asked to draw connections among ideas other than *evaluating* which is about justifying and deciding [24, 25]. Lastly *designing* is about producing new and original work. A supporting tutor could for example guide a group of users in systematically creating a new solution and idea based on what has been learned by them. The cognitive learning goal dimensions as defined by the educator or learning designer then in return can imply the role and relationship a conversational tutoring agent may fulfill.

Based on this, the educator has then to account for the different learner orientations (i.e., mastery and performance) as these can influence the choice of the design implementation of the agent. Such as, considering how to present learning materials to a learner it matters which kind of goal strategy a learner personally follows and considers. While digital learning with conversational agents differs from traditional learning or even online classroom learning, the same base concepts apply. Therein, students follow two distinct strategies or goals when learning, namely mastery or performance [26]. Mastery-oriented learners focus on effort and outcome of learning activities. Thus, the learners are mainly intrinsically goal driven and motivated as they see oneself efficacy based on success or mastery of their skills, i.e., understanding, improving and achieving. On the contrary, performance focuses comparative outcomes. Therefore, learners are focused on doing better than others, being successful with less effort than others or surpassing standards. However, performance-based learning can become a double-edged sword as learners who do not achieve success after trying can become easily demotivated [26], e.g., when disadvantaged learners are outperformed by high achievers. Thus, differences in learner orientation and capabilities can be important and should be considered. In order to address this, we use build on learner-orientation as a theory [26] and cognitive learning goal dimensions as a theory [25] to

develop a solution suitable for a wide range of learners. For example, tasks reflect the learning activities (e.g., quizzes), authority marks the role and behavior of the teacher (e.g., tutor), and evaluation/recognition address the need for approval (e.g., feedback or rewards). We then apply these concepts to our conceptual framework for gamifying educational conversational agents. Later, we also demonstrate our framework in practice by presenting a prototype agent which we further explain in the discussion.

3 Methodological Approach

To develop our contribution we adopt the three-step process as introduced by Weick (1989) [35]. The first step is to outline the problem. Our work is based on the question of how to gamify educational CAs to make them more engaging and outcome supporting. The second step is concerned with reviewing relevant literature. Third, to analyze and discuss relevant literature, we followed the recommendations given by Vom Brocke et al. (2015) [36] and Webster and Watson (2002) [37]. ***Figure 1*** provides an overview about our systematic literature search.

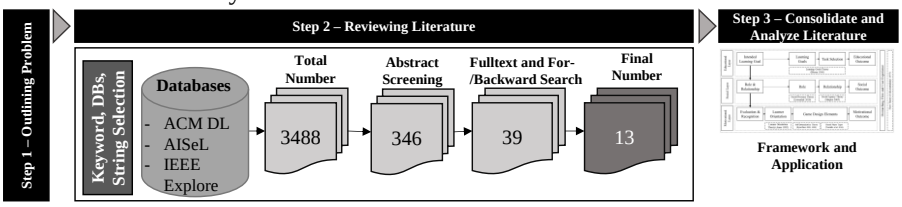

Figure 1: Systematic Literature Search

To identify relevant studies, we used the following search streams which reflect different denominations of CAs as we have defined them for our research paired with keywords targeted as the application domain and our underlying goal of increasing motivation and engagement in learners:

- („chatbot“ OR „conversational agent“ OR „assistant“) AND („learning“ OR „education“ OR „teaching“ OR „tutor/ing“).
- („gamification“ OR „game design“ OR „gameful“) AND („education“ OR „teaching“ OR „learning“ OR „tutor/ing“) AND („motivation“ OR „engagement“)

We searched in three different databases, namely ACM DL, AISeL, and IEEEXplore. We chose these databases because AISeL covers the most significant outlets of the IS community while ACM DL and IEEEXplore cover a more implementation-oriented facet of CAs. After running our keyword combinations in all three databases, we ended up in a total number of 3488 papers. To reduce the number of studies, we first read the abstract of each paper to identify if the studies operate in the context of digital learning and on CAs and gamification. In a second step, we used inclusion and exclusion criteria to screen each paper in more detail. Each paper had to focus on CAs and gamification in the context of digital learning. The studies had to work with design recommendations about how to create and support motivation while interacting with tutoring CAs or implementations of at least game-like or gameful tutoring systems for learning. We did not consider studies that discuss technical aspects

of designing CAs (e.g., underlying computational aspects like machine learning algorithms). Lastly, we did not consider studies that focused on service aspects in the context of digital learning – our goal is to identify studies that operate that are used to support a learning process itself. Including a forward and backward search as described by Webster and Watson (2002) [37], we identified 13 relevant papers which we organized in two concept matrices in the following section (see Table 2 and Table 3). During the process we had two researchers code and validate the literature results.

The third step in the process covers the selection of relevant factors and development of the theoretical perspective and model [35]. In our work we focus on analyzing the literature to determine and extract the relevant criteria and theories for designing a gamified educational CA. These results are relevant to the development of our main contribution, the theoretical model in the form of a framework for designing gamified educational CAs. Therefore, we focused on the setting, role of the CA, the learner orientation and addressed learning goals to account for the learning characteristics.

Further, we also extracted relevant theory streams and used game design elements. We then used these results to develop a framework for designing gamifies educational conversational agents in digital learning.

4 Results

4.1 Gamifying Conversational Agents in Digital Learning

First, we present the results regarding the educational factors (see Table 2). Looking at the learning setting we find that most of the reviewed literature is placed in a non-formal setting (i.e., casual learning such as Duolingo) in contrast to only three finding of formal learning (i.e., academic setting incl. examination).

Concerning the role of the gamified educational CA, we find that not one agent is implemented as co-learner. We therefore conclude that CAs are not being used as equal learning mates for collaborative activities; instead, current educational CAs rely on a more traditional teacher-student role and relationship.

Regarding the addressed learning goals that are mostly in the lower categories with "understand" being the most prominent one, we assume that this approach is sufficient or preferrable, as many agents are being used for quizzes or language learning (e.g., vocabulary, grammar).

As for the learner orientation, we observe that all but one focus on mastery and only one implementation on performance. This is also reflected in the choice of game design elements and theories, where the performance implementation makes use of player types and competitive game design elements (e.g., ranking).

Following, we present the results about the used theories and game design elements (see Table 3). We find that authors rely on three major streams of theories: 1. Motivational theories, 2. Social theories and 3. Educational theories. However, we also find that about half the reviewed literature either does not use any theoretical background or the authors do not disclose used theories.

Author	Learning Setting		CA Role		Learner Orientation		Cognitive Learning Goal Dimensions					
	Formal	*Non-formal*	*Tutor*	*Co-Learner*	*Performance*	*Mastery*	*Remember*	*Understand*	*Apply*	*Analyze*	*Evaluate*	*Create*
Utomo/Santoso [38]		x	x			x	x	x				
Vladova et al. [39]		x	x			x		x	x	x		
Cress et al. [40]		x	x			x		x		x		
Katchapakirin/Anutariya [41]		x	x			x		x	x			x
Pham et al. [42]		x	x			x	x	x				
Hayashi [43]	x		x			x		x		x	x	
Damljanovic et al. [44]		x	x			x	x					
Ruan et al. [45]		x	x			x	x	x				
Winkler et al. [46]		x	x			x	x	x	x			
Ruan et al. [47]	x		x			x		x	x	x		
Alobaidi et al. [48]		x	x			x	x					
Lechler et al. [49]	x		x			x				x	x	
Fadhil/Villafiorita [20]		x	x		x			x	x			
∑ **(n=13)**	**3**	**10**	**13**	**0**	**1**	**12**	**6**	**10**	**5**	**5**	**2**	**1**

Table 2: Educational Characteristics and CA Role

Regardless, we find that most literature relies on motivational theories (for gamification) and educational theories (for educational context), while CAs are based on theory in only one case. With regard to gamification we find the Self-Determination Theory [50] and the Hexad Player Types [22] being used.

Regarding educational theories we find cognitive learning goals to be broadly applied [24, 25]. For social theories we find Social Presence and Social Agency to be prevalent theories [51, 52]. Moreover, we also found the flow theory to partially being taken up which is reasonable as flow engulfs the entire user or learning experience during the overall interaction [53].

Nevertheless, we also find that some researchers do not build upon a solid theoretical foundation or framework which decreases transparency and reproducibility. We therefore want to stress the importance of basing research on a sound theoretical basis and disclosing it as well.

Next, we analyzed what game design elements are being used. Here, we find that the vast majority of analyzed CAs relies on feedback and information elements, as well as goal setting. The remaining game design elements are almost evenly split with occurrences between one and three. Further, we could not find the game design elements “time pressure” and “virtual goods” being used even once. In the case of time pressure it is understandable since additional pressure in a learning scenario may result in negative effects [54]. However, we can only assume why virtual goods are not being used, we assume that the implementation in a CA application may prove as difficult, especially as this mechanic relies on having people to trade with available, which defeats the purpose of the agent.

Author	Theory Stream				Game Design Elements									
	Motivational	*Social*	*Educational*	*Not disclosed*	*Points*	*Badges*	*Ranking*	*Feedback & Info*	*Reminder*	*Narrative*	*Avatar*	*Level*	*Progress Bar*	*Goals*
Utomo/Santoso [38]		x				x		x	x		x		x	x
Vladova et al. [39]			x					x			x			x
Cress et al. [40]	x							x						
Katchapakirin/ Anutariya [41]				x	x							x	x	x
Pham et al. [42]				x					x					x
Hayashi [43]				x				x						x
Damljanovic et al. [44]				x				x						x
Ruan et al. [45]				x				x			x			x
Winkler et al. [46]			x					x						x
Ruan et al. [47]				x				x		x				x
Alobaidi et al. [48]	x		x					x		x				x
Lechler et al. [49]	x							x						
Fadhil/Villafiorita [20]	x				x		x							
∑ (n=13)	**4**	**1**	**3**	**6**	**2**	**1**	**1**	**9**	**2**	**2**	**3**	**1**	**2**	**10**

Table 3: Theories and Game Design Elements

4.2 Framework for Gamifying Educational Conversational Agents

Based on the results of our systematic literature analysis we construct a framework (see Figure 2) incorporating the theories and concepts we found in literature and presented in our theoretical background. We developed our framework as a theory-driven and outcome-oriented solution. Our framework is constructed in a three-layer design that follows the fundamental principles of Ames (1992) [26] of Task (i.e., learning goals conjoint with Anderson et al. 2001 [25]), Role and Relationship as well as Evaluation and Recognition. We then construct the framework using the relevant theories from out systematic literature analysis as well as theoretical background as fundament of each layer. The layers itself lead to the outcome of each layer and include the relevant design concepts for each layer. We explain the framework (see Figure 2) as follows.

The design of the learning experience or agent in this case starts with the selection of the intended cognitive learning goal dimension [24, 25] which is represented in the educational layer. To select the learning goals we here draw on the taxonomy by Anderson et al. (2001) [25]. Depending on the selected goals, the tasks (e.g., quizzes) are implied and selected. These represent the educational outcomes (i.e., what knowledge should be attained using which exercises). The next step or layer is the social layer. Implied by the chosen cognitive learning goal dimension, the role and relationship of the conversational educational CA to the learner can be derived and thus the social outcome. Here, we incorporate the social presence theory [51] and social agency theory [52]. The intention here is to define the role (i.e., presence of the agent) and the relationship (i.e., agency) of the CA. For example, a tutoring role with the agency to primarily teach knowledge. Moreover, we presume that on the one hand, the

lower the intended cognitive learning goal dimensions are set, the more the agent will lean towards a traditional tutoring role and thus more formal relationship to the learners. Whereas on the other hand, the higher the intended learning goals, the freer can and should the role of the agent be. We explain this by the complexity of the learning setting. Simple learning settings can use a straightforward approach, whereas complex high-level setting may require additional components as we can observe in analog learning settings (e.g., base vs. advanced learning) and is reflected in the dimensions [25]. On the one hand, when learners are expected to analyze and evaluate a case, they may require a more complex role like a sparring partner to be able to fully permeate the depths and widths of knowledge as well as to apply it correctly for problem solving [55]. On the other hand, more simplistic knowledge (i.e., simple knowledge basics) in order to learn the very foundations of a topic may not require such a complex relationship, instead a more formal and simple teacher may be sufficient [55].

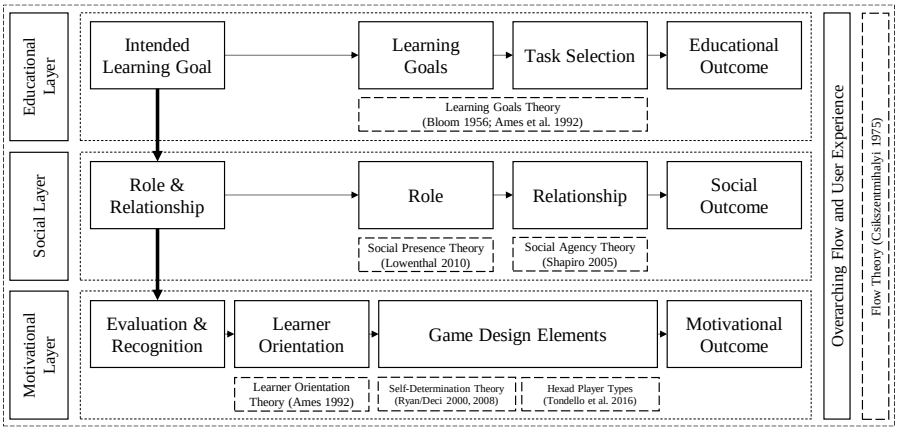

Figure 2: Gamified Educational Conversational Agent Framework

Continuing down the framework, the last layer and step is the evaluation and recognition – the motivational layer. Here, the mechanism of ensuring motivation of the learner are selected. In this layer, the learner orientation [26] plays a crucial role as the orientation implies the game design elements to be chosen (i.e., competitive elements for performance; achieving elements for mastery). In this layer we draw on theories from the realm of gamification. The self-determination theory [50, 56] and hexad player types [22] are used as these theories or concepts explain the relationship between motivation and potential game design elements. The selection of appropriate game design elements along these concepts then represents the motivational outcome. Furthermore, we incorporate the flow theory [57] as an overarching frame because flow is intertwined in all three layers. The learning goals should neither be too boring nor too overwhelming, the interaction too must not be casually boring or anxiety introducing (i.e., strict teacher), as well as the game design elements, where flow is widely applied [58]. In summary, we use flow to engage learners as finding flow is an integral part of all activities of our lives [53].

4.3 Presenting Micromate – A Gamified Educational Conversational Agent

As proof of concept, we present Micromate (see Figure 3), a gamified educational CA that we developed with our framework. Micromate features what we consider the DNA of a good gamified educational CA based on the results of our systematic review and constructed framework. As presented above, the majority of gamified CAs address the lower-level cognitive learning goal dimensions (i.e., remember, understand). By focusing on these two lower-level cognitive learning goals of remembering and understanding [25], the selection of tasks or exercises will be focused on simple question answering, quizzes and multiple choice assignments. The educational outcome here is to teach learners the basics of a topic (e.g., basics of IT security), make them remember the fundamentals and understand the implications relevant to their field of study or training on the job.

Figure 3: Micromate – A Gamified Educational Conversational Agent

Next, in the social layer we define the role and relationship of our agent. Because we focus on this lower level, *Micromate* will fulfill the role of a tutor in the rather traditional sense, (i.e., ask and evaluate questions like a tutor or teacher). Thus, considering the social agency theory [52] (i.e., teach basics) and social presence theory [51] (i.e., as tutor), *Micromate* presents itself a rather formal relationship with the agency to primarily teach. Lastly, we conceptualize the motivational layer. Here, we focus on the mastery orientation [26] of learners because of the potential drawbacks that performance orientation and related game design elements can introduce [54]. These kind of elements have so far delivered mixed effects in research and should be handled carefully [54]. Drawing on the self-determination theory [50, 56] and the hexad player types [22] we primarily focus on individuals in accordance with the learner orientation, hence our motivational outcome targeted at intrinsic motivation. Here, we focus mainly on the types of achievers, players and free spirits that show the most overlap with our targeted mastery-oriented learners that can be observed in the game design elements these types respond to. These player types thrive by unlocking and collecting things (e.g., badges), progression (e.g., progressive badges, levels) and challenging tasks [59]. Moreover, these three player types reflect the majority of the population and thus are a good starting point for gamification. [59].

Overall, by choosing and appropriate setting, challenging but not too difficult tasks as well as appealing game design elements, we ensure that the learners is kept in a pleasant or enjoyable learning flow [53, 58], building a good learning experience. *Micromate* is implemented as Microsoft Teams plugin, featuring tasks and tutoring-role interaction (see II and III), as well as motivational components, particularly unlockable badges that can be collected through challenges (see I).

5 Discussion, Contributions, and Conclusion

As our research is primarily based on literature, we want to start with highlighting the existing issues and gaps as well as potential future research opportunities. Firstly, we want to point out that although we conducted a systematic review of literature, after filtering only 13 relevant articles remained. This may signify that research on this topic is still in a rather early stage, thus requiring further research. Research discusses how to consider motivational elements to support collaborative CAs that aim to contribute to better group cooperation. Because human-computer collaboration has still some unanswered questions, we consider this a potential opportunity for future research [60]. Especially as collaborative co-learners could be useful for more higher-level learning goals like argumentative tasks. Furthermore, when looking at the theories, the articles we analyzed rely on, we have to outline that many authors either do not use or do not disclose a theoretical background. A theoretical basis to create CAs could assist to better predict and understand why and how users react towards interacting with CAs, for example when issues occur during the interaction [61]. This is also true for the used methodology. We noticed that many authors simply apply gamification to their CAs and just briefly specify the design making it challenging for others to apply such designs to other agents. Therefore, we consider our framework as a tool to bridge this gap and provide a theoretical fundament. However, our research is not without limitations. While the framework is a systematic solution for text-based CAs, it may not be appropriate for voice-based CAs, as we did not include literature for them. Therefore, we urge future research to expand our framework to cover voice as well. With the continuous success of voice agents like Alexa a systematic framework may become a necessity in future. Overall, our study contributes to theory and practice. From a theoretical perspective, we present a framework that summarizes important aspects to be considered once gamifying an educational CA. Therefore, we combine different streams of literature involving learning and motivational theories. Additionally, we consolidate literature about educational CAs and explain how they were used in combination with game elements. From a practical perspective, we present our framework and our developed agent *Micromate*, to support practitioners in developing gamification concepts for CAs. Our framework can provide guidance to practitioners by presenting what needs to be considered once creating a gamified educational conversational agent. Concluding, with our work we provide clarification about the relevance and meaning of gamifying CAs in the context of digital education and support practitioners in creating such agents, by presenting our developed conceptual framework that we hope researchers find useful to base future research on.

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