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ABSTRACT

Chatbots are currently applied to a variety of fields and are increasingly put to work in education. Some aspects of their use in education remain, however, unexplored: What are educational chatbots' advantages and limitations? What pedagogical approaches emphasize their capabilities and help overcome their shortcomings? What are the best scenarios for their integration into a digital educational platform? To explore answers to these fundamental questions and to ascertain successful chatbot integration strategies, this thesis proposes a prototype of a crowdlearning-based educational platform that integrates chatbots contributing to more successful learning.

This research is in fact at the intersection of cognitive science (education and collaborative learning) and informatics (HMI, ITS, digital learning environment). The cognitive component of our research pays particular attention to the phenomenon of crowdlearning and chatbots used as learning companions (peer-chatbots).

The IT component essentially contributes to the improvement of digital learning platforms. This part of the thesis focuses on an analysis of the literature on chatbots in education in order to 1) formulate the essential characteristics of chatbots that are to be integrated into a digital learning platform and 2) test the validity of such use of chatbots in an online language teaching. A prototype of an online language course platform based on crowdlearning and incorporating automated messaging bots serves as a testing ground of the above-mentioned approach.

Overall, this study is intended to show that, in the context of learning systems, crowdlearning involving chatbots is a form of learning that is both creative and effective.

Keywords: educational chatbots, peer-chatbots, crowdlearning, collaborative learning platform, technology-enhanced learning (TEL) system; e-learning

RÉSUMÉ

Les agents conversationnels sont présents dans plusieurs domaines et sont de plus en plus recherchés en éducation. Cependant, certains aspects de leur emploi en éducation demeurent inexplorés : quels sont leurs avantages et leurs limites ? Quelles approches pédagogiques mettent en valeur leurs possibilités et permettent d'atténuer leurs désavantages ? Quels sont les meilleurs scénarios de leur intégration dans une plateforme éducative ? En vue d'apporter quelques éléments de réponse à ces questions fondamentales, cette thèse propose un prototype d'une plateforme éducative basée sur l'apprentissage collaboratif intégrant des chatbots de manière à mettre en évidence leur contribution à un apprentissage plus efficace.

Cette étude se situe de facto entre les sciences cognitives et l'informatique. Le volet cognitif de notre recherche accorde une attention particulière au phénomène de l'apprentissage collaboratif et aux chatbots éducatifs utilisés comme des compagnons d'apprentissage. Il s'agit dans ce volet d'identifier les enjeux pédagogiques de ceux-ci et de démontrer leur valeur pédagogique en éducation.

Le volet informatique contribue essentiellement à l'amélioration de plateformes numériques d'apprentissage. Il s'agit dans ce volet de procéder à une analyse de la littérature sur les chatbots en éducation afin de 1) formuler des caractéristiques nécessaires des chatbots qui doivent être intégrées à une plateforme d'apprentissage numérique et 2) tester la validité de ce mode d'emploi des chatbots appliqué à l'enseignement d'une langue en ligne. Un prototype de plateforme de cours de langues en ligne basée sur l'apprentissage collaboratif et intégrant des robots de messagerie automatisés sert de terrain d'essai à l'approche décrite ci-dessus.

Par cette étude, nous cherchons à montrer que, dans le contexte des systèmes éducatifs, l'apprentissage collaboratif impliquant des chatbots est une forme d'apprentissage à la fois créative et efficace.

Mots clés : agent conversationnel éducatif, compagnon numérique d'apprentissage, l'apprentissage collaboratif, plateforme d'apprentissage collaboratif, environnement informatique d'apprentissage humain (EIAH), apprentissage en ligne

INTRODUCTION

Advances in digital technologies, machine learning, and artificial intelligence brought about significant improvements in automated communication and conversational applications. Among the software that has demonstrated a considerable potential to contribute to this evolution are chatbots—conversational agents that mimic human interaction. The leaders of chatbot adoption are such spheres as commerce, customer service, healthcare, and finance, where chatbots became "a staple of digital transformation" (Feraco, 2023). Already between 2007 and 2015, chatbots participated in 30-50 percent of all online interactions, and the rate of deployment of new applications continued to increase (Radziwill & Benton, 2017). During the 2023-2028 period, according to Mordor Intelligence (2023), the compound annual growth rate of the global chatbot market is expected to surpass 29%.

Rapid technological development of the past few decades has been transforming education too, both teaching and learning. E-learning allows people to study any skill, trade, or science using internet resources or formal online courses, making education accessible to millions around the world (Lachs, 2017). Employing technology in education serves a source of innovation but, at same time, is accompanied with a number of issues. The process of studying in a virtual class demonstrates certain downsides, thus, research by Parr (2013) reveals that only about 7% of individuals who enroll in online courses actually complete them. Winkler and Söllner (2019) cite numerous studies highlighting problems in higher education, both in-class and online: growing student-faculty ratios, Massive Open Online Courses (MOOCs) that report high dropout rates, lack of individualized support provided by teachers, and increasing number of students who are unable to engage in effective learning and experiencing low motivation and dissatisfaction. Winkler and Söllner, taking up one of the arguments of Bloom's (1968) concepts of learning pedagogy mastery, argue that "the best solution would be to have one teacher per student," which is unattainable without the use of technology.

One of the main reasons for these issues is that most courses consist of pre-recorded classes that do not provide enough support and feedback for students. According to Lachs (2017), this is a gap that chatbots have a potential to fill in the future: as teaching assistants or tutors. Certainly, such an important element of learning as teacher-student communication is crucial for a successful outcome in a technology-assisted classroom, but student-student interaction should not be neglected either. In their turn, Intelligent Tutoring Systems (ITS) are conceived to customize teaching to individual needs and to act not only as a

tutor or an assistant but also as learner's companion (Winkler & Söllner, 2019)—a pedagogical approach still not fully realizing the social aspect of learning. In our digital technology dominated age, however, students are increasingly in need of academic support and a motivating learning environment, which are created not only by teachers and tutors, but also by peers.

Educational chatbots, due to their interactive nature and their ability to personalize, demonstrate great potential in ensuring communication flow and, at the same time, they can reduce costs and even perform the work of teachers (Riel, 2020). New pedagogical methods and tools that appear, thanks to this technology, not only change the setting of traditional classrooms but also add new formats of teacher-student, student-peer, and student-machine interactions.

The first successful attempts to use conversational agents in solving the issue of teacher-student ratio were realized in the 1990-s. Thus, Rickel and Johnson (1998) explored the use of an animated agent, STEVE (Soar Training Expert for Virtual Environments), designed to teach learners individual procedural tasks and which acted as a tutor or a co-learner, when a human co-learner was not available. Designed for Web-based learning materials, ADELE (Agent for Distance Learning Light Edition) was another example of a pedagogical agent technology developed for continuing medical education (Johnson et al., 2000).

Technology in classrooms impacts, both positively and negatively, the emotional state of students. In an educational setting with integrated chatbots, the atmosphere in the classroom and the vivacity of the student-machine interactions depend in great part on the specific qualities of the conversational agents. In this regard, Nkambou et al. (2007) emphasize the role of emotions in learning and in the motivation to learn, hence the importance to explore ways to implement emotionally intelligent conversational agents that are built taking these aspects of learning into account. Thus, Gaha et al. (2007) developed the architecture of a Conscious Tutoring System (CTS) with an extension allowing the agent to consider the learners' cognitive evolution and to manage their emotional state in order to optimize learning.

Despite numerous successful projects in building digital tutoring systems that include chatbots, the use of chatbots in education is still not as widespread, as in commerce, healthcare, and finance, and this for a number of reasons: the complexity of the pedagogical framework, the problem of chatbots acceptance and adoption by teachers and course creators, the difficulties of generalization of systems designed for specific disciplines or courses, and the lack of resources in educational institutions (Riel, 2020; Roos, 2018),

among others. Also, the intelligent tutoring systems (ITS) are resource-intensive and not always readily available for the wide pedagogical community. As for individual chatbots, Winkler and Söllner (2019) note that few of such applications are used in education on a regular basis, and this probably because their capabilities are still poorly explored and documented. According to the authors, developing simpler and more flexible solutions based on chatbot applications already functioning in various sectors of business may provide potential solutions.

Using educational chatbots in the social network setting may be one of the ways to mitigate difficulties of integrating this technology into an online classroom. The massive arrival of social networks and new ways of interacting and learning brought about by Web 2.0 have led to significant changes in human society. The "extended cognition of Web 1.0" became the "shared cognition of Web 2.0": accessibility and interactivity enabled users to contribute, exchange, and collaborate in various ways in all spheres of life (Brabham, 2013; Dron & Anderson, 2014; Surowiecki, 2004; Tchounikine, 2011).

New ways of communication and collaboration, extrapolated into the online learning sphere, bring about new ways of integrating chatbot technology too. Proulx (2004) points out that technology and society are two interconnected and mutually influencing entities and, therefore, technical innovation is also a social evolution process. Harvey (2004), speaking of the emergence of new models of social interaction, exchange, and transaction, observes the massive emergence, throughout the world, of the "communautique": of activities and experiences by several communities—governmental, academic, and voluntary—who create and use new information and communication technologies (ICT) in their activities.

According to Surowiecki (2004) and Brabham (2013), there is an inseparable link between technology and new ways of working, including motivated collaboration: such phenomena as crowdsourcing, for example, only occur in specific situations and conditions—technological and social.

One of the contemporary trends in education, crowdlearning (as a subcategory of crowdsourcing) established itself as one of the most successful practices in digital learning and is the subject of numerous studies. Among such research projects and developed tools are Networked Learning model exploiting the pedagogical potential of Web-based technologies and human connections (Dron & Anderson, 2014); Crowdlearning as a theory and a teaching practice (Farasat et al., 2017); Intelligent IntraNet Peer Help-Desk—a combination of cognitive tools for peer help that creates a comprehensive environment to

support various styles of learning (Greer et al., 1998); assessment of Crowdlearning—its history, concepts, and its influence on the learning process and instructor's role (Kalisz, 2019); analysis of crucial components of effective online instruction—appropriate course content, adequate student-teacher interaction, well-prepared instructors, dynamic online learning community, and integration of technology—for efficient transitioning to teach online (Sun & Chen, 2016); and Educational Software Design—multidisciplinary work in Technology Enhanced Learning (Tchounikine, 2011).

In summary, technological advances and the social evolution of the last decades allowed proliferation, on the one hand, of new forms of work, learning, and communication and, on the other hand, of the design and use of various software, including conversational agents. Today's technologies offer accessible tools to develop educational chatbots, specialized or generic, and, at the same time, students of various ages are increasingly willing to collaborate not only in work, but also in learning. Therefore, now is the time to combine these trends. In doing so, we have the potential to create—using free or low-cost online resources—a learning platform that harnesses the advantages of chatbot technologies and mitigates their shortcomings by integrating them into a particular framework: a collaborative learning setting.

In the context of our study, it is important to emphasize that a considerable number of research papers on successful employment of chatbots in digital learning environments for humans describe the use of chatbots in the roles of either tutors or co-learners in a setting where students are aware of interacting with software, not humans (Graesser et al., 2005; Heller & Procter, 2009; Riel, 2020; Roos, 2018; Russel & Norvig, 2009; Winkler & Söllner, 2018; Woolf, 2009). The research demonstrates that such awareness impacts users' perception of their digital interlocutors, which, in its turn, determines the modalities of such interactions.

Studies on how users perceive conversation with chatbots that do not hide their automatic nature (do not pretend to be humans) reveal the complexity of human-machine communication: depending on the context, human interlocutors prefer either neutral or emotionally engaged chatbots or even choose to converse exclusively with either human or automated interlocutors (Chen et al., 2016; Clark, 1983; Creed et al., 2014; Fryer et al., 2017; Han et al., 2022; Winkler & Söllner, 2019). Also, a student previously enthusiastic of talking to a machine may gradually lose interest in the conversation or experience dissatisfaction with the linguistic or emotional quality of interaction (Fryer, 2018; Fryer et al., 2017; Fryer & Bovee, 2018; Fryer & Bovee, 2016; Rouse, 2022; Shawar & Atwell, 2007). Disappointment and

dissatisfaction are precisely the issues that designers of chatbots for e-learning courses want to avoid at all costs.

Despite the fact that most chatbots employed in intelligent tutoring systems (ITS) are explicitly virtual agents, the idea of using peer-chatbots whose digital nature is hidden has always fascinated pedagogues and designers of digital learning environments. Such a setting suggested numerous advantages, in particular, the possibility to individualize teaching, to support a high level of motivation, and to provide pedagogical support without authoritarian pressure on the part of the teacher.

Thus, at the beginning of the era of chatbots, Aimeur et al., (1997), Chan and Baskin (1988), and Dillenbourg and Self (1992) considered using conversational agents to act as peers of human learners without disclosing their digital nature. According to the researchers, those conversational agents would fulfill two roles: the role of a teacher and the role of a companion to a human learner. It is important to underline that in the cases described, chatbots were intended to be used implicitly: human learners were not to be informed that the system employed chatbots pretending to be their peers, which would allow using the technology without risking resentment, lower motivation, or loss of interest on the part of human learners.

It should be noted that those studies were conducted in the 1980s-90s, and the research facilities lacked powerful machines, appropriate software, and platforms that were able to properly integrate those different types of agents. All that prevented the implementation of plans to use chatbots as virtual learners pretending to be peers in a digital classroom; therefore, the architectures of such settings remained on paper. As for the ideas of using chatbots in a tutor or a companion role, they were implemented through personified, embodied, conversational agents—cartoon-like characters with an ability to communicate verbally and nonverbally (Ball et al., 1997; Elliott et al., 1999; Johnson et al., 2000).

As mentioned above, technological advances and the social evolution of the last decades provided us with more tools and methods to be used in an online classroom. Thus, in our study, we chose to employ message bots disguised as peers to students in a social network-like learning setting. The students, therefore, although informed about the possible use of chatbots in the online classroom, are not aware of the fact that some of their peers' accounts are in fact message bots. Such chatbot use is meant to remove from the equation the problem of chatbot technology resentment and to demonstrate that, used a certain

way in certain settings, even a simplest communication technology has a potential to enrich an online course.

The general objective of our project is to design and test a prototype of an online learning platform based on the best practices of digital learning, including crowdlearning. The proposed platform is a system that integrates digital agents—peer-chatbots (called Student-Chatbots in our study)—and human agents (Students) into a unified collaborative learning framework. The underlying idea is to highlight the advantages offered by chatbot technologies while mitigating their shortcomings.

This study aims to build a prototype of an online learning platform, to recruit volunteers to participate in a course, and to gather users' impressions of its three essential elements: 1) crowdlearning; 2) platform and content, designed to favour the crowdlearning; and 3) peer-chatbots, integrated into the platform.

Our interest in this study was threefold: (i) to explore the crowdsourcing as an online teaching method, build an appropriate platform for it, and fill it with appropriate pedagogical content; (ii) to explore the potential of peer-chatbots and to understand better the user experience in such environment; and (iii) to determine if crowdlearning-based learning environment and chatbot technology are complementary and, therefore have the potential of enhancing each other's advantages.

It is important to emphasize that our intent was not to design an intelligent tutoring system (ITS) architecture, but rather to build and test a learning environment using free or low-cost tools available on the Internet. In our literature survey, we therefore study not only sophisticated ITS projects but also examples of commercial chatbots that can be developed using open-source software. Nevertheless, the different approaches employed by ITS architectures are important for our literature review, as they provide valuable insight into educational innovations involving digital technology.

Overall, for our thesis, we developed a platform and recommendations for its use that can be considered as one of the easily accessible and user-friendly distance learning tools. In our work, we aimed to analyze different aspects of online multi-agent collaboration, to formulate the requirements for the design of such a system, and to suggest methods of deploying chatbots in the context of crowdlearning.

Chapter 1 (Literature Review) of our thesis is a review of the literature on chatbots: it touches upon their history, terminology associated with this technology, chatbot typology, particularities of chatbot use in education, as well as the advantages and problems of educational chatbots.

Chapter 2 (Methodology) is devoted to the methodology of the thesis: it states the purpose of the study and the research questions; describes the prototyping method, participant recruitment process, and prototype testing procedures; and explains how we managed the ethical considerations in relation to the human participants in the study.

Chapter 3 (Crowdlearning on the discussion forum with chatbots: design rationale) specifies and substantiates the choices we made for our prototype concerning the pedagogical method, the platform, the course content, and the chatbot roles in the online learning process. It also contains modelisation of the prototype architecture, interface, use case, and common scenarios.

Chapter 4 (Building and testing the prototype) describes the process of prototype building and testing: how the appropriate tools and platforms for the course platform were determined and what each platform revealed as its advantages and flaws.

Chapter 5 (Survey Results) is a summary of the survey that participants, both Students and Teacher-Consultants, completed. The Students reported on their experience of participating in the online course, and the Teacher-Consultants expressed their opinion on the course architecture, course content, and the collective learning productivity.

Chapter 6 (Findings) is a post-mortem analysis of the process of the prototype building and the online course managing, the answers to the stated research questions, and recommendations for future projects of a similar nature. The findings are presented in the following order: 1) our choices relating to content and pedagogical approach (crowdlearning) and our experience in building and managing the platforms for the course; 2) survey results: the Students; 3) survey results: the Teacher-Consultants; 4) research questions answered; and 5) recommendations for online crowdlearning platforms.

Chapter 7 (Conclusions and contribution to knowledge) summarizes the conclusions, states the limitations of the study, and describes possible directions of future studies.

CHAPTER 1: **LITERATURE REVIEW**

Reviewing the literature on chatbot technologies—their use in education, their strengths and shortcomings, as well as the best design and integration practices—is an important part of this work. It should also be noted that there are numerous definitions of the term "chatbot," and the word has many synonyms, partial or complete, which is indicative of the different approaches to building and deploying of this tool.

According to Roos (2018), as chatbots are not yet widespread in education, it is important to take note of what has already been done in the field of conversational agents in general and to summarize it in a concise and relevant way. Such a summary of the literature on chatbots will, among other things, make it possible to discover what educational uses are already offered; whether chatbots can be useful on their own or whether additional technology is required; what can be done to improve their abilities; how to overcome their shortcomings; what type of chatbot is best for a particular educational context and how to properly adapt it to a course; what type of architecture to use; and how to obtain the greatest educational value from it.

1.1 Chatbots: technological progress and evolution of communication

1.1.1 Definitions

As Arthur (2019) notes, "a technology is a means to fulfill a human purpose," whether it is a method, a process, or a device; simple or complicated; material or non-material; and with an explicit or implicit purpose. As for chatbots, definitions formulated for this technology invariably include words like "human," "conversation," "natural language," or "dialogue"—everything that is inherently human.

Resulting from the contraction of the words "chat" (conversation) and "bot" (robot), a chatbot is a computer program that attempts to simulate conversations of human beings through text or voice interactions (Rouse, 2022). Chatbots are, therefore, various types of software that enable humans to converse with a computer. Dale (2016) defines chatbots as a language technology, any software application that "engages in natural language dialogue with a human." Roos (2018) defines chatbots as an application designed to simulate conversations with users: "the analogy that a chatbot often treats a conversation like a game of tennis can be used to describe the conversation flow of a chatbot, i.e. get message, reply, get message, reply, and so on."

The list of synonyms, both full and partial, of the term is growing, although the term's underlying idea is always dialogue and assistance. To cite just a few of the definitions:

- Chatbot (also "chat bot" or "chat-bot"), Chatterbot, Conversational Agent, Conversational System and Pedagogical Agent (or Intelligent Pedagogical Agent, IPA) (Roos, 2018);

- Intelligent virtual assistant, voice-driven or text-based digital assistants, conversational interfaces (Dale, 2016);

- Talkbots, chatterbots, conversational agents, artificial conversational entities, "and also virtual assistants such as Amazon's Alexa or Google's Home" (Rouse, 2022);

- Conversational agent, chat bot/chatbot, pedagogical agent, intelligent tutor system, dialogue system, smart personal assistant, smart assistant (Winkler & Söllner, 2019).

Rouse (2022) insists on distinguishing between various types of the interaction software. According to the author, chatbot is an application that "operates on a single-turn exchange basis (like 'Ok, Google')." Conversational agents converse with the user trying to "understand" the problem and potentially solving it. Personal or virtual assistant demonstrates its own "personality" and is unique for each user acting as a personal assistant: it "retains information associated with the user to provide contextualized answers; answers improve over time as virtual assistant learns more about the user."

1.1.2 Historical Context

In his observation of how computer intelligence (CI) is changing society, Meisel (2019) argues that the ability to communicate with computers using natural language is one of the most important technological achievements. According to the author, automated conversations using natural human language—speech or text—is a technology that has proven undeniably useful and is improving at an accelerating rate.

Such acceleration in technological progress affects its reciprocal relationship with human society: new technology continuously influences our social habits and creates new communication formats, which in turn create the need for new technology to accommodate and facilitate them. As Jones (1997) notes, the impact of new technologies radically changes our understanding of what constitutes a primary human

group: interactive group communication no longer requires face-to-face conversation and is not restricted to a few people.

Changes in the human interaction style, therefore, invite new communication applications. Thus, according to Rouse (2022), advanced technology and our society's transition to more passive text-based communication created a niche that chatbots help to fill and, in a way, replace telephone conversations. Consequently, one of the major factors facilitating the proliferation of the chatbot technology is the evolution of the way we as individuals communicate: our statements are shorter, the exchange is faster, and the discussion is often asynchronous (Dale, 2016).

The first attempts at designing a chatbot took place in 1964, when the application ELIZA was created: it analyzed input sentences keywords applying decomposition rules and created responses based on the reassembly rules associated with the decomposition rules of the input (Winkler & Soellner, 2019). The following decades produced a number of more successful conversational applications. Appearing in the early 1970s, the chatbot PARRY successfully mimicked the behavior of a patient with mental illness (Rouse, 2022). Russel and Norvig (2009) describe chatbots, including MGONZ, dating from the mid-1990s, that managed to convince their correspondents that they were talking to humans; moreover, to make chatbot correspondence look more human, typing errors models for conversational agents were developed.

More than thirty years after the first chatbot, A.L.I.C.E. was developed using AIML (Artificial Intelligence Markup Language). Recognized as one of the most important programs of its type, A.L.I.C.E. won the Loebner Prize (annual competition in artificial intelligence awarding the most human-like computer programs) three times in the early 2000s. The chatbot used natural language processing (NLP): it applied heuristic keyword recognition rules, followed by the stimulus-models that were matched with the most appropriate response patterns to a user input (Winkler & Söllner, 2019).

In 2008, Cleverbot was launched and, unlike the output of previous chatbots, its responses were not pre-programmed: Cleverbot learns directly from human input (a comment or a question) to then identify the matching keywords or exact phrase of the input.

Generally, chatbots of the last 15 years are able to capture a wide range of user cases and direct the user in the desired direction, which ensures their ubiquity in various fields of business and commerce (Winkler & Söllner, 2019). Thus, Dale (2016) called 2016 "the year of the chatbot," noting that there are experts

who consider current chatbot technology so disruptive that it has the potential to eliminate the need for websites and many applications. The author sees chatbot technology as a revolution in the way humans interact with devices, websites, and applications. According to Pelk (2016b), in 2020, approximately 20 billion "connected objects" could be found in an Internet of Things (IoT) environment, and chatbots play a huge role in the interfaces managing this environment.

The more widespread the technology, the more of its versions are produced for different needs. Thus, experts (Beillaud, 2016; Meisel, 2020) emphasize the importance of distinguishing between two types of bots: personal assistants such as Siri, Google Now, or Cortana (based on artificial intelligence and capable of processing a large number of information) and more specialized bots, aiming at a specific objective and accomplishing a particular mission, following a predefined scenario (video game bots, bots in healthcare and legal practice, assistant bots for banking and shopping sites, etc.). Meisel (2020) predicted that the latter category, which generated global revenues of $7.9 billion in 2016, would reach $623 billion in 2020. Meisel (2019) also argues that enterprise-specific chatbots-digital assistants will act as portals for corporate websites in the relatively near future.

The market for chatbot technologies is expanding with a growing speed, and chatbot development teams continuously produce impressive products. Thus, trained on a massive amount of data by OpenAI, ChatGPT—already in its fourth iteration[1]—generates answers to most complex questions, translates, and produces human-like texts on a vast variety of topics based on the user's input.

According to the Villani Report[2] (2018), Canada is well positioned in this rapidly evolving area of expertise, and the efforts made by Quebec contribute to making Canada, along with Israel and the United Kingdom, one of the three emerging countries in AI. At present in Canada, chatbots are most successfully implemented in the field of marketing, taking care of optimization of advertising targeting: chatbots act as a means of engagement with customers and systems for recommended viewing (e.g. on YouTube and Netflix) or online purchases (e.g. on Amazon).

[1] https://openai.com/product/gpt-4 (accessed on 2023-08-23)

[2] https://www.aiforhumanity.fr/pdfs/MissionVillani_Synthese_FR.pdf (accessed on 2023-08-23)

1.1.3 Typology of chatbots

Numerous synonyms for “chatbot” reflect researchers’ and developers’ attempts to classify various types of this conversational software. Thus, Grudin and Jacques (2019) report 161 synonyms for “humanlike conversational AI”: from “artificial conversational entity” to “virtual support agent,” which the authors do not consider real synonyms. The distinctions between them suggest categories and subcategories of chatbots, some of which overlap: “For example, ‘Twitterbots’ are considered ‘social bots’ which are “a particular type of ‘chatterbot’ [or ‘chat bot’]” defined by the use of natural language.” Some categories of bots do not use natural language, for example, web crawlers that generate a large volume of web traffic.

Analyzing the debate over the quantity and classification of available types of this still relatively new technology, Rouse (2022) describes some of its most common types:

- Scripted or quick-response chatbots—basic chatbots based on a hierarchical decision tree; they interact with users through a set of predefined questions until the user's question is answered; this category is similar to the menu-based chatbot, which requires making selections from a predefined list (menu), to provide the bot with cues of what the customer wants.

- Keyword recognition-based chatbots —more complex applications that attempt to track user keystrokes and respond accordingly using keywords from customer responses; they are based on a combination of customizable keywords and AI, but they struggle when keywords are misspelled or used repeatedly and when the user asks similar questions.

- Hybrid chatbots—combination of the elements of menu-based bots and keyword recognition-based chatbots; they allow users to choose between receiving direct answers to their questions or making selections from the chatbot menu.

- Contextual chatbots—more complex and data-centric; machine learning (ML) and AI are used to remember conversations: the “memory” increases, which improves the functioning of the chatbot.

- Voice-enabled chatbots—based on the input of users’ spoken dialogue that serves as prompts for answers or creative tasks; they can be created using text-to-speech (TTS) and speech recognition application program interfaces (APIs).

Regarding the approach to designing chatbots, Winkler and Söllner (2019) suggest three dimensions for classification of chatbots for learning:

- Chatbot design principles: retrieval-based (using predefined responses and an algorithm) and generative models (produce responses from the input using machine learning techniques). Both approaches have advantages and disadvantages: retrieval-based methods are easier to develop and do not make grammatical mistakes, but they cannot handle cases that do not match any predefined answer; generative models are harder to develop, but they are able to use the aforementioned information in conversation, which makes the chatbot look more human and allows it to have longer dialogues.

- Chatbot input mode: speech or text. While voice input offers a more natural and convenient conversation, text input allows the user to start conversations in places and situations where sound might be prohibited.

- Chabot dependence on contextual information: the type of embedded contextual information—linguistic (information already mentioned in the text) and physical (such as date/time, location, particular user information) for the selection of correct answers.

Følstad et al. (2019) distinguish between chatbots "designed to resemble Victorian servants, only aiming to satisfy their masters' requests" and the ones built "to persuade its users and lead them towards a particular goal." Chatbots can also be classified according to the duration of the interaction with the user: some chatbots are built for brief exchanges, while others are created for long-term interaction and even relationship with their users. Another key characteristics that Følstad et al. (2019) consider is "the locus of control for user's interaction with the chatbot (user- driven and chatbot-driven)," which depends on the scenario: it is either the user who is the first to initiate a conversation or it is the chatbot that starts the dialogue.

In their chatbot typology overview, Skrebeca et al. (2021) classify chatbots "by their interaction, information gathering, and usage goal types, e.g., Text-Based and Voice-Based for interaction mode, Open Domain and Closed Domain for knowledge domain, Task-Oriented and Non-Task-Oriented for goals, and Rule-Based, Retrieval- Based, Generative-Based for design approach."

Chatbot classifications may also depend on such criteria as the area of knowledge they are based on, the need they serve, and the field of application: business, industry, commerce, health-care, culture, and education (Adamopoulou & Moussiades, 2020).

1.2 Chatbots in education

According to Woolf (2009), technology alone does not revolutionize education: changes in society, access to knowledge, teacher training, organization of education, and IT agents all help to propel this revolution. The author maintains that information technology, although having profoundly changed our society, only subtly affected the sphere of education. Unlike previous technologies (cinema, radio, television), IT still has a limited impact on learning despite the overwhelming speed with which the Internet, artificial intelligence, and cognitive sciences have recently developed. According to the author, several new teaching methods, including collaboration and inquiry-based learning, are now possible thanks to information technology. For example, multi-user activities and online chat provide opportunities that were not previously possible in the classroom.

Over the past decade, technology has nevertheless produced an effect on the way we teach and learn, presenting a wide variety of choices in online learning (Dale, 2016). The chatbot technology and the field of human-machine interfaces has benefitted from the AI evolution, promoting Life Long Learning (Villani, 2018). Dale (2016), however, observes that although the presence of chatbots on the Internet continues to grow faster than ever, the potential of this technology for the learning community has not yet fully been realized. Most of the research on chatbots in education focuses on the applications used in language teaching, psychology, business, engineering, and computers (Hwang & Chang, 2021; Winkler & Söllner, 2019).

1.2.1 New learning technology

The period from 2005 to 2018 saw rapid improvement and spread of chatbots thanks to new technologies such as natural language processing, neural networks, and machine learning (Pelk, 2016a). Inevitably, the new field of educational technology became the center of study and analysis. Winkler and Söllner (2019) carried out a systematic review of 80 articles dating from 2005 to 2017, drawn from the literature on management, education, information systems, and psychology. The authors concluded that chatbots are being introduced in education, and their role is growing.

From their literature review, Winkler and Söllner (2019) excluded studies of chatbots without intended learning outcomes (e.g., customer service or leisure chatbots), bots without a chat function, as well as systems of recommendation and feedback with one-way communication. The authors chose to consider aspects such as input, process, and output, considering this framework to be useful for future research. Thus, they established the main factors that determine effectiveness of chatbots: the potential to adapt to individual student differences, the means of building chatbots, and the quality of the chatbot-mediated learning process. The authors observe that there are mainly pedagogical agents and traditional intelligent tutoring systems (ITS) implemented in the learning scenarios. They also argue that development and use of educational chatbots that are not part of an ITS is still in its infancy.

Winkler and Söllner (2019) consider chatbot-mediated learning (CML) as one of the means of technology-mediated learning (TML). The authors describe CML as essentially web-based, synchronous, self-paced, and focused on an individual student: "CML provides a new individual learning experience where students can proactively use chatbots in their learning process in order to increase their learning process quality and learning outcome." Such an experience allows learners to stay in the "driver's seat" and actively control their learning process, which is the main success factor.

Regarding the yet unresolved issues of chatbots in education, Winkler and Söllner (2019) identify a number of important gaps in the literature: how to successfully adapt chatbots to individual students, how to evaluate the usefulness of chatbots; and how to identify the best practices in design and development of chatbots for education. The authors argue that it is important for the educational chatbot developers to learn from the interactions of commercial chatbots or leisure chatbots, where learning is not a goal.

Skrebeca et al. (2021), discussing the role of chatbots in education and e-commerce, argue that chatbots are especially valuable in a situation of a communication overload, when questions are expected to be answered quickly and the information to be found instantly: "chatbots can be helpful to reduce communication problems in terms of response time."

Ilić et al. (2023), in their literature review on e-learning techniques, distiniguish between two types of virtual characters or chat interfaces used in e-learning setting: a pedagogical agent, whose output is a monologue and who offers hints and solutions, and a conversational agent, who engages in a dialogue

with the student. Such agents are usually part of a complex learning system and their role is to motivate and guide learners.

Highlighting the usefulness of chatbots in education, Molnár and Szüts (2018) report their research discovery demonstrating that students, in their assignment involving search tasks, are more likely to trust their chat companions than a search engine. Furthermore, chatbots have the potential to improve engagement, sociability, and knowledge acquisition by shaping instructional flow as more interactive and dynamic.

Hwang and Chang (2021) performed a literature review on chatbots in education and concluded that the research on the topic, although growing, is still in its early stage and is definitely worthy of more efforts. The researchers recommend analyzing from different angles the performance of both teachers and students, learning behavior of chatbots themselves, and the way chatbots enhance students' learning.

1.2.2 Roles of chatbots in education

In general, chatbots are developed not to entirely replace humans in interactions with other humans but to improve exchange between interlocutors. Thus, when it comes to chatbots in education, Shawar and Atwell (2007) argue that it is always the teacher who is the backbone of the educational process and that learning technology can act as an amplifier, not as a replacement. For example, even if it is a chatbot that answers questions from learners, it is the teacher who can enhance the students' learning outcome by using the chatbot-student conversation archives to reveal the weaknesses of the students and thus being able to help them better. This is the scenario when teachers use a chatbot to detect problems, while the students use it to solve them.

According to Griol and Callejas (2013), chatbots can be used as educational technologies to perform the following functions: (i) to speed up the learning process; (ii) to facilitate access to learning; (iii) to personalize the learning process, and (iv) to enrich the learning environment.

As for the roles of chatbots in education, Roos (2018) identifies five main ones: "Communication with the teacher" (answering questions from students to clarify certain aspects of learning or course administration); "Natural conversation" (conversation between peers, for example, in language practice),

"Student evaluation" (evaluation and feedback); "Questions and answers" (answering factual questions), and "Tutor" (teaching and didactic support).

Chan and Baskin (1988) suggest that, in the virtual learning environment, it is possible to offer a choice of several "teachers" with different characteristics: for example, a patient, soft-mannered, teacher and a demanding teacher. In such a situation, learners may choose either of them according to their own learning styles.

As for the description of the roles of chatbots, Roos (2018) concludes that they encompass different aspects of teachers' responsibilities stating that researchers see a chatbot as an extension of the role of the teacher, rather than as a separate alternative. The author notes that role descriptions are generous in their definitions and often include varying characteristics and attributes. The most frequently mentioned role of chatbots across the literature was that of "tutor," suggesting that a tutor is seen as someone who helps the teacher. According to the author, the literature survey demonstrates that "tutor" is perceived as a common role, which includes carrying out some of the same tasks as the teacher and which is always combined with other roles.

Based on her review of the literature on chatbots in education, Roos (2018) separates the roles of chatbots (what a chatbot is used for) from their features (all the things a chatbot can do) and summarizes them in a list of 17 features:

Table 1. Features of chatbots in education (Roos, 2018).

1	*Demonstrate learning task*	**10**	*Teacher can edit bot content*
2	*Support feedback to students*	**11**	*Point of interaction for learner*
3	*Animated gestures supporting knowledge base*	**12**	*Ask the student questions*
4	*Give recommendations about learning material*	**13**	*Provide output as speech*
5	*Allow input as speech*	**14**	*Conversational strategies*
6	*Hold topic specific conversation*	**15**	*Help students 24/7*
7	*Control e-learning platform's activity*	**16**	*Answer student questions*
8	*Hold general conversation*	**17**	*Provide content from other knowledge* sources
9	*Provide means of contact with teacher*		

Roos (2018) draws our attention to the fact that, in the reviewed literature, none of the chatbots defined as "tutors" were assigned solely to a role of tutor—they were always linked to other roles: "This implies that a tutor might include these other roles or tasks, but, e.g. a 'Student Evaluation' chatbot does not have to be a tutor, it can simply give students feedback." As for the other roles, they are less frequently represented but are always separated from the role of "tutor," meaning that "for example the 'Student evaluation' is a valuable role for a chatbot even without the added responsibilities of a tutor" (Roos, 2018). The author summarizes her analysis with the conclusion that any chatbot role can be tailored to meet a set of particular needs.

Chan and Baskin (1988) also explored the idea of a Learning Companion System (LCS) where a human student studies with a virtual tutor and learning companion. Invoking Vygotsky's (1978) ideas of the importance of social interactions, the authors suggest that the LCS can also be a simulation of peer group learning: a class of multiple learning buddies with different knowledge levels or personalities. A "Companion" can be a human student or a machine, thus creating an environment that supports and controls distributed learning activities.

Woolf (2009) notes that educational software often acts as a learning companion to provide one-on-one help to students. Such an approach began with software that allowed a student to learn as a "prince" (Chan & Baskin, 1988) and developed into various forms of "companions": animated pets, computer toys, 3D intelligent humanoid creatures, and multiple learning companions. Woolf (2009) summarizes the different social roles of such a collaborator (challenger): an adversary, a critic, or even a troublemaker. The approach of "learning by disturbing" (Aïmeur & Frasson, 1996) makes the tutor a "troublemaker" who sometimes provides good advice to the learner but can also make false recommendations. Such troublemaker provokes a reaction from the learner, who has to evaluate his own opinions to resolve the conflict. This approach demonstrates the usefulness of intentional conflicts, a constructive confrontation, in various cooperative learning strategies, proving that social interaction is fundamental to the development of cognition: "Peer strategy is a technique by which agents produce cognitive conflict, expose the conflict, and then resolve the conflict through discussion for a common outcome" (Woolf, 2009).

Lachs (2017) presents the example of a chatbot fulfilling the role of "Teacher Communication": a chatbot designed by a professor at the Georgia Institute of Technology, named Jill Watson, became popular among

users for answering questions about course procedures to more than 300 students in an artificial intelligence class without them knowing they were talking to a robot.

Teachable agents are another form of learning companion – students "learn by teaching" an intelligent agent who initially "knows nothing" about the domain. This is a "Learning by teaching" strategy: "Students teach the agent by developing causal diagrams or concept maps and use this teachable agent to make decisions, perform actions, explore qualitative interactions between concepts, and answer questions" (Woolf, 2009).

1.3 The advantages of chatbots in education

1.3.1 Versatility

Chatbots are being used in all spheres of life where communication plays a role. Literature on commercial chatbots paints a general picture of their strengths, including saving time and money, reducing the stress of interpersonal communication, providing customized interaction, and improving information support. Additionally, chatbots can conduct simultaneous conversations with thousands of users, increasing business productivity and retaining loyal consumers. Overall, from a business perspective, chatbots are cost-efficient and cost-effective conversational applications that monitor and analyze consumer data to improve services and products. They can be used to expand the client base and are easily customizable for global markets (Rouse, 2022). As Dale (2016) notes, almost anything we can imagine as daily actions—booking a flight, buying clothes, or paying a parking fine—can be done on the web and, most likely, there is already a chatbot for it. Consumers accept the service provided through the interface without reflecting on the nature of their interlocutors (Am I talking to a human being or a software?) on the other side of the screen: "Very soon we'll be in a world where some of those conversational partners we'll know to be humans, some we'll know to be bots, and probably some we'll not know either way, and we may not even care" (Dale, 2016).

In cases where the service is explicitly automatic, we even observe a process of humanization of the machines. Thus, several researchers, including Barot (2017), note that the "Eliza effect" (named after the first chatbot)—tendency of individuals to attribute human characteristics to a machine with which they converse—persists across all those decades that we are surrounded by conversational agents.

Chatbots are versatile and, therefore, omnipresent not only due to their effectiveness but also because we as humans adopted a particular way of interaction: more via texts than in person or via audio/video. Suler (2016) observes that we as individuals are moving towards a rather short and abrupt style of messaging, “staccato style.” We are perfectly comfortable communicating with short texts, and we easily participate in several asynchronous interactions at the same time.

Chatbots in education, it can be assumed, have the potential to offer the same benefits to users. In general, the fact that chatbots are widely spread in business, commerce, and online social networks can definitely facilitate integration of artificial conversational agents in an online discussion forum.

1.3.2 Adaptability and stimulation of interest

For those studying online or with virtual tutors, staying motivated is one of the toughest tasks. Vicente and Pain (2002) believe that there is an urgent need for further research to obtain and formalize knowledge diagnosing the state of student motivation during an interaction with an ITS. Nkambou et al. (2007) note that the limits of today's Intelligent Learning Environments (ILE) lie in their ability to establish effective communication with the learner. The authors present several examples of successful ITS that integrate agents offering “emotional interactions”: the modular architecture of MOCAS (MOtivational and Culturally Aware System) designed to maintain learners’ motivation.

Chatbots designers also search for a way to overcome this problem of keeping up the users’ interest engagement. Lachs (2017) notes that, with many online tutoring services already available, chatbots, integrated into such systems, have a potential to offer more to learners: apart from offering tutoring at their own pace and level, on their own devices, chatbots can also deliver lessons tailored to each student.

Moreover, if an ITS is not available, individually employed chatbots can be used to bridge the communication gap. For example, for large-scale learning scenarios like massive open online courses (MOOCs), which cannot boast a high retention rate, Winkler and Söllner (2019) suggest the use of chatbots to offset the insufficient individual support: “chatbots in education can also be used to provide formative feedback to students about their performance and can trigger metacognitive thinking processes by discussing student learning behaviors in a synchronous way.”

Winkler and Söllner (2019) conclude that chatbots can be used to increase student motivation in learning by also stimulating their curiosity with interesting questions. Chatbots can help reinforce students' self-perception by giving them more control over their learning process and leading to higher learning outcomes.

Indeed, Rouse (2022), describing recent commercial chatbot technology, draws our attention to its ability to proactively interact with users: initiate conversations, monitor how users use their websites, and offer user-specific incentives, help them navigate the learning environment, and answer questions. The author mentions another important quality improving user engagement: chatbots can be used to make it more interactive by opening a social media communication channel where timid users can have a conversation without the stress of interaction with another human.

In fact, some studies have shown that sometimes, in education too, removing the stress of human interaction adds value to chatbot technology: when we know we are talking to a machine, we feel a certain freedom: machines do not judge us for our mistakes, which may motivate us to keep trying (Fryer, 2018; Fryer et al., 2017; Shawar & Atwell, 2007). This phenomenon is observable during conversational practice in a language course, for example.

Examining the particularities of human interactions with chatbots in an educational setting, Hill et al. (2015) analyzed 100 messaging conversations and found that humans conducted significantly longer conversations with chatbots than with other humans. Although each message sent to the chatbot is shorter and the vocabulary is not as rich, participants found communication with chatbots enjoyable and the engagement length of such conversation exceeded expectations.

1.3.3 In-depth "knowledge" and tirelessness

In general, people build machines to perform tasks that require too much effort or are even impossible for a human to perform (Arthur, 2019). Here is how Rouse (2022), for example, describes what chatbots can do in the sphere of business and commerce: reduce customer waiting time and provide immediate responses; ensure that users receive 24/7 support service; eliminate the threat of unpleasant human-to-human interactions influenced by mood and emotions of service people and the customer; minimize stress and embarrassment some customers feel when contacting support personnel; reduce wait times and streamlining the conversation; improve the redirection of customer requests; advance brand personality

by customizing the chatbot; and personalize every customer experience with the use of AI-enabled chatbots.

Regarding advantages of using chatbots in education, Fryer (2018) notes that students who participated in his studies reported learning more with chatbots as conversational partners because they offered what human partners were not able to provide (a broad range of expressions/questions and vocabulary); and/or were not willing to do (to keep on talking or to enable repetitive practice). In other words, in conversational practice, chatbots provided "the scaffolded introduction of new vocabulary, grammar, and expressions, which a human partner is unlikely to present." They also ensured "consistent understandable repetition," which humans find difficult to provide.

Extensive knowledge base or the vast resources of the Internet used by various types of chatbots make them machines that "know everything" and are always at our disposal. This aspect is widely used not only in business or commerce but also in the educational environment. For example, for their research, Sarosa et al. (2020) developed self-sufficient English learning media so that the students use it independently, without the help or intervention of teachers.

As far as online social networks are concerned, chatbots occupy an important place there too. Dale (2016) argues that popular messaging platforms and interfaces are near perfect environments for chatbots. Varol et al. (2017), for example, estimate that between 9% and 15% of active Twitter accounts are bots. In video games, as Rouse (2022) observes: "Chatbots can be added to a buddy list or provide a single game player with an entity to interact with while awaiting other 'live' players. If the bot is sophisticated enough to pass the Turing test, the person may not even know they are interacting with a computer program."

1.4 The limitations of chatbots in education

Chatbot technology being versatile, readily available, and adaptable, is a relatively new technology, and a number of issues are still waiting to be resolved. In business and commerce, for example, chatbots present various design and user perception challenges. Moreover, according to Rouse (2022), the issue of security is crucial: "the chatbot design should be secure and able to prevent hackers from gaining access to the chat interface." Just as with other technology, the limitations of chatbots are best mitigated when addressed at an earlier stage of their development because the process of improving a chatbot "can cost businesses a lot of money if the initial interactions cause customers to disengage and turn away."

In many aspects, chatbots used in education present similar issues as the commercial chatbots. Working on our thesis, we concluded that the issues the course developers most often face when integrating this technology in a classroom are the linguistic limitations, the problem of user's perception and emotional response to interacting with chatbots, and technical difficulties relating to the availability, accessibility, and the learning curve of developing and using the chatbot technology.

1.4.1 Linguistic limitations

If over-the-clock readiness to converse and an extensive data-base are nowadays common features of chatbots, the way their output is presented to users can still prove to be problematic. Immense efforts are directed in solving chatbots' linguistic issues, and some ITS demonstrate impressive conversational capabilities of their chatbots. For example, Graesser et al. (2005) present the AutoTutor capable of carrying out "productive and reasonably fluid" conversations. The authors note that conversational software using natural language works quite well in circumscribed conversational contexts; thus, the quality of discourse depends on the topic, the learner's knowledge, the expected depth of understanding, and the expected sophistication of dialogue strategies.

However, linguistic qualities of individual chatbots remain a challenge. According to Shawar and Atwell (2007), chatbot's responses can be predictable, redundant, or fail to remember previous responses. Another challenge, according to Rouse (2022), is to design a chatbot with an appropriate conversational quality: "Varieties in the way people type their message can make it hard to understand their intention. Chatbots must be able to deal with both long and short sentences, as well as chat bubbles with lengthy content versus multiple very short submissions."

For chatbots in education, the most natural type of dialogue is what Woolf (2009) describes as "Mixed Initiative Dialogue," where both the tutor (in our case, the chatbots) and the learners can initiate and lead the conversation. This type of dialogue remains a challenge for most chatbots, and, currently, few natural language processing-based tutors are capable of full blended conversation. According to the author, mixed initiative tutors are difficult to implement: it is necessary to plan different initiative strategies, to diagnose the student's responses, to prescribe the rotation (turn-taking) and the roles of the participants, as well as considering the conversation anchoring (the dialogue's initial information that influences the conversation flow) and repairing misunderstandings. Moreover, "mixed initiative tutors might also need to recognize situations in which students are frustrated or discouraged" (Woolf, 2009).

Grudin and Jacques (2019) offer a classification of reasons for chatbot technology failure to fully overcome linguistic issues. Firstly, the "tasks are complicated": chatbot technology is not yet as mature as some other software it strives to replace in performing the tasks successfully managed by older applications. Secondly, the "conversations are complicated": natural language conversations are "multi-threaded, hop back and forth, and circle around" because human exchanges are not linear and are not limited to just words. Thirdly, the "natural language is complicated": the chatbot technology is still to reach speech and natural language understanding comparable to human capability. Finally, the "Demo Trap phenomenon": "chatbot systems have at best primitive models of their conversational partners," which means that a lot of effort goes to developing a chatbot that is trained in conversation to a rather simple model of a human interlocutor, and in real life, the result falls far behind the success of the demo system.

Fryer and Bovee (2018) argue that users' language proficiency is also a critical issue in human-machine language practice and should be addressed from the initial design phase. Therefore, as Fryer (2018) recommends, the simplest approach might be to develop a wide range of chatbots (or versions thereof), both for different topics and for a range of learning levels.

1.4.2 Emotional limitations

Although chatbots have been around for decades, development of emotionally responsive chatbots is a recent trend: generating human-like empathetic conversations is confronted with challenges such as "the accurate recognition of emotion and emotional state of the user while keeping track of the history of the conversation and generating appropriate responses that are not dull and repetitive" (Bilquise et al., 2022).

Confronting the problem of emotion, chatbot developers principally work on the accuracy of user's emotion detection, as well as generation of emotionally pertinent responses. Apart from the need for an advanced AI, emotionally intelligent chatbots require massive datasets to generate appropriate and varied responses.

As for the research on the role of emotions in human-chatbot interaction, it has been yielding contradictory conclusions—from "humans prefer talking to humans"[3] to "users reported feeling more confident conversing with chatbots than with humans" (Brandtzaeg & Følstad, 2018; Winkler & Söllner, 2019).

While problem-solving chatbots are expected to converse in a neutral, professional, tone, "talking with emotional chatbots should resemble the feeling of talking to a friend" (Eshghi, 2021). Such chatbots (e.g. ELIZA and Woebot) are already used as trusted companions in mental healthcare: users can openly discuss their feelings and personal stories without worrying about social stigma associated with mental health issues. What is important, such emotional companions require an increased security encryption to ensure data privacy.

Creed et al. (2014) studied the impact of emotional and unemotional versions of an embodied agent that simulated a health professional helping patients improve their fruit and vegetable consumption. The researchers found no difference in behavioral impact on users (all of them did start to consume more fruit and vegetables) between emotional and unemotional agents, although qualitative study highlighted a strong preference for the emotional agent.

It is, therefore, compelling to suggest that a chatbot acting as an enthusiastic interlocutor emanating positivity and optimism would be an obvious choice for chatbot designers. The study of Han et al. (2022), however, reports that positive emotional signals of AI service agents (using encouraging and joyful words and expressions) "violated the customers' expectations toward the agent (e.g., machines are not supposed to have emotions)." The researchers discovered that the positive attitude of human service employees is not to be straightforwardly replicated in chatbot design because "the positive effect of expressing positive emotion on service evaluations may not materialize when the source of the emotion is not a human."

As for the emotional aspect of chatbot use in education, surveys by Fryer (2018) confirm learners' interest in interacting with chatbots in language practice. The researcher points out that learners do feel the difference between their interactions with human speakers/tutors and their exercises with the help of

[3] https://www.forbes.com/sites/gilpress/2019/10/02/ai-stats-news-86-of-consumers-prefer-to-interact-with-a-human-agent-rather-than-a-chatbot/?sh=f397cd22d3b2 (accessed on 2023-08-23)

chatbots: there are specific situations (working on improving certain linguistic aspects) where students prefer to converse with chatbots. With time, however, learners lose interest in conversations with chatbots, retaining enthusiasm for conversations with humans. Thus, the author concludes that "educators should not rely entirely on chatbots to stimulate interest in language practice." The author maintains that his study, along with the previous studies (Fryer et al., 2017; Fryer et al., 2016), provides clear evidence that interest in language practice stems primarily from conversational experiences between humans. This may happen due to a novelty effect or simply the lower value of chatbots compared to human assistants.

Winkler and Söllner (2019) also observe that students are generally enthusiastic about interacting with chatbots, but "this effect seems to decline rapidly over time as students lose interest in chatbots as language partners compared to human learning partners." Indeed, numerous studies (Chen et al., 2016; Clark, 1983; Creed et al., 2014; Fryer, 2018) reveal that the novelty effect remains a significant challenge for educational technology in general.

Brandtzaeg and Følstad (2018) cite research concluding that people tend to open up more easily to chatbots than to fellow-humans. The authors, however, caution against relying exclusively on software because we still cannot confidently predict how human-chatbot relationships will develop in the long run: whether chatbots can generate increased loneliness or depression or whether they can be balanced in a way that can be beneficial for users' mental health. The authors also warn against educational chatbots overuse because that may promote reduction of teacher-student interaction. As Cunningham-Nelson et al. (2019) stress, it is important that chatbots are seen as just one component of the learning experience, not its entire setting. The principal recommendation resulting from the findings of Fryer and Bovee (2018, 2016) is that teachers should convey to their students the notion that practicing with chatbots is "an opportunity to Learn-more" and not just an accessible tool for "practice anywhere and anytime."

In general, when it comes to human-computer interactions, the most difficult task is to design an application that will provide the user with an experience comparable to human interaction (Saarem, 2016). As Rouse (2022) points out, humans "always want the best experience, but are rarely satisfied," which means that chabots need to be constantly updated and improved to ensure user satisfaction.

We venture to suggest that the issue of negative emotional impact on chatbot users has the least chance of arising when chatbots are used in a group discussion where interlocutors interact without revealing their nature—human or chatbot—and where chatbots maintain neutral and neutral-positive attitude.

1.4.3 Technical limitations

Technical limitations of chatbots in education, just like in any other field, can be discussed in terms of performance-to-cost correlation: advanced performance and high-cost chatbots vs. moderate performance and low-cost chatbots, where the cost means all the resources invested into building, launching, and maintaining a chatbot.

The project of developing and implementing a powerful chatbot is resource-intense in terms of hardware, software, expertise, time, and funds. Additionally, an instructor's steep learning curve can also be considered as a technical issue, especially when it results in teachers' reticence towards new technology.

The AI-based advanced performance and high-cost models are "smart" and often give an impression of conversing with a human; however, these types of chatbots are difficult to program, train, and maintain. In addition, in the early stages of exploitation such chatbots frequently produce linguistic and contextual mistakes. Frustratingly for the users, such issues tend to occur in long sentences during open-ended conversations due to a vast variety of the ways a conversation might develop (Brandtzaeg & Følstad, 2018; Molnar & Szuts, 2018).

Certainly, there is a number of chatbot frameworks, like Dialogflow, QnA Maker, Luis.ai, Microsoft Bot Framework, and Botkit.ai, among others, with an in-built set of functions facilitating creation of a chatbot, but only by building the application from scratch developers can fully control their own chatbots (Abdellatif et al., 2020; Raj, 2019). It should also be noted that chatbot construction differs from other types of software development and depends upon different kinds of skills and tools; at the same time, chatbot designers, often unfamiliar with the spectrum of available tools, do not always select them appropriately (Grudin & Jacque, 2019).

Currently, few educational institutions can afford developing an AI-based chatbot using machine learning and natural language processing because the process requires a team of dedicated experts, considerable time, and appropriate funding, especially if the chatbot is built in-house and from scratch. For example,

the development of the AsasaraBot for English language learners at the University of the Aegean involved concerted efforts of software engineers, conversational AI specialists, and language education experts (Mageira et al., 2022). Furthermore, in an educational institution, students, as end-users, often have to participate in extensive testing of chatbots because the error rate of the application is initially very high, and the chatbots can function only within some of the predefined topics (Molnar & Szuts, 2018).

Admittedly, a vast variety of online classroom activities can benefit from the use of rule-based chatbots that are not as complex, costly, and time-consuming as the AI-powered applications. Rule-based lower-cost chatbots structured as a dialogue tree are easier to develop and are often more reliable when used in a strictly circumspect setting. Such chatbots do not commit linguistic errors thanks to the set of pre-generated messages. The scope of topics covered by such chatbots, however, is limited, and the users are frustrated when the system cannot find appropriate responses when the questions venture beyond the predefined topics (Molnar & Szuts, 2018).

At the same time, even less sophisticated chatbots, like a Short Response Quiz Chatbot or a FAQ Chatbot, require a good deal of meticulous work: putting together an exhaustive base of validated data and testing it numerous times to ensure the reliability of the automated decisions (Cunningham-Nelson et al., 2019).

Finally, in an educational setting, competency acquisition is one of the important factors of successful chatbot implementation (Zhang et al., 2023). Therefore, overall digital competence of educators (DCE), defined as the set of knowledge, abilities, and skills related to Information and Communications Technology (ICT) in connection with teaching is crucial for solving pedagogic issues in the modern society of knowledge (Cabero-Almenara et al., 2021).

Teachers often develop their online courses themselves, so they should be provided with adequate training that ensures an efficient online education activity (Grenon et al., 2019). In the situations when the teachers are provided with ready-to-use chatbot technology, special training programs are needed to prepare instructors not only to accept using chatbots in their courses but also to use them creatively (Dewi et al., 2022). Technical aspects of such training are important, although they must also be accompanied by instruction covering pedagogical approaches to promote interaction, collaboration, and discussion among online students (Barak, 2012; Grenon et al., 2019).

Recently, the question of the availability of resources for online educational platform design, which would be effective, accessible, and reliable, has become even more critical. For example, in 2020-2022, educational institutions struggled to provide students with the opportunity to continue their studies. Nadeau and Barlow (2020) lament the fact that the school network in Quebec was not prepared for remote teaching and call for a more contingency-ready teaching framework. It is, therefore, important to design tools and technical support for schools and universities, which would certainly benefit from a variety of platforms and teaching approaches.

Overall, we estimate that the main technical issues preventing a wider use of chatbots in education are prohibitive costs of the AI-powered chatbots, limited capabilities of the rule-based chatbots, and insufficient digital skills of teachers who often find this technology too confusing and complex.

Having reviewed the literature on educational chatbots, we can conclude that versatility is one of the main features making chatbots popular in business and commerce spheres. In education, too, that feature turns the chatbot technology into a fruitful and, in a way, unique tool. Moreover, employing chatbots in education reveals their other most relevant qualities: adaptability, stimulation of interest, in-depth knowledge, and timelessness in helping students acquire knowledge and practise new skills.

The use of educational chatbots, however, also poses a number of issues that chatbot developers and course creators strive to avoid. The problem of building a linguistically sophisticated conversational agent that is well-received on the emotional level by students and easily adopted by course instructors is technically complex and requires significant resources, both financial and human.

Our goal, therefore, is to build a prototype of an online educational platform that embraces the strong sides of the technology and mitigates its shortcomings. We envision an architecture based on a combination of crowdlearning and peer-chatbots as an inexpensive and productive solution that is not complex in development and implementation and does not represent a steep learning curve for the course instructor all the while maintaining a motivating and positive atmosphere in the online classroom.

CHAPTER 2: **METHODOLOGY**

Our study has three components: (1) building a platform for an online course that consists of a discussion forum and peer-chatbots (Student-Chatbots); (2) recruiting participants, Students and Teacher-Consultants, for the course and running our 5-lesson learning session, followed by the post-mortem data collection and analysis (questionnaires on the experience of participants and the opinions of the Teacher-Consultants); (3) summarizing the conclusions concerning productive approaches to the design of a crowdlearning platform with peer-chatbots, as well as formulating recommendations for such courses' teaching material and chatbot features.

The peer-chatbots' role in our prototype is to motivate and direct the participants in their collaborative learning and to allow the teacher to convey necessary ideas without exercising top-down pressure on the students, all the while saving efforts and time. The concept of peer-chatbots takes the form of scheduled message bots, which we deem sufficient for testing the proposed online learning platform architecture.

In the first part of the course, we use the Wizard of Oz technique, in which we simulate the behaviour of a peer-chatbot. In the second part of the course, we use scheduled message bots that continue to act as participants of the study contributing to the group discussion.

All through the study, the participants are to believe they were interacting with each other, although in the Recruitment and the Consent Forms, it is indicated that the study intends to explore the modalities of deploying chatbots in an online learning setting.

At the end of the 5-lesson course, the Students complete a survey. A group of teachers is also recruited as consultants, and they, in turn, complete a survey based on their examination of the course material and the discussions.

The process of building the platform, conducting the course, and the obtained results in the form of the survey answers provide insights and help us formulate recommendations for designing online learning platforms based on crowdsourcing with integrated peer-chatbots.

Our study is of the qualitative nature, which is most pertinent for our educational platform project, as in education in general, qualitative and mixed-method studies are growing in popularity (Check & Schutt, 2012). Qualitative research design focuses on finding answers to how and why and uses open-ended questions helping the subjects express their views clearly. Qualitative research is also ideal for projects that aim to understand users' behaviour and requirements. Qualitative research is not designed to establish causality or navigate reproducibility, but rather to develop rich descriptions of phenomena (Creswell, 2013).

2.1 Research Questions

Research Question 1: **What are the advantages and shortcomings of chatbots used in an online educational setting?**

In our first research question, we investigate the advantages and shortcoming of chatbots used in education. Having studied literature on the topic, we address this question from two perspectives. First, we focus on the benefits associated with integrating chatbots into a classroom. Second, we concentrate on the difficulties related to design and use of chatbots for teaching, offline and online.

Research Question 2: **Does a crowdlearning-based online educational setting have a potential for reinforcing chatbots' advantages and mitigating their shortcomings?**

In our second research question, we investigate the possibility of integrating chatbots into an online classroom organized as a discussion forum. We address this question from three perspectives. First, we focus on such a phenomenon as crowdlearning: what it means, how to organize it best, what possibilities it brings to the classroom, and how peer-chatbots may become an effective part of such architecture. Second, we suggest a specific approach to the course material for this educational setting. Third, we investigate available open-source platforms and tools that allow building a prototype of a crowdlearning-based online classroom with chatbots.

Research Question 3: **What are the winning approaches to peer-chatbot integration into a crowdlearning-based online platform? What do we learn from the students' experience and potential teachers' opinions?**

In our third research question, we launch our prototype to study its functioning and investigate participants' general impressions of it. We address this question from three perspectives. First, we use the Wizard of Oz methods to determine appropriate timing and nature of chatbot operation, then we test the methods using scheduled message bots and analyze the overall functioning of the learning platform. To address the second aspect of the research question, we analyze the participants' (course students' and teachers-consultants') responses to the post-mortem survey. The survey covers such topics as participants' self-reported perceptions about the discussion forum as a classroom: level of comfort, effectiveness, and satisfaction. Finally, we summarize the findings and formulate recommendations for the design of online crowdlearning platforms with peer-chatbots.

2.2 Prototyping

The general objective of our project was to build and test an online learning platform based on crowdlearning—online collaborative learning. The platform was conceived as a system that integrated digital agents (chatbots) and human agents (teachers and learners) into a unified collaborative learning framework. The idea underlying our work was that the online crowdlearning setting is an environment where the chatbot technologies can be incorporated in a way that highlights their advantages and mitigates their shortcomings.

Firstly, we designed and built an online learning platform with integrated message bots. The platform for this study was a prototype, "a model or preliminary implementation suitable for evaluation of system design, performance and production potential, or for better understanding or determination of the requirements,"[4] of an online educational platform with integrated chatbots that act as regular students and assist the teacher ensuring a productive discussion flow and material presentation.

Our project occupies a space at the intersection of cognitive informatics and online pedagogy, the disciplines where prototyping is widely used to formulate and test concepts and hypotheses. In the field of software engineering, prototyping means building a scaled-down working model to evaluate "the performance, usability, and aesthetics associated with the graphical user interface, graphical renderings,

[4] https://www.btb.termiumplus.gc.ca/tpv2alpha/alpha-eng.html?lang=eng&i=1&srchtxt=prototype&codom2nd_wet=1#resultrecs (accessed on 2023-08-23)

data exchange throughput, or data presentation forms, including printed or plotted material" (Schmidt, 2013). In the field of the Human-Computer Interface (HCI) design and research, prototyping is regarded as a productive way to "develop, refine, and test theories, concepts, and interactive systems in a human-centered fashion" (Odom et al., 2016). Prototyping is widely used in building websites and online courses with evaluation done in natural settings (Yanfi & Nusatra, 2023). In Digital Humanities, the digital artifacts of prototypes "have meaning, not just utility, and may constitute original contributions to knowledge in their own right" and should be considered a peer-reviewable form of research (Galey et al., 2010). In the field of academic research, prototyping is used to produce new knowledge, "to strengthen or weaken an argument," or to serve as a "phase in product development" (Ruecker et al., 2014). Overall, prototyping is "creating a manifestation that, in its simplest form, filters the qualities in which designers are interested, without distorting the understanding of the whole" (Lim et al., 2008).

Discussing working prototypes, Galey et al. (2010) distinguish between vertical—"with one important function working properly"—and horizontal—"with many functions working superficially." The production system that follows has "everything working to some extent, although still subject to bug fixing and iterative improvement." Lim et al. (2008) distinguish between low and high-fidelity prototypes, as well as experience prototyping, which allows active engagement with model, and paper prototyping, which is visual representation of the intended model.

The platform we built for our study was an experience prototype that can be deemed medium-fidelity, a combination of the vertical and horizontal types. The prototype hosted an online course organized as a discussion forum, where automated accounts—message bots—were integrated to act as peers to human participants. While being a working, fully functional model, the platform will need to be further developed and equipped with more functionalities to realize its full potential and provide an enriched user experience.

According to Odom et al. (2016), prototyping plays a crucial role in building user-friendly and efficient technology. The researchers offer a term "the research product as an extension and evolution of the research prototype to support generative inquiries in this emerging research area" and name four complementing aspects of research products: inquiry-driven, finish, fit, and independent.

The platform we built was a representative model that allowed us to evaluate it in terms of availability and affordability of the tools to be used, “verifying the design via functional and performance testing,” and “optimizing the product design features” (Schmidt, 2013). The platform was based on open-source, free or inexpensive, online tools and provided an opportunity to conduct a comprehensive educational project based on crowdlearning and the use of automated peer accounts.

2.3 Participants: Recruitment

The participants were selected based on the following criteria: 1) Adults aged 18 or over; 2) Speaking Russian or English and knowing how to read and write the Cyrillic script (used in the Tatar language, too, with additional letters); 3) Speaking the Tatar language at the beginner-intermediate level; 4) Willing to participate in the online course in collaboration with other learners.

The participants involved fall into two categories: Students and Teacher-Consultants. The Students were recruited by the heads of the Tatar Culture Centers (the Centres) in Canada, Hungary, and the Republic of Bashkortostan, Russia. The Students are members of these communities of the minority language (Tatar, in this case) speakers and culture enthusiasts. Such communities are not official educational institutions, and their activities do not require institutional approvals.

The Tatar Culture Centers are communities of ethnic Tatars with varied levels of command of the language, which belongs to the North Kipchak Branch of the Turkic Language family and is the largest minority language in the Russian Federation (around five million of active speakers). Such Centres function on a voluntary basis and conduct cultural activities based on the language and traditions of the Tatar people. There is no relationship of authority between the heads of the Tatar Cultural Centres and their participants. The members of the Centres participate in cultural events, municipal and regional, where they present their traditional dances, songs, musical performance, as well as cuisine. Often, such Centres organize language courses where volunteer teachers help students learn the Tatar language or improve their language skills. The Centres are not linked to any employers or school boards and are informal groupings of culture and language enthusiasts.

The Students were expected to participate in the online collective learning process on the discussion forum designed by the Researcher for the Tatar language course. Upon finishing the course, the Students were to complete the Participant’s (Student’s) Questionnaire.

The minimum required number of course participants was 8-10 individuals. The maximum limit was 15 participants (traditionally a maximum number of learners in a language course in the Russian Federation). Of the 15 participants who expressed their desire to take part in the course, 12 signed up for the course, but only 10 actually created accounts on the platform and studied. Due to the measures taken to protect the anonymity of the students, we were not able to draw a socio-demographic picture of the participants. Thus, the only information we possessed was that the participants met the Recruitment criteria described in the beginning of this section.

The course consisted of five lessons, each starting with a text in Tatar that has to be completed, the vocabulary covering the lexical part of the text, and the grammar section related to all the morphological and syntactic phenomena of the text. The students' task was to "solve the riddle" by either filling in the voids in the text or rearranging the sentences or parts of the sentences to recreate the original text in Tatar.

The educational goal of this course was to help students refresh and systematize their knowledge of Tatar offering them a stimulating environment and logically laid out engaging material. After the course, the students were expected to feel empowered to start using Tatar in their everyday life or continue improving their knowledge.

The participants' role was to get acquainted with the material, complete the tasks, and submit the assignments. The learning process involved discussion of the problematic elements of the assignment with the peers, and the students were to act both as tutors and apprentices to each other. Upon completion of the course, the participants filled in the questionnaire to report on their experience.

Five Teacher-Consultants were recruited for the project: three of them are members of Tatar Culture Centres; and all five were recommended to the Researcher by the heads of the Centres. Two of the Teacher-Consultants reside in Canada, one in Great Britain, and two in Bashkortostan, Russia. All five possess university diplomas in teaching: four are English language teachers, of whom one is also an IT teacher, and one is a Mathematics teacher. Four of the Teacher-Consultants speak or are familiar with the Tatar language, and one is familiar with the Kyrgyz, a language close to Tatar. In addition, two of them speak Russian, English, and French; two of them speak Russian and English; and one of them speaks only Russian.

The Teacher-Consultants' role in this project was to conduct the post-mortem analysis of the online course: to peruse the discussion forum logs, to examine the teaching material, to observe the learning process, and to share the findings in the Participant's (Teacher-Consultant's) Questionnaire.

As for the recruitment process, the course was announced to the Tatar Culture Centers by the Researcher via email. It was, therefore, only the heads of the Centers who personally knew the Students. The list of the potential participants and their email addresses was drawn up by the heads of the Centers and submitted to the Researcher.

The Researcher contacted the Students by email to obtain their consent to participate in the research. Once the Students confirmed their consent by answering the emails with the Consent Forms, they received access to the course site, where their profiles with nicknames (pseudonyms) and avatar pictures (stylized first letters of their nicknames) had already been created. The real names were thus replaced by fictitious names, and the participants of the discussion forum were not aware of each other's identities. In the data collected, therefore, only the fictitious names of the participants appeared, which protected the identity of each participant.

2.4 Prototype testing

To test the prototype, the recruited Students took part in the 5-Lesson online Tatar language course. Overall during the course, the Students' tasks included (1) registering on the platforms under the nicknames and with the avatars created for them by the researcher; (2) logging in and getting acquainted with the lesson content; (3) discussing the course assignments with the peers; (4) completing the assignment and submitting it to the researcher.

Each lesson started with a text in Tatar that has to be completed, the vocabulary covering the lexical part of the text, and the grammar section related to all the morphological and syntactic phenomena of the text.

The texts were chosen based on two criteria: their originals could not be found through online search and they, as well as their sequence in the course, represented the desired lexical and grammatical difficulties. The topics and the tone of the chosen texts were either poetic or humorous, to motivate and amuse the students.

The students' assignment was to "solve the riddle" by either filling in the voids in the text or rearranging the sentences or parts of the sentences to recreate the original text in Tatar. As the course was designed as a collective learning process, the assignments and the solutions were discussed in the online forum, but the works were submitted individually.

In our project, we had two types of agents: "Administrator" (under the name of AnaTele Miras, managed by the Researcher answering Students' questions concerning administrative issues) and "Student," (under a variety of pseudonyms), which included "Real Student" and "Student-Chatbot" (two fictitious accounts mimicking the functioning of chatbots). The architecture and the agents' roles are described in section "3.4 Modelisation."

It is important to mention that the course was divided into two parts, and the virtual classroom in the form of the discussion forum took place on two platforms: the first three lessons on a website and the two remaining on a content-sharing social network.

The use of two different platforms was dictated by, firstly, our plan to investigate the possibilities of a variety of online tools, and, secondly, by the specific qualities of the tools: while one online platform offered a more convenient space for material display and discussions, the other allowed an easy message bot integration. The process of platform selection and prototype building is described and explained in Chapter 4.

During Lessons 1 to 3, the dummy accounts were operated by the "Wizard" (the Researcher) with an aim to monitor the conversation and to ensure an active status of the discussion (the process is described in section "4.2 Platform for Part I"). This kind of intervention had three goals: (1) to ensure the discussion flow by posting comments or questions in situations when the participants have not yet started interactions—24 hours after the assignment publication; (2) to try out and determine the appropriate tone, emotional and linguistic, of the posts; and (3) through the comments and questions, to cover problematic issues of the assignments and provide key words and notions in the answers to the Students' questions to guide them in their search.

During Lesson 4 and 5, the Researcher continued playing the role of the "Administrator" who answered the Students' questions and helped them to solve problems with logging into the platform, posting works, and finding the necessary resources.

As to the two “Student-Chatbot” accounts, during Lessons 4 and 5, they were used by the Researcher to post comments and questions on the forum. At this stage of the prototype testing, the Researcher did not manage the fictitious accounts on a daily basis but scheduled the message bots to act as peers in the online classroom. Such pre-programming of message bots thus mimicked the functioning of Student-Chatbots.

Upon completion of the course, the survey was conducted. The Students filled in questionnaires to report on their experience. Overall, during the testing period of 4 months, the Students were expected to log in the platform 4-5 times a week and to spend around 20 minutes a session.

For the prototype evaluation, we recruited Teacher-Consultants to take part in the evaluation of the prototype by perusing the course material, studying the discussion logs, and completing the questionnaires to report on their opinion and to suggest improvement. The Teacher-Consultants were expected to spend around 3-4 hours on reading the material.

During the prototype testing, the Researcher also studied the efficacy and user-friendliness of the tools used to build the platform, the effectiveness of the proposed architecture, the modality of interactions between the participants, and the potential benefits of peer-chatbots employed in an online classroom discussion.

2.5 Survey

To evaluate the platform, we conducted a survey in the form of a questionnaire. The survey was a series of questions on the participants’ experience, and it covered four main topics: the platform, the online discussions among the Students (crowdlearning), the course content, and the peer assessment.

As a rule, prototypes allow evaluation of the user experience, “physical, sensual, cognitive, emotional, and aesthetical issues; the relationship between form, function, and content; as well as fuzzy concepts such as fun and playability” (Fallman, 2008). Therefore, testing of the prototype and gathering the users’ opinion aim to confirm “that the prototype properly manifests the design characteristics it was envisioned to represent” and “to ensure that the prototype will provide the data necessary to solve the problem the prototype was intended to resolve” (Schmidt, 2013).

The Students and the Teacher-Consultants in our project were to complete a questionnaire, “the main instrument for collecting data in survey research” that can be regarded as a kind of interview, “in which the conversation is governed by the wording and order of questions in the instrument” (Lavrakas, 2008). The survey is an important tool for data collection; it is versatile, efficient, and generalizable (Check & Schutt, 2012; Singleton & Straits, 2009).

It should be noted that the studies mentioned in our literature review measuring the level of learners’ satisfaction with their interactions with chatbots (Fryer, 2018; Hill, Ford & Farreras, 2015; Radziwill & Benton, 2017; Vijayakumar et al., 2018) were conducted in a setting where human learners knew they were interacting with machines.

As to our study, to highlight the level of learner approval with the online classroom activities involving artificial accounts, we conducted a feedback survey to evaluate the level of satisfaction with 1) the collaborative teaching-learning method, the platform, and the course content; and 2) interactions with their peers, of which part are accounts administered or scheduled as peer-chatbots.

Importantly, the Recruitment and the Consent Forms revealed to future participants, both Students and Teacher-Consultants, that one of the goals of the project was to study the use of chatbots in an online educational setting. However, the exact moment of activation of automated accounts, the specific role of chatbots, or artificial nature of some of the peers were not disclosed.

We considered it important not to attract participants’ attention to the artificial nature of some of their peers’ accounts to be able to evaluate the participants’ general satisfaction with the online learning process. In our online classroom, the overall architecture, the sum of all elements---crowdlearning, course content, and artificial peers---constituted the prototype.

The post-mortem evaluation of the Students’ experience included four important aspects: platform ease of Use, content satisfaction–Student Perspective, collective learning usefulness–Student perspective, and peer participation evaluation–Student perspective.

The Teacher-Consultants evaluated the platform not through their active participation but by examining the learning material and studying the course activity screen-shots. The evaluation by the Teacher-Consultants, therefore, included such aspects as Platform Visual Comfort, content satisfaction–Teacher

perspective, collective learning usefulness–Teacher perspective, peer participation evaluation–Teacher perspective, and Student-Chatbot acceptance.

The main body of the questionnaire for the participants, the Students and Teacher-Consultants (Appendices C and D), included inquiries concerning the devices they used during the process, their experience and impressions, as well as their comments and recommendations concerning the platform, the content, and the collaborative learning.

The questionnaires for our survey consisted of elements as Boolean "*Yes/No*" questions, comment box open-ended questions, and rating scale questions. The only two exceptions were one multiple-choice question (concerning the device used) and one special (*How many..?*) question.

Following Lavrakas's (2008) scheme, the questionnaire applied the pattern where neutral questions (in our case, concerning the device used for the course) were placed first, followed by questions "that require greater effort (e.g. complex, core questions)" regarding participants' opinions on their personal learning experience; and ending with rather sensitive questions concerning the participants' peers. The questions were formulated in simple syntax and without complex vocabulary; there was only one question in an item; the questions were concrete as to time and events; they did not lead to particular answers; and the response options were exhaustive and not overlapping.

Although Lavrakas (2008) cites "closed-ended (or fixed alternative)" questions as more frequent in surveys, our questionnaire contains about 70% of (17 of 25) open-ended questions where respondents are asked to name another participant or to comment on their particular experience. Certainly, such questions "require a subsequent postcoding," which suits our study, which is mostly qualitative.

The close-ended questions of our questionnaire were Likert-type questions asking to rank on a scale ranging from 1 to 5 the level of approval or satisfaction, as well as to provide semantic differential scale responses (*Very Comfortable* to *Uncomfortable*) as to a particular aspect of the course or the platform. The suggested categories were exhaustive and mutually exclusive.

The questionnaires were to be administered on a single occasion, post-mortem, by delivering the documents in the Word format via email. We opted out of administering the questionnaires in the Web

form because certain web platforms cannot be equally easily accessed in all parts of the world. The results of the survey are revealed and summarized in Chapter 5.

2.6 Ethical Considerations

The approach to building the course content and application of the teaching methods are based on our background. Belonging to the Tatar ethnic group, the researcher grew up bilingual (speaking Russian and Tatar) and graduated from high school, which included a five-year Tatar Language and Literature course mandatory for the students of the Tatar origin in the Tatar Autonomous Republic of the USSR. The university diploma that followed was a result of a five-year university program in Romance-Germanic Philology at Bashkir State University, BSU, in the city of Ufa, Russia. The university diploma granted three professional qualifications: researcher in Philology, teacher of English as a Second Language, and an English-Russian interpreter/translator. Our teaching experience included two years of lecturing in English Grammar at the BSU and five years of teaching English at the ESL courses. For both teaching experiences, we built the course content and applied instruction methods according to the pedagogical principles taught at the university and following our own innovative methods, which is reflected in the course content for this thesis and in the prototype architecture.

As Dubois-Flynn and Chapman (2018) note, creating knowledge is a fundamental aspect of human nature. Academic research is, therefore, “a profoundly social activity that connects you both to those who will use your research and to those who might benefit—or suffer—from that use” (Booth et al., 2008). Thus, adhering to the scientific code of conduct and ethical requirements is critical for any academic activity.

As to our study, various ethical aspects of our project were considered and the Request for Approval by the "Ethical evaluation process" of the UQAM (*EPTC 2, Politique 54, lois et règlements québécois*) was submitted, for which the Approval was granted. Prior to the request, we completed training in research ethics (Formation en éthique de la recherche ethics.gc.ca/fra/education/tutorial_didacticiel) and read the “Ethical Decision-Making and Internet Research” by the Association of Internet Researchers (http://aoir.org/reports/ethics2.pdf).

Designing, building, and deploying a conversational agent in a social digital environment imposes ethical responsibility that the researcher must confront and take into account (Ruane et al., 2019). Regardless of the technology engaged in the research involving humans, there are always two serious ethical concerns:

not to harm the participants and to guarantee the security of their private information (Eicher et al., 2018; Pedró et al. 2019).

As for the safety of the participants, we believe that chatbots and other software can and should be developed and deployed without posing any danger to humans. For example, chatbots are already widely used in clinical psychiatry and have proven to be not only reliable, but also safe tools that provide mental health therapy (Bendig et al., 2019; Creed et al., 2014). As to our online learning platform, the automated accounts participating in online discussion with human participants post messages of neutral or emotionally positive nature that promotes learning and emotional comfort.

Dubois-Flynn and Chapman (2018) suggest adopting a pragmatic approach to ethics, which means mastering critical analysis skills to consider "relations of power and context": to reflect critically on which party exercises power and has voice in a certain context, and which party is not able to have its voice heard; which party gains and which party loses; what the effects of certain actions are and in what circumstances.

Before the participants were engaged in the online learning course, they were presented with a Recruitment Letter (Appendix A) and a Consent Form (Appendix B), which explained the nature of the project, the process of participation in it (online learning followed by completing a questionnaire), and how the researcher ensured confidentiality of the participants. "It is a sort of 'contract,' where the costs and benefits for collaboration between the respondent and the researcher are defined" (Lavrakas, 2008). Upon completion of the course and the questionnaire, the participants were asked to give their consent for the collected data–discussion logs and survey results—to be used.

Consensual participation in research is a critical ethical issue and social responsibility of researchers towards human participants and the society as a whole (Dubois-Flynn & Chapman, 2018). As to our study, the Recruitment and the Consent Forms (Appendices A and B) informed the participants of the voluntary nature of their participation in the project and of their right to withdraw from the study:

> Your participation in this project is entirely voluntary. You may refuse to participate or you may withdraw from the study at any time without the need to justify your decision. If you decide to withdraw from the study, you only need to verbally inform Gulnara Shaydullina; in this case, all data concerning you will be destroyed.

Although we did not reveal to students which of their peers were message bots, or chatbot-imitating accounts, we informed them in the project description (Appendix B) that the project aimed to study the use of chatbots in an educational setting and that various software and chatbots could be deployed in their platform, so there was no subterfuge in the process.

Regarding the private information security concerns, we considered the anonymity of the participants and the login-protected platform of the discussion forum to be adequate measures ensuring a secure environment where private data was not shared and therefore could be disclosed.

In addition, to ensure the anonymity of the student participants, we created accounts for each of them and assigned them pseudonyms. Each account contained a profile picture, an avatar, which represented a stylized image of the first letter of the assigned nickname. The nicknames, in their turn, were randomly selected words from the Lorem Ipsum text and did not, therefore, carry a meaning or hint to the participants' age, gender, or background.

Thus, all the participants were only identified by their pseudonyms and were visually represented by the avatars. Neither the Teacher-Consultants nor the Students knew which of the participants was represented in the Forum under a given pseudonym. The participants do not all live in the same city or country, and the majority of them are not personally acquainted.

Due to the above-mentioned, we consider that the data collected, itself or combined with other data, did not allow identification of individuals.

As Lee (2021) notes, "though the technology per se is neutral, yet the use of the technology is not." Therefore, the manner in which the data is collected must not be used against the data subjects, and they must maintain the right to that data. The data privacy must not be breached, and the content must be properly stored.

The data for our research (texts of discussions on the forum and survey results) is stored on a computer dedicated to research and locked by a password known only to the researcher. All this data is encrypted and protected by a second password (WinAce). Any transport of information is done from a USB key, also encrypted and protected by a password (WinAce). The data will be kept for the period of 5 years and then destroyed with the help of the CCleaner software.

The study of literature on educational chatbots and the definition of methodology lays the groundwork for a prototype of our online educational platform, which embraces the strong sides of the chatbot technology and mitigates its shortcomings.

CHAPTER 3:

CROWDLEARNING ON THE DISCUSSION FORUM WITH CHATBOTS: DESIGN RATIONALE

Having identified the strong points of chatbots (versatility, potential to adapt to a variety of interlocutors, availability anywhere anytime, and the ability to learn), we also identified their weaknesses: language limitations, emotional issues, and technical complexity. Chatbots in our project aimed to support crowdlearning, and their main function was to promote communication and collaboration between learners. Our general objective was, therefore, to design and test an online learning platform that allowed us to highlight the strengths of chatbots in online learning and to level out their deficiencies.

As Koehler and Mishra (2009) maintain, "at the heart of good teaching with technology are three core components: content, pedagogy, and technology, plus the relationships among and between them." According to the authors, the interactions between these three components manifest differently in various settings and influence the quality of educational technology integration. To build our platform, we consider those three above-mentioned components and the research on successful practices. This chapter is, therefore, a resume of the reasoning and arguments behind the decisions concerning our prototype.

In the prototype of our online classroom platform, we incorporated three essential elements, which can be called three pedagogical tools, in such a way that they mitigate each other's problematic aspects and enhance each other's effectiveness. Crowdlearning in the form of an online discussion group is the first element of the pedagogical approach. The second one is the appropriate teaching content that suits the online classroom setting. Finally, we used the idea of peer-chatbots, which, integrated into the crowdlearning process, were to become an invaluable part of a successful online learning platform.

3.1 Crowdlearning on the discussion forum

3.1.1 Crowdlearning

As mentioned earlier, in our educational platform, we rely on collective learning—crowdlearning—both as an effective educational approach and an environment where peer-chatbots can be integrated, thus increasing the learning process effectiveness. Introducing the term "crowdsourcing," Howe (2006) describes the modus operandi of the company Threadless, which produces t-shirts for online sale: the Internet community members submit their sketches online and vote for the best designs, following which the authors of the best models receive cash prizes. However, Howe (2008) explains that crowdsourcing as

a form of work organization is not limited to a single strategy: it is a set of ways of producing. According to the author, there are four main strategies that represent this phenomenon: Crowd Wisdom (use of the knowledge of the "crowd" on specific themes), Crowd Creation (use of the creative energy of the "crowd"), Crowd Funding (use of the monetary contribution of the "crowd") and Crowd Voting (use of the judgment of the "crowd").

It should be noted that the combination of Crowd Wisdom and Crowd Creation has given rise to several other forms of collaboration, including crowdlearning—collaborative learning. Regarding our project, the collaborative learning platform employs crowdlearning in the form of a discussion forum.

Crowdlearning is one of the crowdsourced activities that has been rapidly gaining force with the digital communications progress. Brabham (2013) defines crowdsourcing as "an online, distributed problem-solving and production model that leverages the collective intelligence of online communities to serve specific organizational goals." The author argues that the concepts underlying crowdsourcing have always existed, but it was only with the high-speed connectivity of the web and with the participatory culture of the 2000s that the phenomenon came into being.

Brabham (2013) stipulates the conditions under which the organizational structure becomes a crowdsourcing project: this form of work organization must present a balance of power between the community and the company—a combination of bottom-up creativity and top-down management.

Surowiecki (2004) asserts that the collective wisdom of a "crowd" surpasses the individual wisdom of its members, but for a group to become a "wise crowd," four main conditions must be met:

- diversity of opinions and skills of the group members;
- independence and decentralization of group members: geographic heterogeneity, time desynchronization, and lack of hierarchy;
- freedom of opinion ensured by free and informed access to information;
- availability of an appropriate digital platform (a website, an online forum, etc.) allowing the aggregation of opinions and the formulation of a relevant result.

The first two characteristics are critical to the success of collaboration: diversity and independence are important because the best collective decisions are the product of disagreement and confrontation, not consensus and compromise (Surowiecki, 2004). With regard to the other two conditions for successful collaboration—freedom of opinion and the appropriate technique of aggregating opinions—contemporary communication technologies offer practically unlimited possibilities to ensure access to information and free and rapid aggregation of various opinions. Thus, omnipresence of digital technologies and migration of social networks to web platforms allow the organization of "wise crowds" on a large scale (Surowiecki, 2004).

Farasat et al. (2017) call crowdlearning a new educational paradigm where students experience deeper learning by collaboratively creating learning materials with each other. According to the authors, this paradigm is based on metacognition, learning by teaching, peer assessment, and problem formulation with the potential to ensure deeper learning. Crowdlearning can be adopted as classroom practice, but it is most productive on an online platform for learners to build and refine "problem banks" for particular academic subjects. These banks of questions and problems can become "ideal companions" for online classes, especially for MOOCs. As for peer assessment, crowdlearning contributes to students' learning processes and motivation, improves their perception of the quality of their work, and increases their responsibility and satisfaction in the learning process. Finally, the adoption of learning-by-teaching in the crowdlearning environment engages students and helps them develop metacognitive abilities (Farasat et al., 2017).

Investigating the potential for combining online educational technologies with collective learning, Tenório et al. (2021) conceptualize the term "collective intelligence (CI)" as "the ability of a group of individuals to perform a variety of tasks of creation, innovation, and invention through the intellectual cooperation of its members."

Tchounikine (2011) describes collaborative learning environments as "environments designed to favor the emergence of some kind of interaction among peers (e.g., building on each other's ideas) and providing support and constraints designed to favor the addressing of the targeted objectives." Such "building on each other's ideas" is at the core of the pedagogical strategy of crowdlearning that we envision for our online platform.

Harvey (2004) notes the emergence of virtual communities of collaborative learning: “communities of knowledge that transdisciplinarily integrate technological, psychological and pedagogical perspectives in considering the best ways to organize learning socially to maximize its benefits.” In such an environment, group members contribute their understanding and ideas and together build understanding and knowledge (Harasim, 2011), as well as play a more active role in online classrrom sometimes even creating their own pedagogical content (Tenório et al. 2021).

Research in collaborative learning points out the importance of the aspects and conditions underlined in literature on crowdsourcing (Brabham, 2013; Howe, 2006; Surowiecki, 2004). For example, Blanchard & Frasson (2007) offer recommendations to facilitate the design and development of ITS inspired by Self Determination Theory (SDT). The authors identify three psychological needs that condition an individual’s motivation:

- Need for autonomy: “encouraging learners’ freedom and decision-making”;
- Need for competence: “provide pedagogical support to the learner to guide him, maintain an optimal level of challenge and improve his confidence (competence) without affecting his autonomy”;
- Relational need: “give the possibility to several learners to share the same learning experience.”

The diversity of viewpoints is an important aspect of collective learning, as “the best collective decisions are the product of disagreement and contest, not consensus or compromise” (Surowiecki, 2022). Similarly, Woolf (2009) describes a collaborative learning environment as a situation where students, who work in groups and explain problematic issues to each other, learn more than the best individual student in the group. According to the author, in a collaborative environment, “while voicing disparate views, humans collaborate to construct a joint conceptual model, each participant expressing her viewpoint and listening (or not) to integrate the viewpoint of the other.”

The prototype of our educational platform is based on the pedagogical principle of collective learning—crowdlearning—to take advantage of what a group of students can offer: motivation, curiosity, and prior knowledge. Each crowdlearning project needs a space to host free and enriching discussions. Among ways for such knowledge and opinion exchange is discussion, which can take different forms and be organized in a variety of ways.

3.1.2 Discussion forum as a form of crowdlearning

There is hardly a more egalitarian and self-expression-friendly way to study than online collective learning. While in a regular classroom, students wishing to participate are supposed to wait for their turn, in an online discussion the learners do not have to stand by until they receive the right to interact (Schwab, 2011). The "pedagogy of textual conversation" (Baldwin, 1996) of the online classroom discussion, therefore, offers a chance to everyone to develop their reasoning and rhetorical skills, to better understand learning material, and to establish connections between concepts and ideas. Online discussions offer a unique opportunity to reflect on the topic through sharing ideas with peers—"be bold, state and defend what you think, and you will enhance your learning experience" (Fuster, 2017b).

There is a variety of online teaching settings, both for lectures and discussions: synchronous, asynchronous, and bimodal (Grenon et al., 2019). A fully synchronous online teaching setting puts a lot of pressure on instructors: during a Web conferencing, for example, teachers have to continuously interact with the audience while managing and moderating the exchange between the students. Teachers also have to possess a certain technological knowledge level and confidence to effectively configure and use the online conferencing tools in real time.

Asynchronous discussions, therefore, lower the stress of instructors and open more possibilities for the students. Online discussion forum, due to its asynchronous nature of exchange, sets standards for learners' public communication (Dignum & Vreeswijk, 2004), and discussion board assignments motivate students to learn about and from each other "through frequent conversations and debates on salient academic topics" (Fuster, 2017b). Participation in a discussion can be deemed "a crucial part of learning in general," effective especially in the context of language-learning (Schwab, 2011).

The centre of our prototype's pedagogical approach is discussion, the process that allows collective thinking, encourages collective decision-making, and allows students to "defend own position; identify problems, conflicts and inconsistencies; get feedback from/about students; draw on students' expertise and prior knowledge" (Eberly Center, 2023).

Among online platforms where a discussion can be developed, we considered such types as chats and discussion forums. Each has its own advantages and shortcomings, and we considered both forms before we opted for one of them

3.1.3 Building the Discussion Forum

3.1.3.1 Format selection: Group Chat vs. Forum

The first online discussion spaces appeared in the era of Web 1.0. Thus, Jones (1997) formulated criteria for a virtual community: a shared public space for sustained discussions between a number of participants with a substantial continuity of membership. The researcher, having studied the relationship between technology and online behavior, coined the term "virtual settlement": a virtual community's cyber-place with computer mediated communication (CMC). In his turn, Ekeblad (1999) regarded mailing lists as an earlier variant of online discussion platform, a "consumer-producer ecology" where the participants were a renewable resource.

Currently, chats and forums are two most popular methods of online communication that share a number of characteristics: both allow a group of people to exchange messages, both can be part of a social networking platform, and both can be used in an educational setting.

The online courses where communications tools—forums and chats—are used as a teaching format make "hiding behind the backs of peers" harder because all communication can be traced (Barak, 2012). On the other hand, shy students find it easier to communicate online because they have time to compose their message and do not have to conduct face-to-face communication. Importantly, online exchanges among students "serve as a way to generate communities of learners as well as professional communities."

Chats are considered best for conversations in real time: all the participants are usually present and communicate synchronously. The exchanges, therefore, are fast-paced, and the topics, too, can be changing fast. Forums, on their part, tend to be asynchronous and the participants do not have to be online at the same time.

Chats are usually structured linearly, so if a conversation changed topic, the exchange log will still continue as one long list of utterances. Therefore, to find a particular spot in the conversation, one has to scroll through a long page with messages. Consequently, due to the speed of the exchange, chats tend to have a "shorter lifespan": the text displayed in chats continually refreshes as new posts are added, and the chat log often looks like a fast running tape.

Forums tend to be organized hierarchically, with new themes or questions branching out in “threads,” or parallelly, with discussions separated into topics and listed on the main page of the discussion forum. Thus, forums preserve their content longer, the topics are archived and are searchable with keywords or user names. The forum threads usually look like web pages and are comfortable to read.

Chats, being fast and mostly synchronous, rarely have a person who would organize the conversation. When Chat-rooms are moderated, the moderators often have difficulty checking each message before it is displayed, and when they manage to do so, it significantly slows down the communication process. In open public chats, there might be filters that block spam or inappropriate expressions, and there are rules for the users to follow, if they do not want to be banned for posting unsuitable content.

Forums are often moderated, and the rules of exchange are usually listed on its main page. The slower pace of forums allows them to have moderators check messages before they are posted to ensure appropriateness and adherence to the topic of the discussion. In general, forums are a more formal setting: they usually require registration with a valid email address. Most forums display information on the user: the name, the avatar, the user’s post count, the date of registration, and a signature under each post. Overall, such a setting contributes to a sense of a stable community with shared interests.

From the technology perspective, chat conversations often take place on smartphones and are parts of a social network or a messaging system. The majority of chat rooms support the use of microphones or webcams, but not all chat applications allow attachments.

Forums are displayed as regular websites, and the use of microphones or webcams is rarely possible. To see the newly posted messages, one has to refresh the browser page. Forum format allows posting attachments: pictures and documents. Overall, forums are considered to be more computer-screen-friendly.

Considering all of the above, we chose the format of a discussion forum for our prototype as a more comfortable and welcoming learning space.

3.1.3.2 Structure of the Discussion Forum

The choice of software and decisions on the future forum structure were important because they were to shape the exchange and sharing of information between students and to provide artifacts, tools, and services. Technology directs learners to interact with their peers or directs how and when they should communicate, ask questions, and inform and motivate their interlocutors (Woolf, 2009). Thus, we had to choose among the types of forums for our project (announcement/news forum; general discussion forum; group discussion forum, etc.).

For the chosen general discussion forum, we then decided what types of activities would be allowed to users (reading, posting, and commenting) and how topics would be organized—chronologically as per Lessons (vs. hierarchically). Within the main discussion thread, comments or questions on a new topic started new subthreads, which is important for the legibility and orientation in the log. As Woolf (2009) observes, some collaborative environments provide a simple threaded discussion, but the imposed tree structure may be inadequate: "In threaded discussions, each participant submits an idea, with one contribution or note leading to another and discussions proceed along ever diverging lines as ideas branch out, and there is no systematic way to promote convergence" (Woolf, 2009).

The forums differ in their requirements for access to the message board (Fuster, 2017b). Most discussion forums do not impose strict posting rules: everyone immediately sees a new post, just like in a regular online chat. There are also forums, called "post-first" discussion, set up to require that students submit their own message before they can get access to what others have posted.

On the one hand, this format forces students to write more informative posts instead of just agreeing—silently or in a written form—with what others have submitted. In addition, this format motivates students to engage more actively in the collective work and express their opinion free from the influence of peers. Such motivation is especially important for the introverted students who would otherwise spend time as bystanders (Fuster, 2017b).

On the other hand, in a "post-first" discussion students risk repeating comments already posted. They might feel less confident, and even stressed, about asking questions (What if the issue has already been discussed?; or What if I will look silly asking the same question again?). In addition, such a format creates the divide between the offline classroom exchange, where everybody is in the context of the conversation,

and the online discussion, where students are not aware of what happened before they offered their opinions (Fuster, 2017b).

In our Discussion Forum, each new Lesson opened a new chapter where each new question or comment started a new thread. The "post-first" rule was not applied, so that the participants retained their right to choose between their Sender or Bystander status, both of which we consider acceptable and useful in an online classroom built as a discussion forum.

3.2 Course content: learning material and assignments

According to Kalisz (2019), when a large number of people perform a task, they perform collaborative learning. The role of the teacher in such a collaborative learning system is to provide information on available resources, help learners formulate their needs, and promote the use of a variety of study methods.

Fuster (2017) lists nine most common types of online classes assignments: 1. "Read or watch, then respond," similar to offline lecture-and-tests; 2. Research paper writing; 3. Exams; 4. Discussion forums, replacing in-class seminars; 5-6. Blogs and Journals; 7. Wikipedia-style writing, where students edit a shared document; 8. Case-based assignments; and 9. Self-paced individual assignments.

Eberly Center (2023) identifies a similar set of online classroom instructive strategies—Lectures, Discussion, Case Studies, Writing, Lad/Studios, Group Project, Recitation, Public Reviews, Service-earning, and Independent Student Projects—noting that teachers should be flexible and use a combination of the activities depending on the course objective.

In designing our course material, we considered educational activities that lend themselves well to discussion forums where chatbots can add value: collaboration and inquiry learning, which Woolf (2009) considers as two similar approaches. According to the author, in inquiry, students actively construct their own knowledge: they ask questions and collect data to support and refute hypotheses, which resembles scientific or historical research. In the process of a group inquiry, "students learn which questions to ask and how to make predictions from theories, test theories, and derive theories from data" (Woolf, 2009).

For our project, we modelled the assignments after Student Olympiad quizzes that usually include case studies, problem solving, and riddles. Such assignments open space for discussion on how to properly, and creatively, apply the theoretical material provided. In our online language class, the tasks included filling in the blanks, restoring the word order in a sentence, and restoring the sentence order in the text.

The questions/problems in the assignment represented the 1:1:1 ratio as to their difficulty level, which means that around 1/3 of the tasks (e.g. insert the right word in its correct grammatical form into a sentence) was relatively easy (Category 1); 1/3 – represented a medium level of difficulty (Category 2), and 1/3 was rather difficult to complete (Category 3).

We consider "Easy questions" (Category 1) as a necessary part of any quiz because they give a chance to all participants to manage at least a part of the given assignment independently. Category 2 questions provide participants a chance to apply an individual effort and to discuss them in a group, if necessary. Category 3 questions represent issues requiring a serious effort and, therefore, usually serve as a topic for group discussions. Teachers, as experts in their field, usually apply their pedagogical knowledge to classify the questions accordingly, so that students acquire new knowledge and skills keeping "positive dispositions toward learning" (Koehler & Mishra, 2009).

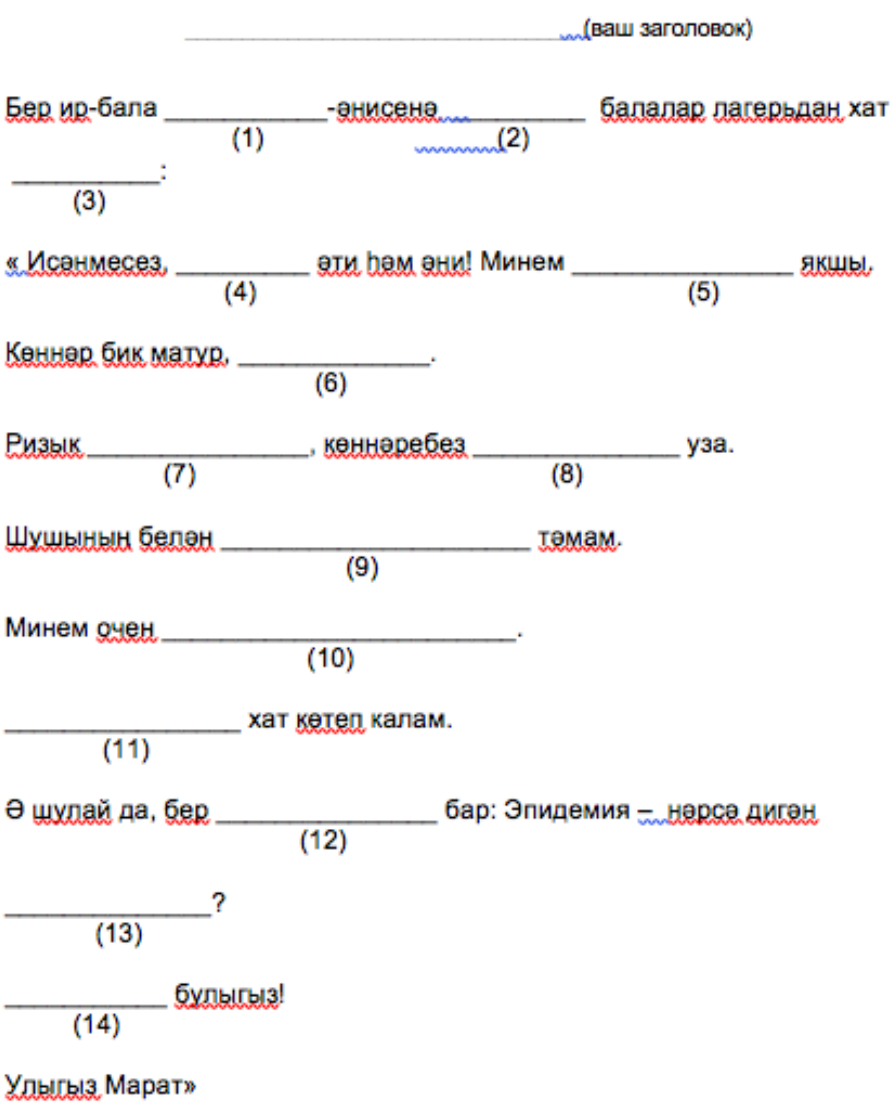
Consequently, the areas of the assignment that must be manipulated (words, numbers, or signs to be inserted into a designated space) were numbered or had letter codes assigned to them. Such coding—tagging—corresponded to the list of correct answers under the same codes. Such tagging served two functions: (1) the numbers/codes/letters are convenient for Students to refer to in the discussions and (2) they are used by the course designer to program/schedule the chatbot posts referring to a specific question.

Figure 1 features the assignment to Lesson 1 with 14 numbered (tagged) mini-tasks: numbers 1, 4, 12, 14 belong to Category 1; numbers 2, 3, 6, 7, 13 belong to Category 2; and numbers 5, 8, 9, 10, 11 belong to Category 3—all depending on the complexity of the task.

The learning material for each Lesson was divided into Vocabulary and Grammar Sections. The vocabulary was presented in an alphabetical order. The Grammar Section was divided into two parts—nouns/adjectives/pronouns vs. verbs—and covers the elements that occur in the respective texts. The texts grew in complexity with each Lesson.

According to Barak (2012), material for an online class “must be clear, concise, and well organized,” and the “course contents should evoke motivation to learn, enhance higher-order thinking, and induce self-directed learning.” We, therefore, found it important to ensure that the material to each Lesson was both concise and self-sufficient, and the Students were neither overwhelmed by the lengthy theory section nor required more detailed explanation to be able to complete the assignment.

Figure 1. Assignment to Lesson 1: tagged mini-tasks.



The self-sufficiency of the material is important also for the chatbots programming: the coded parts of the assignment and the material are to be used in programming the chatbot posts where questions and comments mention the issues correspondingly to their number/code.

In our prototype platform, a special Useful Resources section was added listing the resources that can be used both while performing work for the class and in the future studies: links to the best available sites on the subject matter, online dictionaries and reference material, online keyboards with special symbols, and the link to the language online corpus.

Overall, we consider it to be of utmost importance to find the right balance between providing comprehensive information and necessary tools on the platform and not overloading the space with elements that distract and hinder learning and concentration.

3.3 Peer-Chatbots in the Discussion Forum

Teaching an online course is demanding and, by placing the material online, teachers do not get free of their teaching obligations: they have to continue to support the students and monitor the progress becoming "guide on the side" (Barak, 2012). Interactions and interventions—responding to students' questions, following the exchanges on the forum, correcting assignments, directing the online discussions, and many other teachers' tasks—often prove to be more exhausting online than in the offline classroom.

We see peer-chatbots in a crowdlearning setting as enhancing tools, useful both for the teacher's work and for the students' efforts because they support discussions in many ways: "conversational interfaces powered by chatbots are an important breakthrough from the past of computer interaction because they naturally enable multiparty applications" (Candello & Pinhanez, 2017). Conversing with chatbots, users often "build social bonds" with the automated agent, so in education, chatbots may provide a more engaging and dynamic instructional exchange (Roos, 2018). Research suggests that chatbots may considerably improve students' information retention and improve learning outcomes.

The benefits of collaborative learning lie in discussions that stimulate participants' interest and allow each individual to express their point of view and ask questions. Hence the idea of integrating software in the form of chatbots into such discussion to support interest and to offer individual support when needed, as Dillenbourg and Self (1992) did when they developed their computational approach of "socially distributed

cognition" (SDC). The authors explored an approach different from the traditional instructional setting where a student interacts with and learns from an expert. Instead, the authors studied a system—a micro-world—with two students, a "human learner and a computerized co-learner," solving problems and thus learning (Figure 2, p. 69). In such a setting, according to the authors, "a group is a cognitive system," and learning takes place in the form of a dialogue.

In designing our platform with chatbots, we also considered Fryer's (2018) advice that chatbots should be designed as a "Learn-more" opportunity and not a "Learn-from" situation. This means that chatbots should not copy human interaction, but use their own strong points—knowledge and persistence. In our prototype, the knowledge is represented by the course designer's expertise and anticipation of the issues the students may encounter, and the persistence is in the way the message bots' scheduled interventions support the discussion.

3.3.1 Digital co-learners: peer learning and learning by disturbing

Having studied the literature on chatbots in education, we found that, amid the variety of chatbot roles, it is the role of companion (co-student, peer) that offers an array of interesting pedagogical opportunities. They are, however, still underexplored, and their potential has not been fully realized.

Among the research on automated co-learners, the Learning Companion System (LCS) by Chan and Baskin (1988) proposes a three-agent learning situation: cooperation between a human learner and a simulated learning companion. These two learners study together under the guidance of the tutor (the third agent). The companion and the learner perform the same task, exchange ideas about the problem and only ask the tutor for help if they cannot find a solution. The role of the tutor is to alternate between the problem presentation and the learner's solution critique: "the goal of the learning companion is to stimulate the student's learning through collaboration, competition and demonstration" (Chan & Baskin, 1988).

In this three-agent learning situation, Chan and Baskin (1988) propose applying the "learning by disturbing" strategy where a computer simulates two agents: a tutor and a "troublemaker" (the companion). The authors argue that, to provide reasonable competition, the troublemaker's skill level must be higher than that of the learner because, when in difficulty or doubt, the learner naturally turns to the teacher rather than towards the companion as the teacher is the authority on the matter (top-down

management). If the student considers the companion to be knowledgeable enough, then the problem can be discussed with the companion instead of the teacher (bottom-up creativity).

Similarly, Aimeur et al. (1997) describe intelligent tutoring systems (ITS) with a cooperative relationship between the system and the student: evolving from simple knowledge transfer to the constructive learning process. According to the authors, this trend creates new cooperative tutoring strategies, such as peer learning. Cooperative learning systems, also called social learning systems, employ the computer as a partner rather than a tutor. Several agents, simulated or human, can work on the same computer or share a computer network.

Contrasting two approaches—peer learning and learning by disturbing—Aimeur et al. (1997) find that they share some similarities. The only difference is that the learning companion in the second approach is not just a cooperating fellow-student, but a deliberate "troublemaker." The authors link this strategy to the theory of cognitive dissonance and suggest that such simulated students must possess pedagogical knowledge to effectively plan their interactions.

It should be noted that the chatbots employed in the above-mentioned research were explicitly artificial agents. We are of the opinion, however, that the "chatbot-troublemaker" and the "chatbot-tutor" have a potential to play their educational roles better, if students perceive them as humans. Integrated into a discussion forum as regular participants, peer-chatbots can productively contribute to the discussion, not attract particular attention, and not cause human-machine perception problems.

3.3.2 Dialogue vs. multilogue/discussion communication

Based on the number of the participants and their roles, Shank (1993) identifies three types of communication: monologue, dialogue, and multilogue. Understandably, chatbots are built for either dialogues or multilogues.

A typical dialogue consists of a series of utterances, where all, or most, contributions are "both backward directed to the preceding contributions and forward directed to the next contribution" (Allwood, 1994). Dialogues between human interlocutors are usually reciprocal: the partners are expected to contribute equally to the conversation (Følstad et al., 2019).

It is important to point out that the majority of chatbots are designed to conduct a dyadic dialogue: a conversation between two interlocutors who take turns, an interaction between a single chatbot and a single user (Candello & Pinhanez, 2017). In most cases, chatbot dialogues proceed according to a strict scenario where each partner plays a distinguished role of either a leader or a follower; consequently, there are two principal models: a Chatbot-driven dialogue and a User-driven dialogue (Følstad et al., 2019).

For most commercial chatbots (customer support, recommendations, and personal assistant chatbots), the basic model of such dyadic two-sided conversations is a single-turn exchange between the Sender and the Receiver, where it is usually the User who asks a question (being the Sender) and the Chatbot who responds (first playing the role of the Receiver, and then the Sender), thus completing the interaction on a chosen topic (Roussou et al., 2019; Shank, 1993). Contrary to such User-driven models, content curation chatbots actively guide users to a particular content, and chatbots for coaching help users with a specific task (Følstad et al., 2019), and such interactions are, therefore, considered Chatbot-driven.

A group discussion, hereinafter referred to as just "discussion"—defined in various studies also as a multilogue (Shank, 1993), a multi-party dialogue (Dignum & Vreeswijk, 2004), a multi-user interaction (when more than one user is engaged in the same activity with one application), or a multi-person conversation (Candello & Pinhanez, 2017)—is an interaction of a number of interlocutors, where an individual Sender addresses multiple Receivers, and the Receivers take turns as Senders (Shank, 1993). A discussion, both offline and online, usually has a Starter—the initial Sender—who starts a Topic (in an offline format) or a Thread (in an online format).

Considering the differences between dialogues and multilogues, Nagda et al. (2008) observe that while in dialogues the interlocutors' identities and differences are key to the communication; in discussions the participants do not usually pay attention to identity, status, or power. Also, in a dialogue one listens to the other to connect, understand, be convinced by the other's opinion, and modify one's perspective; and in a discussion one usually listens with a goal of getting a chance to "insert one's own perspective," giving little significance to other participants. Finally, in a dialogue the goal is to arrive at a common goal, an agreement; although in a discussion, as Nagda et al. (2008) note, "the more perspectives voiced, the better."

A multilogue is a complex communication format, and it functions as a combination of a variety of roles. As Dignum and Vreeswijk (2004) note, a multilogue is not just a number of dialogues running in parallel: it gives rise to a range of participant roles, such as group addressers (the Senders), overhearers, and bystanders, the latter two being the Receivers but with different intensity of involvement. Ekeblad (1999) sees online multilogues as a self-regulating process of interaction between "distributed agents": readers, writers, and texts. In such communities, active contributors can become read-only participants and vice versa, and it takes time for many to feel comfortable, "at home," in the environment.

Furthermore, in multilogues, differences in participant status also result in different obligations for the participants (Ginzburg & Fernández, 2005). From the dialectic perspective, Dignum and Vreeswijk (2004) distinguish two opposites in a two-party dialogue: a proponent and an opponent. The multi-party dialogue demonstrates a different type of interaction and role distribution: "neutral party, interested party, interviewer, advocate, respondent, examinator, challenged party, mediator, or arbitrator." Consequently, the agent's role determines the responses: mediators, for example, offer alternatives or request additional information following the first argument exchange; and the social role of a chairperson includes commanding over the turn taking, the access and exit of the participants, and the termination of the conversation.

Finally, Dignum and Vreeswijk (2004) consider conversations, both dialogues and multi-party communications, from the point of view of the interests of the participants. In both types of exchanges, there can be participants who are interested in reaching an agreement, in disrupting the negotiation, or in extending it indefinitely.

Organizationally, conversations can represent open and closed systems (Dignum & Vreeswijk, 2004), where dialogues are considered closed systems because both participants must be present for the dialogue to happen. The more parties involved in an exchange, the more open the system: in online news groups, for example, the participants freely join and leave the conversation and are not obliged to stay till its end. If there is an expert or a group of experts in a news group, they normally make only a small part of the exchange, and they are usually the only party who stays until the conversation is completed.

There is an important difference between an offline and online discussion too. In face-to-face group conversations, the Sender (for example, a teacher in a classroom) can easily control and direct the

conversation. Online, on the contrary, once the discussion has started, the Sender can lose control of it because the responses are not based on turn taking (Shank, 1993).

Ekeblad (1999) observes that scholarly and educational online interactions exhibit cycles of "concentrated beginnings and distracted endings," and online multilogue undergoes swings between distinct phases of intense discussion, topical divergence, and diminishing interaction frequency. Understandably, in an open setting of a multilogue it is rather complicated to establish whether the discussion has arrived at a conclusion (Dignum & Vreeswijk, 2004). Baldwin (1996) considers online discussions to be a particular conversational model, a "hybrid form of writing," a "polyphonic (multi-vocal) composition" where themes are related, but at the same time different, expressed by several voices taking turns and marked at the end by an "open-ended climax rather than a conclusion."

Evidently, different communication settings not only dictate different scenarios, roles, and characteristics of chatbots but also offer an array of the potentially effective pedagogical approaches.

3.3.3 Chatbots in multilogues/discussions: conversational style and linguistic qualities

As for the linguistic properties of chatbots for our project, our assumption was that multilogues did not demand that peer-chatbots communicate in a perfectly coherent written speech: their "voices" would only be part of the "choir" where the participants would not pay too much attention to the linguistic qualities of the polyphonic exchange. Thus, the designers of the AutoTutor, Graesser et al. (2005), observe that, usually, the tutorial dialogue is not very constrained and, therefore, the tutor has a great deal of latitude on what can be said without interrupting the conversation. In this sense, the conversations of a tutor are quite flexible. In general, humans don't expect perfection when exchanging messages online, and therefore, the presence of linguistic imperfections in chatbot messages would serve the purpose of the peer-chatbot disguise.

Regarding the linguistic qualities of chatbots, Radziwill and Benton (2017) question one of its attributes: the ability of a chatbot to pass the Turing test. The authors observe that, for most researchers, this is a top priority, but others do not give it as much importance. Yet, in general, the task of "passing as a human" offers several conversational and behavioral aspects to consider, for example, *What does it mean to "sound human"*?; *Is it being perfect or imperfect, coherent or slightly incoherent, strictly logical or slightly illogical*? In our prototype, we determined that peer-chatbots would pass the Turing test, if they "behave"

and “interact” like other students in the online classroom, i.e. they should sound casual but not “too perfect” in their utterances.

Another important linguistic quality of a chatbot is its ability to process repairs—clarifying different forms of misunderstandings during conversation. Undoubtedly, the ability of a chatbot to ask for clarifications, to produce statements causing problems of understanding, and even to “self-correct” would contribute to its “human image.” Indeed, as observed by Corti and Gillespie (2016), for a successful interaction, it is necessary that the interlocutors engage in self- and inter-repairs during their exchanges. The authors point out an important fact: individuals make more “intersubjective” efforts to establish common ground, i.e. produce more repairs when interacting with an agent they perceive as human. In our prototype, the peer-chatbots were part of a discussion, and therefore, the issue of repairs was not as pressing, as in a dialogue setting.

Overall, as Grudin and Jacques (2019) note, chatbot linguistic problems are mitigated by social media, which led to the spread of social bots, and “Twitter’s telegraphic message style made simulating a human easier.” As for the conversational style of chatbots, it is dictated by the fact that discussion forum posts, although following certain linguistic standards, are usually formulated in a casual manner (Fuster, 2017b).

We decided, therefore, that two main linguistic characteristics of peer-chatbots in our system would be staying within the context of the given conversation and sticking to one's own style of speech. Of course, in more sophisticated future systems, such an approach should develop into a more detailed strategy and certain qualities would be added to the list of the peer-chatbot desired properties. For our prototype, however, we considered the above-mentioned characteristics to be the most relevant.

3.3.4 Chatbots in multilogues/discussions: technical complexity

The question of technical complexity of chatbots is closely linked to the specific task the chatbot is intended to perform. As Makasi et al. (2022) maintain, effective chatbot-mediated service requires a suitable type of chatbot. The authors classify chatbots in public service matching their technical properties and capabilities—from basic (rule-based) to advanced (AI-powered)—with the levels of sophistication and complexity of the kinds of service they provide: from triaging to information gathering and analysis to service negotiation. Depending on the context and setting for each service type, the task can be achieved by both basic and advanced chatbots.

Rouse (2022), describing different levels of chatbot complexity, distinguishes the two main ones: static (stateless) and dynamic (stateful). A static chatbot approaches each conversation as if it interacts with a new user. In contrast, a dynamic chatbot can revisit past interactions and frame its new responses in the current context. Since this type of complexity is not a simple static-dynamic dichotomy, but a range (there are also semi-static chatbots, "loyal" chatbots, etc.), the degree of complexity is decided based on the needs of different types of conversations.

Considering the key characteristics of multilogues (a variety of participants' roles, interlocutors' role switching, open nature of the communication setting, theme divergence, discussion intensity fluctuation, and frequent lack of conclusion), we argue that the acceptable complexity range for group discussion chatbots is significantly larger than for the chatbots designed for dialogues. By "larger" we mean the possibility for even the simplest message bots to make a meaningful contribution when used in a discussion forum.

A chatbot for a multilogue, therefore, may be less complex but no less effective. In a group discussion each participant has a right for an utterance and, at the same time, no one is obliged to contribute. Unlike a dialogue, a multilogue is a forgiving setting, where errors, interruptions, and inconsistencies happen without causing a disruption of the overall collective conversation. The contributors' utterances often deviate from the topic, contain linguistic errors, or do not quite make sense—all that without causing unease or surprise among the peers. Consequently, in such a setting, linguistic or contextual shortcomings of chatbots often pass unnoticed; moreover, teachers (or developers) may even consider "planting" some errors in their chatbot utterances for them to "sound more human."

An online learning environment organized as an online discussion is, therefore, a favourable setting for the use of chatbots positioned as peers that assist the Teacher in implementing a particular pedagogical scenario. In this setting, the chatbot technology's limitations are minimized and its advantages are fully exploited. A chatbot for a group discussion can be developed simply by using a rule-based chatbot platform or even a group post bot and still contribute appropriately to the dynamic and evolution of the collective online work.

3.3.5 Chatbots in multilogues/discussions: highlighting the benefits and transforming limitations into advantages

Research relating to classifying chatbot technology has not been unanimous as to how many different types of chatbots have been successfully developed and deployed. One of the most important classification criteria being its area of application, it is obvious that business and commerce spheres are in the lead. Within the educational sector, however, chatbot technology is still in its early stages of development, and, therefore, users should experiment with it to determine the benefits and shortcomings of chatbots in this particular sector (Beckingham, 2019). In the case of our prototype, we tested, among its other aspects, the practicality of not revealing the digital, artificial, nature of the peer-chatbots.

The chatbots in our project are viewed as conversational agents hidden behind the avatars of the discussion forum participants. This approach aims to provide the teacher with a teaching tool that channels productive ideas and directs collaborative work in the right direction without the top-down pressure. For learners, these chatbots are to serve as tireless and stimulating co-students, and not revealing their digital nature aims to not raise the question of the human-machine relationship.

Many studies explored the difference in perception of interlocutors vis-à-vis humans and conversational applications, and the results are contradictory. For example, the research by Brandtzaeg and Følstad (2018) concludes that successful chatbot projects are those where the users are informed about what to expect from the beginning: “they are transparent about who the users are having a conversation with—that they are interacting with a chatbot and not a human.” On the other hand, as Dale (2016) points out, users of commercial sites tend to stop paying attention to the identity of their online interlocutors. Furthermore, Barot (2017) describes the tendency of users to perceive chatbots as individuals.

Corti and Gillespie (2016), having explored misunderstanding repairs, found that interlocutors are less likely to initiate repairs when they know their interlocutor is a digital agent. This is an important finding, as it suggests a potential limit for humans’ acceptance of artificial agents, hence a conclusion: if one day the roboticists build “a machine that is indistinguishable from an actual human in terms of appearance and communication […], the mere knowledge of it being something ‘artificial’ might suppress the amount of intersubjective effort people exert when interacting with it” (Corti & Gillespie, 2016).

Grudin and Jacques (2019) write about Humbots (HUM-ans and chat-BOTS)—human-computer symbiosis—when humans act as invisible chatbots partners and vice versa. These phenomena gave rise to a number of ethical debates over situations where people thought they were dealing with a chatbot or, on the contrary, that they were conversing with a human—and in both instances they were mistaken. According to the authors, it proves effective for software and people to work interchangeably more and more as the humans embrace technology.

We considered it practical, therefore, to explore the functioning of a peer-chatbot in a discussion forum where it is perceived by the students as just another participant. As Ekeblad (1999) and (Shank, 1993) note, online social interactions tend to be incoherent in turn-taking and topic development, which we view as an advantageous setting for a peer-chatbot. Online discussions are asynchronous; all the posts are listed chronologically; and no participant feels interrupted. At the same time, any new post by any participant can start a new topic and begin developing a new thread.

As Ekeblad (1999) suggests, written conversations, "this distributed and loosely coordinated medium," have a learning potential where small interventions, "organized episodes," and "the right timing" can produce considerable effects. In an online discussion, therefore, the teacher is free to schedule the peer-chatbot to publish a post according to the adopted pedagogical strategy—underlining an important issue or changing the conversation direction altogether—and the peer-chatbot's utterances integrate seamlessly into the thread, contributing to the bottom-up creative process.

Theme divergence, discussion intensity fluctuation, and acceptable lack of conclusion are also the multilogue characteristics favouring integration of peer-chatbots into an online classroom based on collective learning. The chatbots can publish emotionally-laden or humorous posts to make other students feel more at ease and welcome both to participate in the discussion or to just listen and learn from it. Also, in a discussion group populated with peers, the peer-chatbots are part of the group; they "look" and act just as any other participant and do not cause unease that some people feel when communicating with a machine.

Our prototype can, therefore, be seen as an attempt to circumvent both the problem of top-down governance on the part of teachers and the problem of rejection of artificial companions by learners. The online environment of collective learning and the hidden nature of chatbots that we advocate may allow,

in our opinion, to showcase the advantages that chatbots have to offer and to overcome the problems that this technology has not yet solved.

Thus, in our learning platform, we aimed to demonstrate that an online discussion setting is a format that highlights the key advantages of chatbots (versatility, subject-knowledge, and indefatigability) and helps to overcome, to an extent, their shortcomings (users' reticence towards interaction with a machine, users' difficulty to establish emotional connection with the machine, and various kinds of technical limitations).

3.4 Modelisation

Certain forms of collaborative learning incorporating human and digital agents as learning companions have already been explored. Vanlehn et al. (1994), for example, studied the opportunities offered by learner simulation systems where teachers improve their practices on simulated students; learners work collaboratively with a simulated peer; and finally, instructional designers test their products on simulated learners.

Vizcaíno (2005) describes an architecture called the Simulated Learner used in a collaborative and synchronous system for learning computer programming. The architecture is designed to detect and avoid three situations that diminish the benefits of collaborative learning: off-topic conversations, passive learner behavior, and various learner learning issues. Such architecture proved to be adequate for the majority of learning situations.

In our prototype, we used two additional student accounts for the first part of the experiment in the Wizard-of-Oz manner. In the second part of the course, those accounts were used as automated message bots imitating integrated peer-chatbots, Student-Chatbots, into the online discussion classroom. We deployed a user-friendly Telegram bot allowing scheduling posts with questions and comments that appeared as posts published by the designated Student-Chatbots. Such an approach offered an uncomplicated way to preprogram messages according to a chosen scenario to stimulate the discussion among the students and to optimize teacher's time and efforts.

We decided that at least two Student-Chatbots should be engaged in the discussion, so that the options of pedagogical interventions are not limited to one artificial student's "character." If the class size is small and there is a need to create a more populated environment for students, teachers may choose to engage

three or more peer-chatbots, which would provide more options for scheduling various additional "interactions" in the virtual classroom.

There are two reasons that prompted us to use two chatbots: the pedagogical approach of having a Tutor and a Disturber in the classroom and the need to mitigate the limitations of such automated classroom assistants. It is becoming a common practice to test and use a combination of chatbots for various projects, commercial and educational. In the situation when a chatbot manifests inconsistency or provides an inadequate response, the user can lose interest in continuing the conversation (Fryer et al., 2019), therefore, until more robust chatbot technology is introduced, using multiple chatbots can be a solution (Candello et al., 2017). Several chatbots offering different answers or asking different questions might provide learners with an acceptable amount of information to support learning (Fryer et al., 2020).

The major functions of Student-Chatbots on our platform were 1) populating the forum; 2) starting a discussion; and 3) directing the discussion by asking the "right" questions and thus stimulating participation of peers.

As to the function of "Populating the forum": the moment the students log in into the forum, they see that there are other "students" there. This makes learners "feel welcome" and helps teachers avoid the situation when their students feel lonely in an "empty classroom" in the beginning of the course.

Concerning the "Starting the discussion" function: a chatbot can be an invaluable teacher assistant tool when it publishes, as just another learner, questions and comments in the discussion thread thus providing an incentive for other students to publish a response or a new question in the forum.

Finally, as for the "Directing the discussion" function: the chatbots are scheduled to ask questions concerning the points that the teacher expects to be problematic; to post "thinking-out-loud" comments with a potential to stimulate discussions of peers; and, finally, to ask "silly questions" or post "ask-for-help-cries" that motivate students to provide explanations to their "distressed peer" thus improving their own understanding of the subject.

The online classroom based on crowdlearning that we built is an example of an online multilogue where the participants are not structured hierarchically. The roles in such an educational setting are assumed by the participants and are based on their activity: Sender and Receiver. The latter can be either an Active

Listener (a potential Sender waiting for the turn) or a Passive Listener (Bystander) with no intention of active participation in the exchange. The roles are in a constant flux, and Passive Listeners can switch roles with Active Listeners, and, consequently, Senders and Receivers continuously change their positions. In such an environment, therefore, chatbots can serve as educational assistants, the role that does not oblige them to deal with every complex question (Molnar & Szuts, 2018).

Educational chatbots in our multilogues often switch roles too. Depending on the education scenario, a chatbot in such a setting is supposed to be able to initiate and maintain a collective conversation performing two main conversational roles: (1) Sender: provide a statement / ask a question; (2) Receiver: provide a comment to a statement / answer a question.

Horizontally fluctuating roles of the participants lower the chatbot performance expectations, allowing the chatbot to be "spontaneous" and not necessarily obligated to offer a reply to each utterance in the conversation. The Student-Chatbot can thus be programmed to intervene in the multi-voice communication to "insert its own perspective," as Nagda et al. (2008) defined it. The Student-Chatbot's perspective is, of course, the Teacher's: the Chatbot's utterances—comments or questions—are the ones that the Teacher considers useful and productive for the group activity and would like them to be published without exercising the Teacher's top-down authority.

The above-mentioned features of an online educational multilogue and the open nature of such communication setting create a "comfortable" environment for a chatbot positioned as a peer to the participants: a low-cost rule-based chatbot or even a scheduled messenger bot can be seamlessly integrated into a collective of learners discussing their assignments online.

3.4.1 Platform: architecture

For our project, we considered the general architecture of a human-computer collaborative learning (HCCL) system (Figure 2) by Dillenbourg and Self (1992) and MOCAS (Figure 3) by Blanchard and Frasson (2007).

The HCCL contains a microworld, in which a human learner collaborates with a computer-based learner. The authors call such collaboration "socially distributed cognition" (SDC). According to Dillenbourg and Self (1992), the objective of this model is to foster "authentic collaboration": "The co-learner has no access

to any hidden expertise and it has not hidden didactic intention: it asks questions to get the answers, not to check if the learner knows the answers." In HCCL therefore, a human learner and a computer-based learner, the co-learner, collaborate to learn from their experience.

Such a HCCL comprises five components: (i) a microworld; (ii) the human learner; (iii) a computerized "co-learner"; (iv) the interface through which learners interact with the microworld; (v) the interface between the two learners. The authors argue that, to some extent, any interactive software can be considered an HCCL system: "For instance, an expert system request for complementary data may be considered as a collaboration act. However, a collaborative system supposes a symmetrical interaction among learners: the same range of interventions must be available for both learners" (Dillenbourg & Self, 1992).

Figure 2. HCCL defined by Dillenbourg & Self (1992).

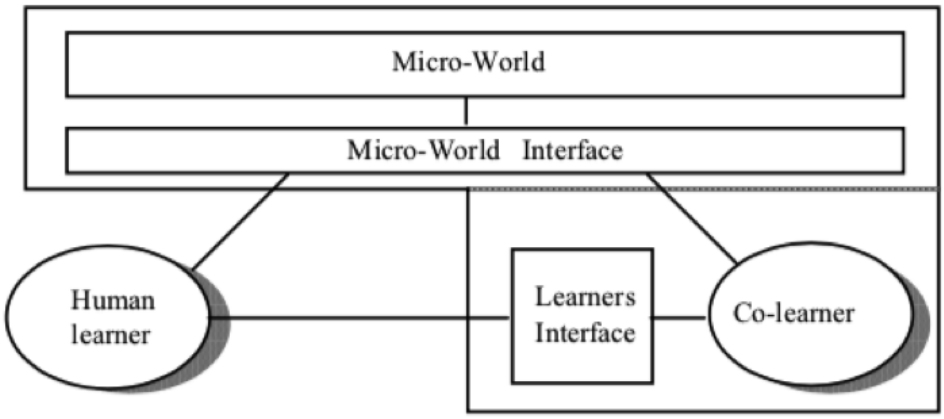
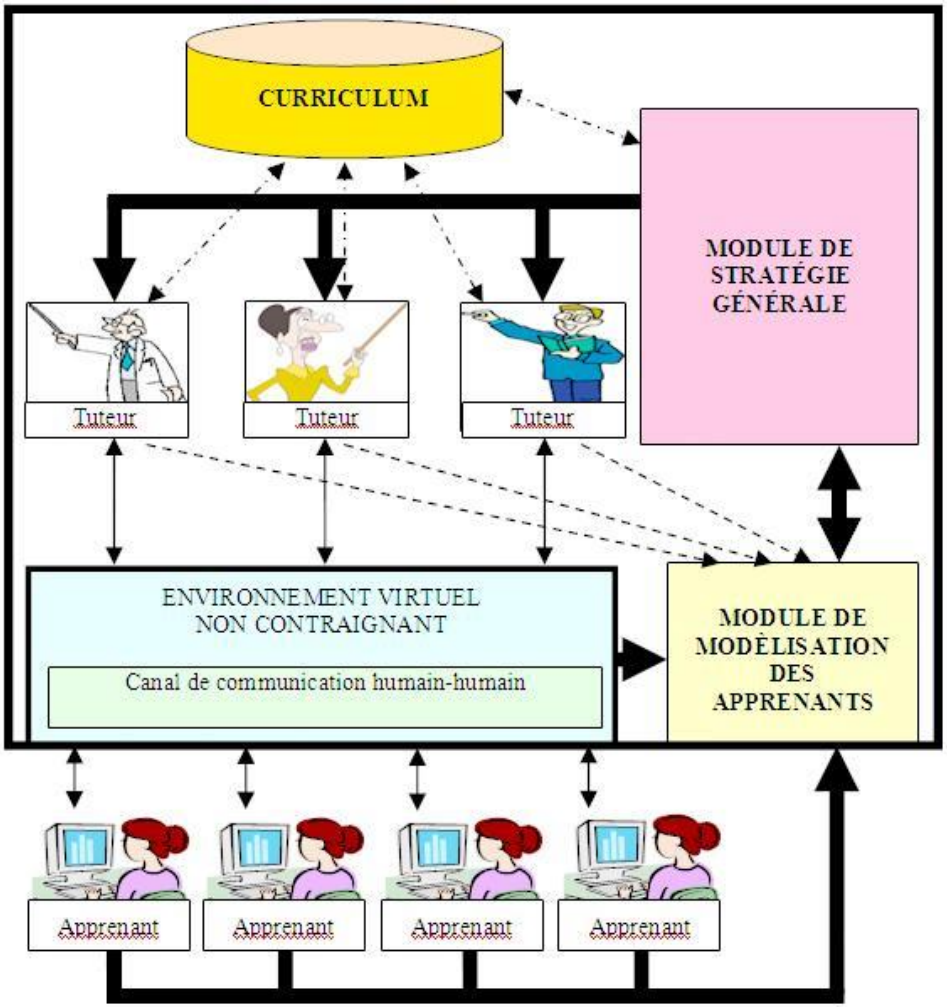
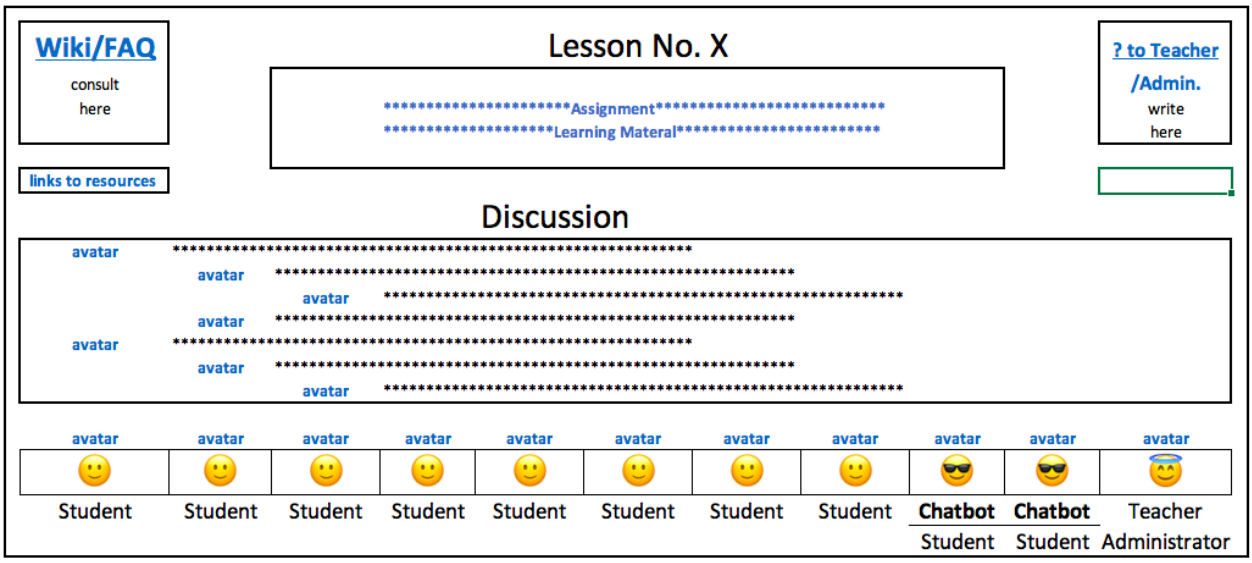


Figure 3. MOCAS by Blanchard & Frasson (2007).



The modular architecture of MOCAS (MOtivational and Culturally Aware System) of Blanchard and Frasson (2007) on Figure 3, which derives from the classic modular architecture of an Intelligent Tutorial System, integrates several pedagogical agents ("tutors" and learners), as well as learner models.

Figure 4. Prototype of the Discussion Forum with peer-chatbots.



In our system (Figure 4), the main actors are Administrator and Students, including the Real Student and the Virtual Student (Student-Chatbot), i.e. the peer-chatbot.

Student

Real student: enrolled in the course, who participates in crowdlearning – publishes their work, reads and comments on the work of peers, votes for the work of peers and asks questions to the Course Administrator.

Student-Chatbot: is managed by the Administrator, who contributes to crowdlearning – publishes his works, scans, and comments on the works of peers, votes for the works of peers.

Administrator

Teacher: creates the course, modifies it, manages it and answers questions from Students.

Teacher's Assistant: manages the course and answers questions from Students.

In our prototype (Figure 4), the Discussion Forum space is what Dillenbourg and Self (1992) named "Microworld" in their HCCL (Figure 2) and what Blanchard and Frasson (2007) entitled "Unrestricted Virtual Environnement" (Environnement virtuel non contraignant) in their MOCAS (Figure 3).

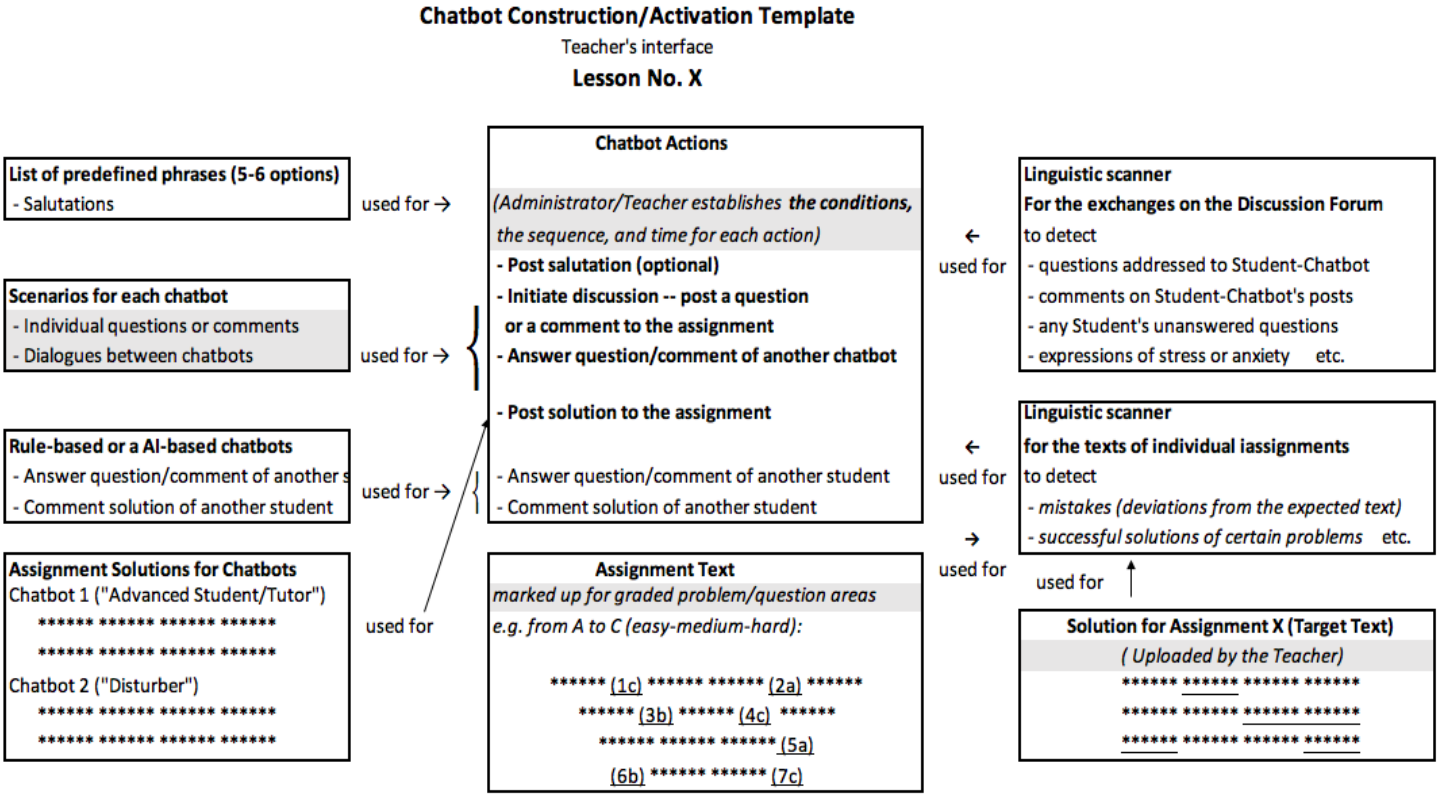
Our Virtual Students represented by Student-Chatbots act like the "Co-Learners" in the HCCL system by Dillenbourg and Self (1992) performing the roles of "Tutors" of the MOCAS by Blanchard and Frasson (2007).

Thus, based on previous Intelligent Tutoring systems architectures and using contemporary technology tools, our prototype is an attempt to take another look at the learning space and rearrange the roles of actors of a traditional classroom.

3.4.2 Student-Chatbots: Interface

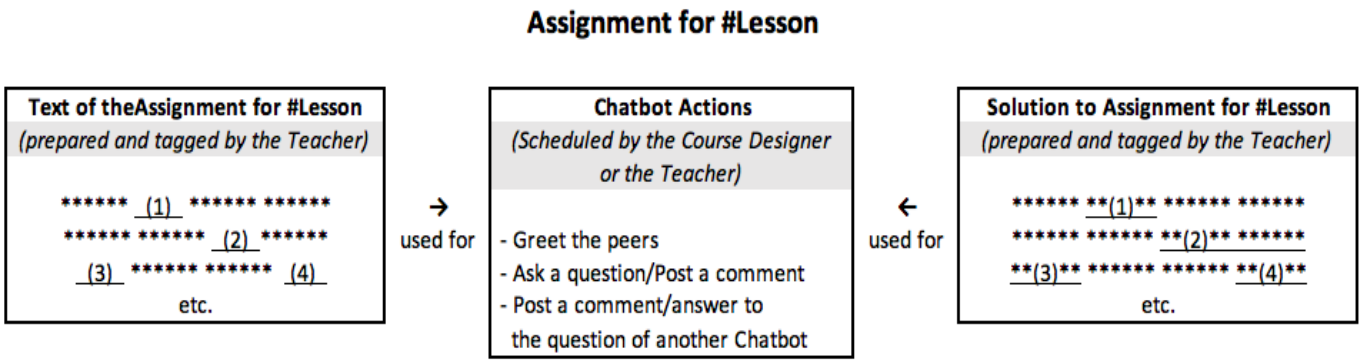
In a high-fidelity prototype, the envisioned platform is to be equipped with a simple and self-explanatory interface that encourages and empowers any average-computer-user teacher (Figure 5). The rule-based chatbot is to be equipped with a linguistic scanner and to have access to the tagged texts of a lesson to be able to not only publish its own posts or answer the posts of another chatbot, but also react to posts of Real Students.

Figure 5. Interface for Student-Chatbot programming for a fully developed model.



In our medium-fidelity prototype, however, the message bots were programmed for publishing their own posts, individual and imitating exchanges between themselves (Figure 6).

Figure 6.Interface for Student-Chatbot scheduling for the medium-fidelity prototype of this study.



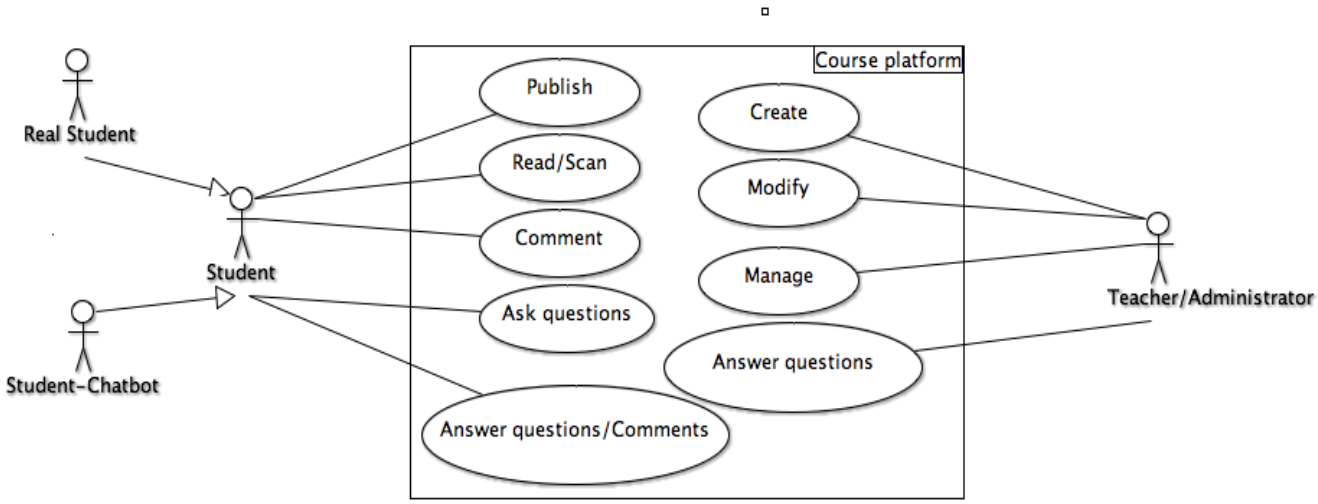
For the purpose of the study, such reduced functionality of automated interlocutors proved sufficient for testing the overall principles of the online classroom architecture.

3.4.3 Student-Chatbots: Use Case

The general Use Case describes the packages of the considered system: there is a generalization/inheritance relationship between the Student actor and the Real Student and Student-Chatbot actors. It is customary for social network users to have accounts with their real-life pictures. In a discussion forum learning platform, therefore, both students and chatbots would be expected to create profiles featuring their photos. Research on educational chatbots, however, suggests that an educational chatbot presented as “an agent without an image” or “an agent with a static image” is better accepted by learners (Heller & Procter, 2009). In our case, the platform designed as a social network features all the learners as avatars, which, on the one hand, ensures the safety of the learners and ease of expression (Lu, 2011) and, on the other hand, allows the integration of peer-chatbots in a less problematic and more natural way (Figure 7).

It is important to distinguish between the two actors: Real Student and Student-Chatbot (Figure 7): although their use cases share most of the actions, their purposes and functions are different.

Figure 7. Student Use Case.



Description of the Use Case "Participate in crowdlearning":

Goal: To acquire the knowledge/skills in the framework of the online course.

Actor: Real Student

Pre-conditions: Have a valid account associated with the online course.

Description: The Actor, represented by an avatar logs in the platform (course site) to view and download assignments, to read and comment on them, to publish his work, to read and comment on the work of other Actors, to read the comments to his/her works, to answer comments, and to vote for the works of the other Actors.

Post-conditions: The Actor has published his work; he/she read the comments to his/her works; he/she responded to comments by other Actors; he/she read and commented on the work of other Actors; he/she evaluated the works posted by other Actors.

For our crowdlearning platform, we considered it to be both productive and cost-effective to use a scheduled post bot for two Student-Chatbots accounts to perform the roles of both the Sender and the

Receiver-turned-Sender: (1) start a topic / ask a question and (2) provide an answer / provide a comment. The limitation in our prototype is in the fact that the second action is possible only for the exchange between the Student-Chatbots. In both scenarios, the pedagogical goal is to initiate a discussion on the assignment's problematic issue, focusing students' attention on a potentially problematic element of the subject, or turning the students' discussion in the more productive direction.

Description of Use Case "Contribute to crowdlearning":

> **Goal**: To help Real Students acquire the knowledge/skills in the online course.
>
> **Actor**: Student-Chatbot.
>
> **Pre-conditions**: Be programmed to perform the duties associated with the roles of an "Advanced Student/Tutor" and "Struggling Student/Troublemaker."
>
> **Description :** The Actor activates on the course site to publish its work, to scan and comment on the work of other actors, and to scan and answer comments to its work.
>
> **Post-conditions :** The Actor published its work; it scanned the comments to its works; it responded to comments on its works; it scanned and commented on the work of other actors.

Every message in any online discussion is an invitation to contribute to the conversation and can "trigger this chain reaction" of comments. In such a setting, the shared conversation is sustained by the "collectively achieved timing of messages," as well as by writing-and-reading time of the participants (Ekeblad, 1999). Certainly, the limited nature of such Student-Chatbots would not allow them to automatically "answer" or "comment" other students' utterances. The Teacher, however, has the power to choose the Student-Chabots' topics and schedule publishing of those questions and comments concerning the assignments thus triggering other participants' reaction and directing the discussion according to the pedagogical scenario.

Ekeblad (1999) observes that active contributors in online discussions often assume roles of facilitators, drawing new participants to conversation and obtaining more visibility in the discussion. In our prototype, such a setting allows creation of a "dialogue" between such accounts, which attracts attention of other participants to the issues that the Teacher wants the Students to reflect on.

Fryer et al. (2020) maintain that, in language learning systems, multiple chatbots posting their own contributions—comments and questions—might provide students with appropriate information and encouragement. It is important, however, to equip each chatbot with the right "character" and to ensure the balance between the chatbots personalities for them to interact successfully in a group. Not all multi-bot systems turn out successful: if their roles are not properly defined, their interaction between themselves and with the User can prove to be confusing (Tan & Liew, 2022).

It is worth noting that our choice is dictated by the time and resource limitations, and a wider and more in-depth research should be conducted with a more sophisticated chatbot application. Nevertheless, using a simplistic version of a group chatbot in the form of a scheduled post bot can be considered a reliable tool for testing the architecture. In addition, it is a free and user-friendly online application that can be deployed by any course designer and teacher without any special IT skills.

3.4.4 Students-Chatbots: Scenarios

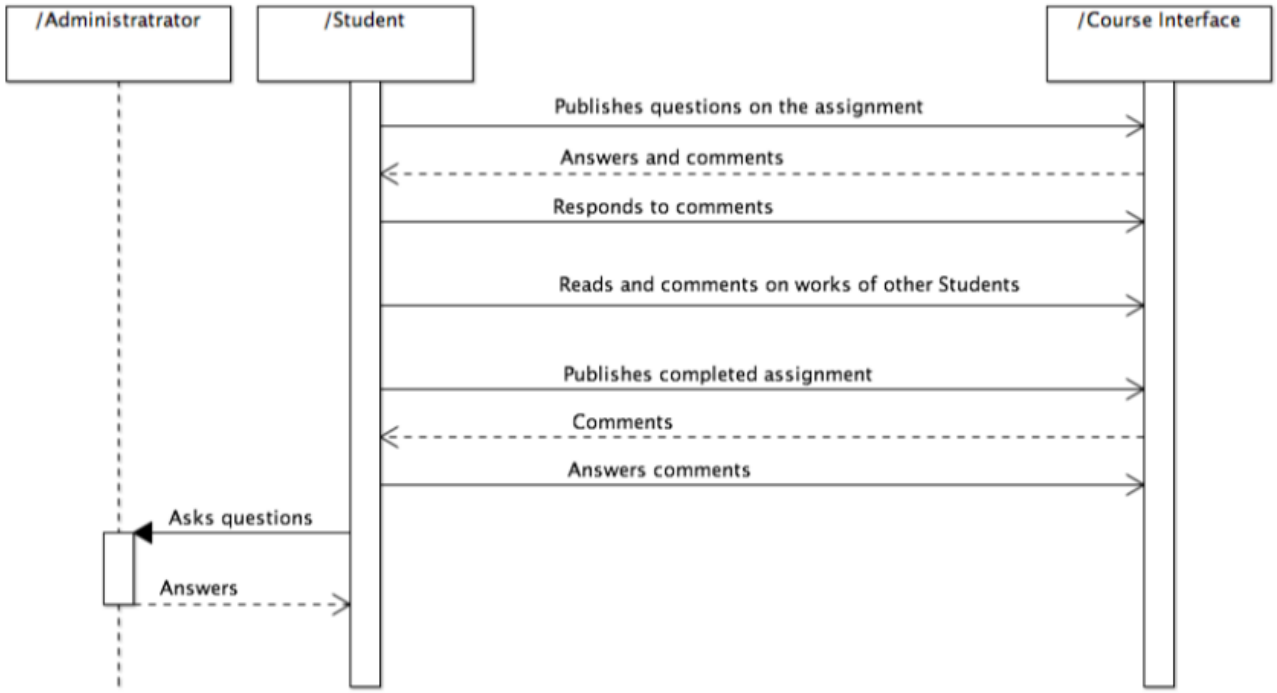
According to Dignum and Vreeswijk (2004), if in a commercial inquiry dialogue, the Client is looking for an answer with the help of the agents, humans or chatbots; in educational discussions, "know-unknown" structure is different: "the Teacher has planned the beginning and the end of the discussion, i.e. the assignment is presented and the desired outcome is expected." In an educational scenario, therefore, the importance is not in the solution, but in the path to the solution, "which is at the same time the learning process." During the teacher's career, such situations are repeated numerous times, and the teacher is often able to predict the most common discussion path and expect the desired outcome.

In multi-party dialogue scenarios, several agents cooperate in search of a solution, and "each of the agents might have a part of the solution, but only their interaction might reveal how to combine all the pieces of the puzzle" (Dignum & Vreeswijk, 2004). Such a scenario usually consists of an unlimited number of agents that communicate concurrently. The multi-party dialogue scenario accommodates a forum where all agents interact. Although the forum is a passive medium, it is responsible for managing and administrating participants and their exchange. Multibot chat systems can be populated with chatbots performing different roles (a moderator, experts on different products or services, etc.), and all may participate in the same dialogue with one human interlocutor (Candello et al., 2017) or a group of individuals.

The Student-Chatbot scenario in our Discussion Forum proceeds similarly to the multi-party dialogue scenarios of Multibot chat system, studied by Dignum and Vreeswijk (2004): it starts with an inquiry dialogue; the agents are equivalent and are not assigned specific roles; the communication takes place in a central medium, the forum, where the messages are public and are not addressed to specific agents; "each agent may be in a consumptive mode or in a productive mode": reading the forum and publishing questions; and, characteristically to multilogues, there is no determined termination to the exchange between the agents. In addition, our scenario includes the login process, and, contrary to the above-mentioned system, the agents in our prototype do not perform a fixed number of rounds.

As Fryer (2018) notes, learners certainly show interest in studying with chatbots, but for communication activities, users mainly prefer to talk to humans. Educational technology must therefore be adapted to the students' desire to communicate with fellow-humans, especially during such intellectually and emotionally intense activities as learning. In our course, therefore, to prevent students from perceiving their digital interlocutors as "emotionless machines," we hid them behind avatars among other learners. We thus recreated the setting of many other discussion forums where participants are represented by nicknames and avatars.

Figure 8. Sequence Diagram: Real Student.



In our model of an online educational platform, we used at least two chatbots as Student-Chatbots to give the teacher a pedagogical leeway: one chatbot was a more “advanced” student and another a “struggling” student. Thus, the two “students” produced different ideas and published work of varying quality. This strategy served two purposes: on the one hand, to better hide the fact that these two “peers” were not Real Students and, on the other hand, to implement different strategies of the Teacher.

The Sequence Diagram (Figure 8) illustrates one of the Use Cases for the Real Student: posting work, reading and responding to comments, reading and commenting on other actors’ work, rating works posted by other actors, asking the Administrator for information.

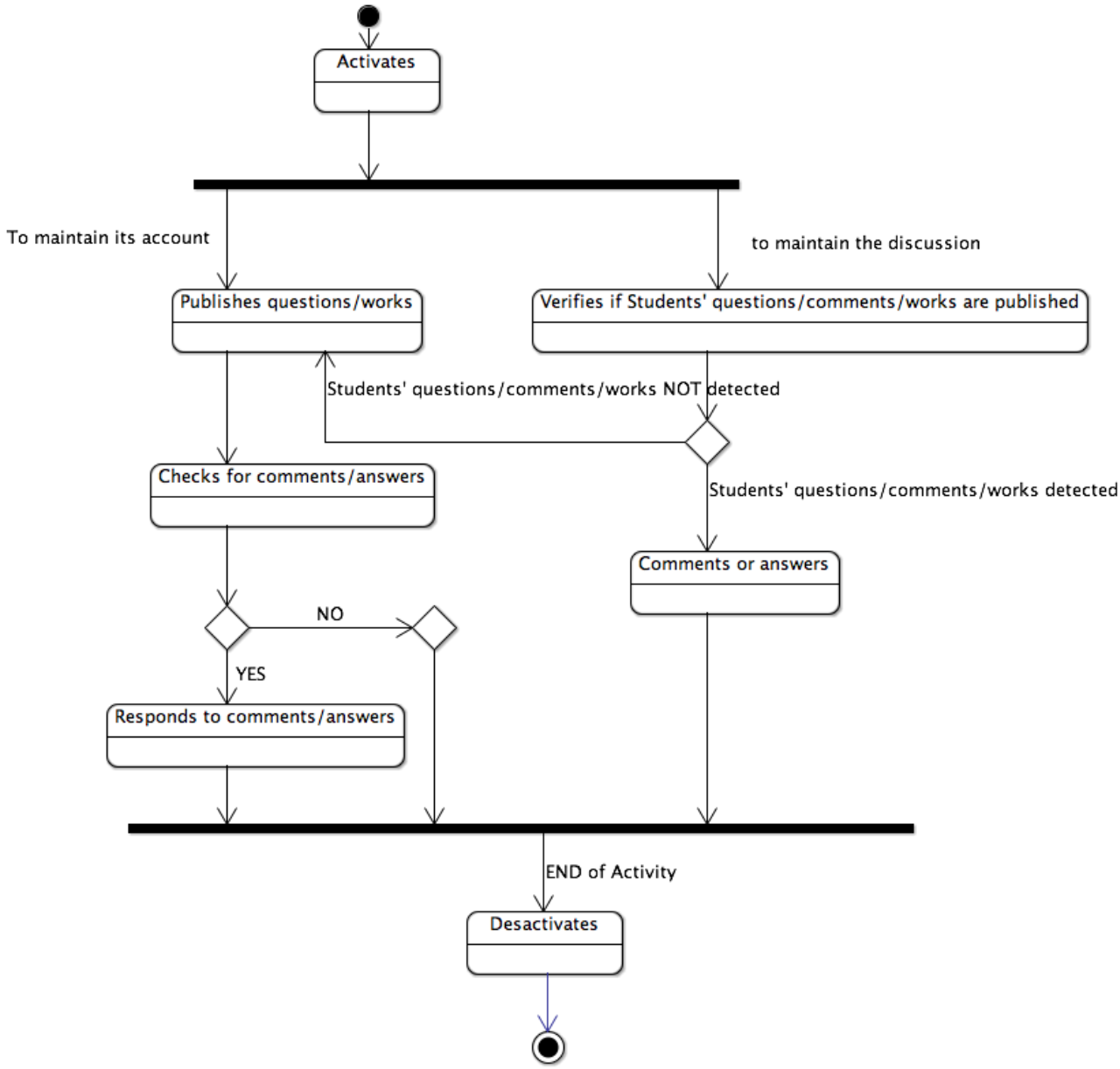
The diagram traces the interactions between the Real Student Actor and the course interface, as well as between the Real Student and the Administrator. Hence the following Scenario:

1. The Actor opens the course web page and enters his identifier (ID) and the password.
2. The system checks the Actor's data and gives him/her access to his/her profile.
3. The Actor clicks on the “Submit your work” icon and chooses how to upload the work.
4. The Actor chooses the file and publishes it.
5. The Actor chooses the discussion to read the comments.
6. The Actor clicks on the “Reply” button, types the responses to posts, and publishes them.
7. The Actor returns to the “Main Page” and chooses the discussion thread.
8. The Actor clicks on the “Reply” button, types the comments, and publishes them.
9. The Actor logs out of the system and closes the course page.

The Sequence Diagram for the Student-Chatbot is the same as the Real Student Sequence Diagram in Figure 8 with two differences: it does not have to login to the system and it does not interact with the Administrator (Figure 9). It is the Administrator, or the Teacher, who schedules the chatbot, intervenes into its activities, and modifies its actions, if necessary.

Woolf (2009) describes working in collaborative learning as a situation when students work independently or in teams: they, “separated in space and time, collaborate on open-ended problems, generate writing or musical compositions, and are generally in control of their own learning. In team activities, they work with remote partners, explaining their reasoning and offering suggestions.”

Figure 9. Student-Chatbot Activity Diagram.



Our Sequence Diagram represents a typical case of educational scenarios based on collaboration. In addition, in an environment of our prototype, teachers can easily modify topics and tasks, as well as observe and trace the activities of learners.

Having determined the crucial elements of the interface and the roles of all agents in our online platform, we passed on to building and testing the prototype.

CHAPTER 4: **BUILDING AND TESTING THE PROTOTYPE**

Building and testing the prototype involved the process of selection of the appropriate tools and platforms for the course, organizing the learning space, and integrating into it automated student accounts, which would simulate the peer-chatbot functioning.

The search and trial for a fitting platform to host our online classroom resulted in a compromise: we made a decision to split our 5-lesson course into two parts dividing them between two platforms. The first one, for Lessons 1 to 3, allowed us to start the course in a user-friendly space, where the discussion forum was conveniently organized and the learning material was easy to display. That platform, however, did not provide an easy solution for an automated account to be integrated into the discussion forum.

It should be noted that at the beginning of the prototype building, we planned to host the entirety of the course on one platform. Yet numerous unsuccessful attempts to connect automated student accounts to the discussion forum of the already functioning online course proved to be unsuccessful on the platform in use: the website building tool allowed only integration of a commercial "chatbot-in-a-window" type of a conversational agent that went contrary to the pedagogical strategy and overall architecture.

Thus, the second part of the course, Lessons 4 and 5, had to be moved to another platform that allowed message bots to be connected to it. The second platform being more dynamic and varied in options, however, proved to be less convenient for discussions and material demonstration, although in general, it allowed the course to be completed with overall success.

4.1 Determining appropriate tools and platforms for the prototype

We designed and built an online 5-lesson course to explore effective practices of integrating chatbots into a virtual classroom designed as a discussion forum. As the envisaged platform is intended for high-school, college, or university teachers lacking in-depth digital skills, we considered only the tools that are easily accessible online, free of charge or inexpensive, and user-friendly.

It should be noted that a range of chatbot building resources are already available, and many of them require no coding. The fastest way to build chatbots is using bot platforms such as motion.ai, Botsify, and Chatfuel; they are simple, possess limited functionalities, and are, therefore, accessible for the beginners

(Cameron et al., 2018). Preprogrammed answers of even the simplest bots can process input in customer support dialogue systems (Skrebeca et al., 2021). More complex functionality can be developed with a bot development framework that provides a set of predefined functions and a code; for example, the Microsoft Bot Framework that can process natural language, speech recognition, and image-processing.

Chatbot integration is usually one of the complicated issues that gathers most attention in the chatbot developers online communities (Abdellatif et al., 2020). Apart from the requirement to be effective communicators, chatbots must cooperate with various existing services and messengers to successfully integrate with a chosen social network platform. Chatbot platforms developers invest immense resources into ensuring a smooth integration of their tools with a desired environment: Dialogflow, for example, allows a one-click integration feature to popular chatting platforms, such as Slack, Twitter, and Skype.

Currently, every social network offers an option to build a simple chatbot for various needs. Developed as an application inside Facebook, for example, chatbots in the form of answering robots have already been deployed as a substitute for teachers and assistants to English language learners (Sarosa et al., 2020). In general, chatbots integrated in social media are found to be more user-friendly because the users are already familiar with its interface and navigation.

Social media platforms were our first choice, but the search-and-try process demonstrated that on the most popular platforms (Facebook, Twitter, Instagram) our goal cannot be achieved. Having registered a Facebook account for a potential platform, for example, we realized that the functionalities of this social network do not allow us to create a chatbot capable of “acting” in the desired way: interacting with several participants in the discussion, posting comments or questions in the comment section of a particular post with learning material or an assignment, or opening new discussion threads. Facebook, like other popular social media platforms, offers and accommodates a plethora of user-friendly chatbot-design templates, but those chatbots only operate in the Facebook Messenger, present themselves overtly as chatbots, and address their communication to a particular user, i.e. conduct dialogues only. Such chatbots are a great tool for commerce, marketing, and face-to-face learning experience, but they cannot be used as peers in a multi-person discussion.

Several instant messaging social platforms, Discord and Snapchat among them, were also examined and deemed not suitable for our project for the same reasons. In addition, we found that the assignment

presentation and collective reflection on such platforms would be problematic due to the platforms' fast-paced dynamics and an overstimulating interface.

Overall, chatbot resources offered by social networks do not allow building the discussion with the features we planned. As Candello and Pinhanez (2017) note, the two most common interaction methods—command-line and point-and-click—do not accommodate multi-user, multi-application, and generic multiparty (many users and more than one application) interactions.

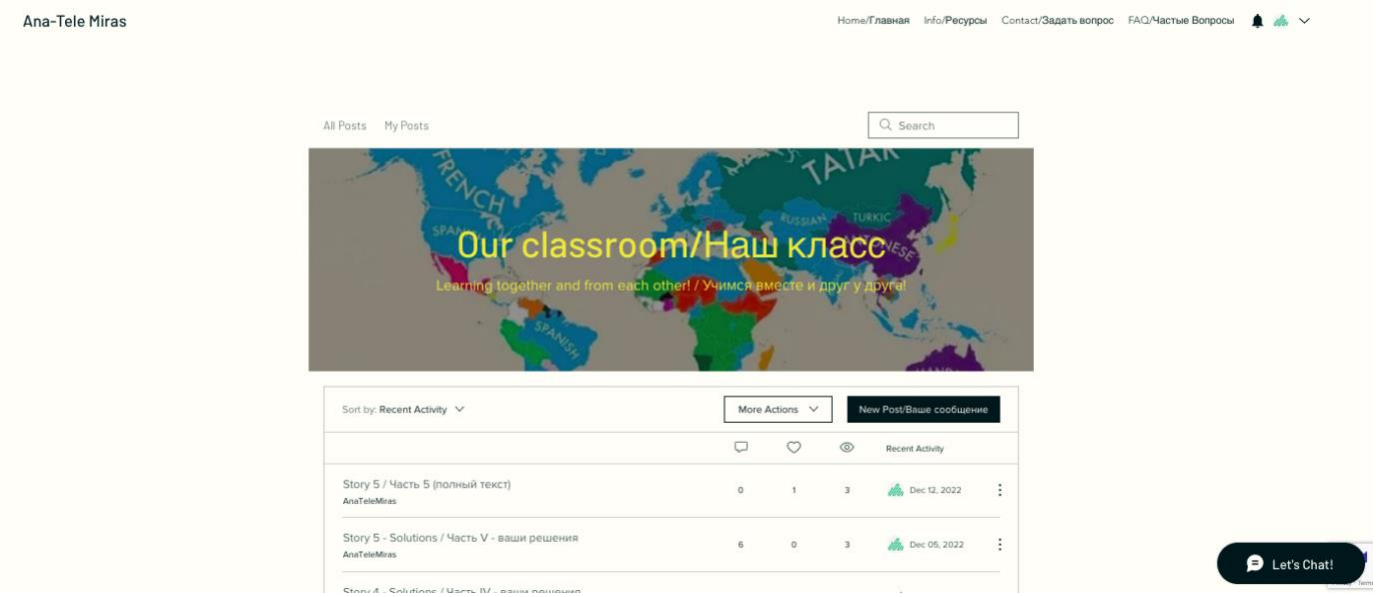
The next option for the Discussion Forum placement were open source website building platforms that accommodate a variety of plugins (software that extends functionality of a website and allows adding features, for example, building and integrating a chatbot). We considered Drupal and WordPress, which offer a wide range of functionalities and an enriched environment. Having scrutinized these two platforms, however, we opted out of using either: the learning curve for an average user would be rather high, certain extended features come at a cost (one-time or annual payments), and the plugins that we considered for our Discussion Forum did not perform as declared and were still awaiting patches and upgrades (according to the users' and developers' comments on the discussion forums devoted to those products).

Working on our project, we did succeed in integrating a chatbot into the discussion group in Slack and Workplace, but we decided against using those platforms for our project for a number of reasons: the visually "polluted" environment of the platforms, the inability of the chatbots to appear as regular users or members of the community, complicated sign-in process, and problems with access to those platforms from certain parts of the world.

4.2 Platform for Part I (Wix website forum page)

Given the above-mentioned, we decided to proceed with our project on the Wix.com website builder (Wix): it proved to be simple, not overloaded with functionalities, and moderately priced (Figure 10). Thus, the first part of the course (Lessons 1, 2, and 3) were placed in the Discussion Forum, as part of the AnaTeleMiras.org website built using Wix.

Figure 10. Wix Forum, Main Page, wide screen, top.



At this stage, we applied the Wizard of Oz method (described further in this section) of studying the peer-chatbot possibilities: we created two fictitious accounts—managed by the Researcher and mimicking the behavior of a chatbot—that "participated" in the course as learners (Students).

First, we aimed to develop a prototype of an educational platform that would function as a discussion forum. Then we designed a 5-Lesson Tatar language course for beginner-intermediate level. For this course, we opened two additional accounts that were to act as learners according to our concept of peer-chatbots: an "advanced student" and a "troublemaker."

As Alevêque (2019) describes, the Wizard of Oz approach consists of human interaction with a "simulated machine with the aim of anticipating advances in computing and their consequences. By playing the role of the program, the researcher materializes an unrealized innovation that refers to a non-human – AI – whose future existence is projected." Kelley (1984) employed this iterative empirical development approach when designing software that uses natural language for personal calendar management. The approach consisted of the steps of simulation of interactions between the user and the software and revisions/improvements of the inputs; in the process, the language capabilities of the system improved and the human speaker dropped out. Candello and Pinhanez (2017) used the Wizard of Oz technique in

their research where a human simulated the response of a system to help shape the design of their chatbot. Thus, the expression “Wizard of Oz” refers to the scientific experimental protocol that makes it possible to develop knowledge and optimize the design of software (Alevêque, 2019).

For our online course, we developed a prototype of an educational platform to function as a discussion forum. Then we designed a 5-lesson language course—Tatar language for the beginner-intermediate level—altogether lasting for 15 weeks. For these courses, we created two dummy accounts to function as the students who agreed to participate in the experiment. According to our pedagogical scenario, our Student-chatbots acted as an “advanced student/tutor” and a “troublemaker/disturber.”

During the first three lessons of the course, we managed the dummy accounts—the method described as the “Wizard of Oz experiment.” For the last two lessons, we employed two scheduled message bots under the same dummy student profiles, thus automating the Student-chatbots’ posts to the discussion forum and verifying the feasibility of using chatbots, rule-based or AI-powered, in an educational setting that we created.

When it comes to designing and implementing software, it is important to choose the most suitable approach. For the development and implementation of our chatbots, we chose the “trial-and-error” technique, an experimental simulation widely used by designers. Indeed, with regard to good practices in the development of chatbots, Beillaud (2016) advises to think about the response objectives of chatbots and to “start simple, then do test-and-learn.”

Simulating user-chatbot interactions is an effective tool for assessing user’s perception of the multi-chatbot interface design (Tan & Liew, 2022). The Wizard of Oz studies allow comparing between various intervention types during collaborative tasks (Avula et al., 2018). The chatbots’ conversational flow and the intensity of contribution are important aspects of the project. The use of the Wizard of OZ technique helped us to identify conversational techniques that promote the pedagogical goal of improving the students’ language skills and provide insights for the automated message bots scenarios.

As described in section “2. 4. Prototype testing,” during Lessons 1 to 3, the dummy accounts were operated by the Researcher who played the role of the “Wizard” (the Researcher) monitoring the conversation and ensuring the flow of the discussion. This kind of intervention helped to achieve three goals: (1) supporting the group conversation flow by posting comments or questions; (2) determining an

appropriate tone for automated accounts in their posts; and (3) covering problematic issues of the assignments and providing clues to guide the Students in their search.

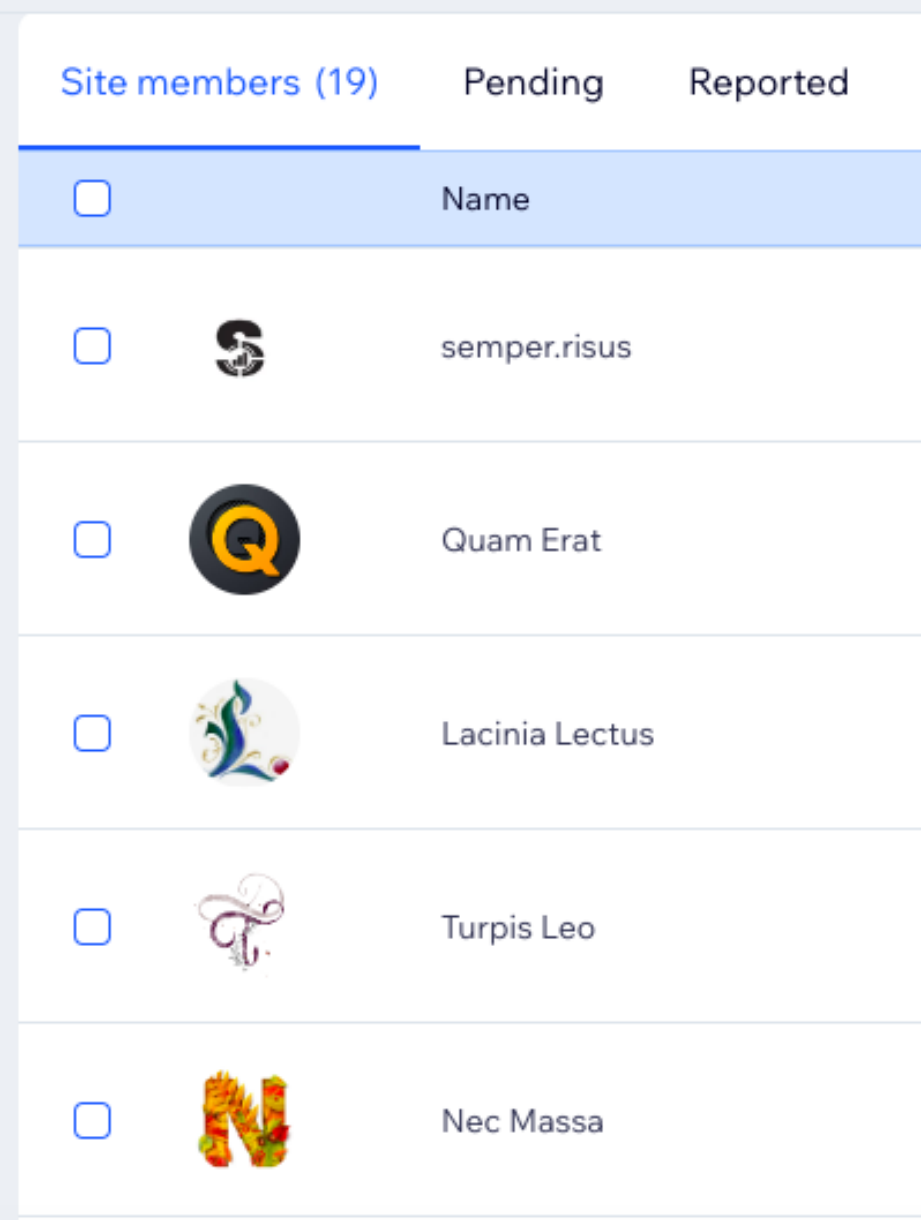
Thus, in our online collective learning environment, the learners (Students) were interacting with each other and with two fictional peers—accounts controlled by the Researcher. The goal of applying the Wizard of Oz paradigm was to study the modalities of interaction between the Students, to try out productive interventions through the fictitious accounts mimicking interactions of human participants, to study the situations and the discussion stages where Student-Chatbots might be the most useful, and to decide which linguistic approaches are preferable. The results of this activity are summarized in Chapter 6 “Findings.”

In our project, the primary functions of chatbots were to create a collaborative environment for a small community of participants. In this role, our fictional accounts acted as “learning companions” (Chan & Baskin, 1988; Griol & Callejas, 2013; Riel, 2020) by asking questions, committing “errors” that learners had to correct, or even playing the role of a “troublemaker” (Aimeur et al., 1997).

As described in section “3.4 Modelisation,” in this part of our project, we had two types of agents: “Administrator” (under the name of AnaTele Miras, managed by the Researcher answering Students’ questions concerning administrative issues) and “Student,” (under a variety of pseudonyms), which included “Real Student” and “Student-Chatbot” (two fictitious accounts mimicking the functioning of chatbots). As mentioned earlier, all the participants received pseudonyms and avatars according to the first letters of their nicknames (Figure 11).

In our Discussion Forum, the two fictitious accounts designated to represent Student-Chatbots were “Quam Erat” (QE) and “Semper Risus” (SR). Both accounts were created before the start of the course and thus were ready to fulfil their first role—“populating” the Discussion Forum space by appearing in the list of the participants at the time when the first human participants were logging in. The presence of “other students in the room” was intended to make the human participants feel more at ease, not “the only ones” on the forum, and thus to contribute to the emotional comfort of the Students.

Figure 11. Part of the participants list: examples of nicknames and avatars.



We assigned the QE (Quam Erat) account the “Advanced Student/Tutor” role: to be among the first to post comments and answers containing information that a course teacher would like the students to be familiar with for an effective collective work.

For the SR (Semper Risus) account, we reserved the role of a student who posts questions on the issues that the teacher would like the students to pay particular attention to (questions of Category 3, and sometimes 2). In addition, SR acted as a "troublemaker," posting inaccurate answers to other students' questions and expressing "confusion" or "panic" regarding the assignments, thus prompting the Students to provide explanations on specific issues.

For Part I of the course, we tried several strategies for the start of the discussion. In Lesson 1, for example, we assumed that one of the Student-Chatbot should publish its first post 24-36 hours after the publication of the assignment for the Lesson. Firstly, this period would allow "super-achievers" among the Students to be the first ones to start the conversation. Secondly, in the absence of such active participants in the group, the Student-Chatbot would start the discussion on the second day of the course thus prompting the rest of the class to join the discussion and helping the shy Students to join.

Table 2. Day of the first post and reactions to it in discussions (#day of the first post after the assignment posting; (#day) of the reaction post to the first posting).

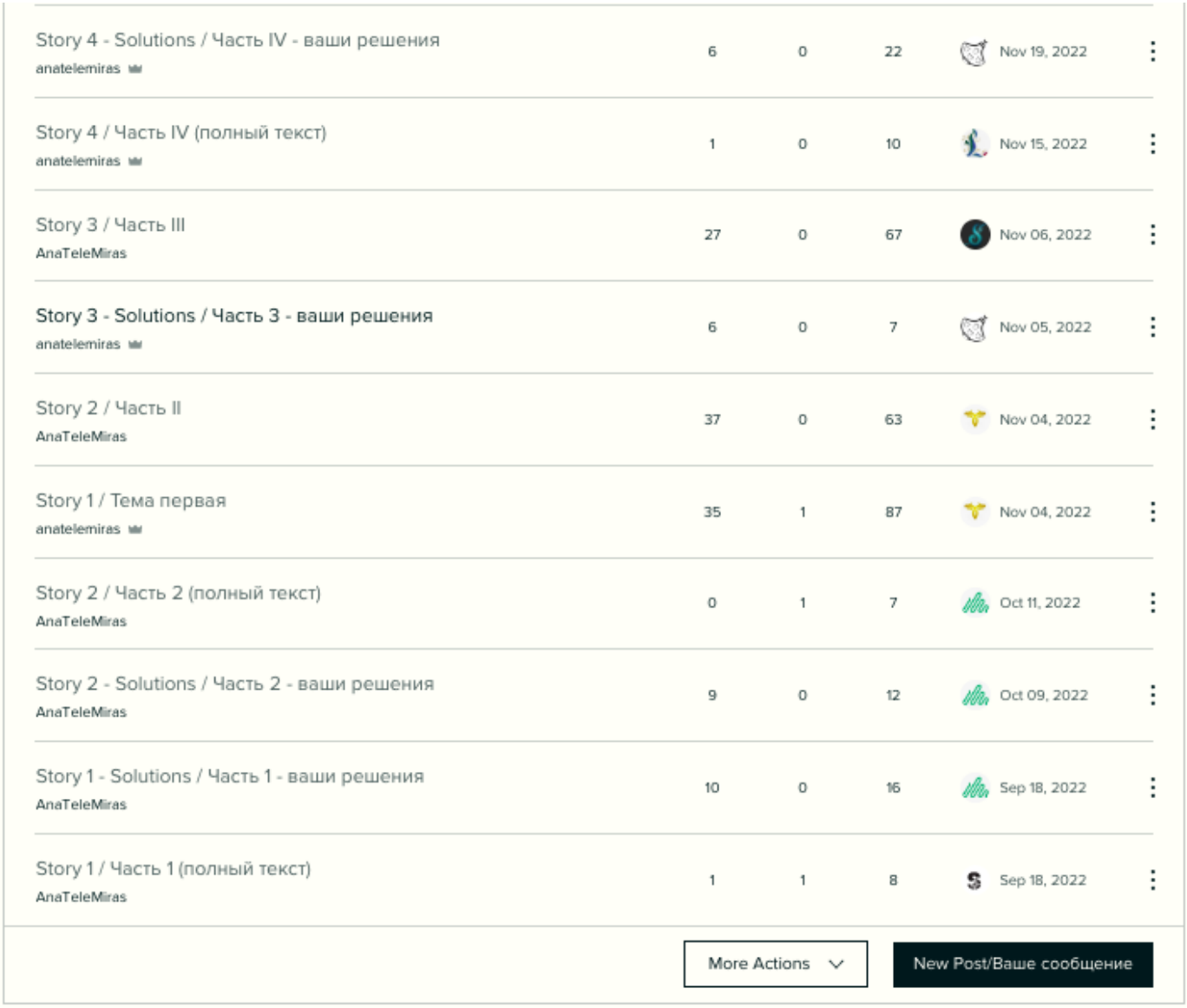
First posts and reactions in the discussion by	Lesson 1	Lesson 2	Lesson 3
QE	**1**	(3)	(11)
SR	**1**	(1)	-
Students	(3)	**1**	**10**

Table 2 shows various scenarios of engaging the fictional accounts in the process of prompting the conversation. In Lesson 1, the fictional accounts were the first to publish their posts. In Lesson 2, it was one of the Students who published the first posts on Day 1. Lesson 3 took a long time for the discussion to start rolling, so on Day 10 it was one of the fictional accounts that had to be engaged.

For Part I of the course, a separate Discussion Chapter was created for the Students to publish their works (the completed assignments). (The Main Page and the Page of Lesson 1 can be seen in Figure 12 and Figure 13). The fictitious accounts also posted assignments according to the pedagogical strategy described above (Chapter 3, section 3.1.2). Anecdotally, from the heads of the Tatar Culture Centres, we got some

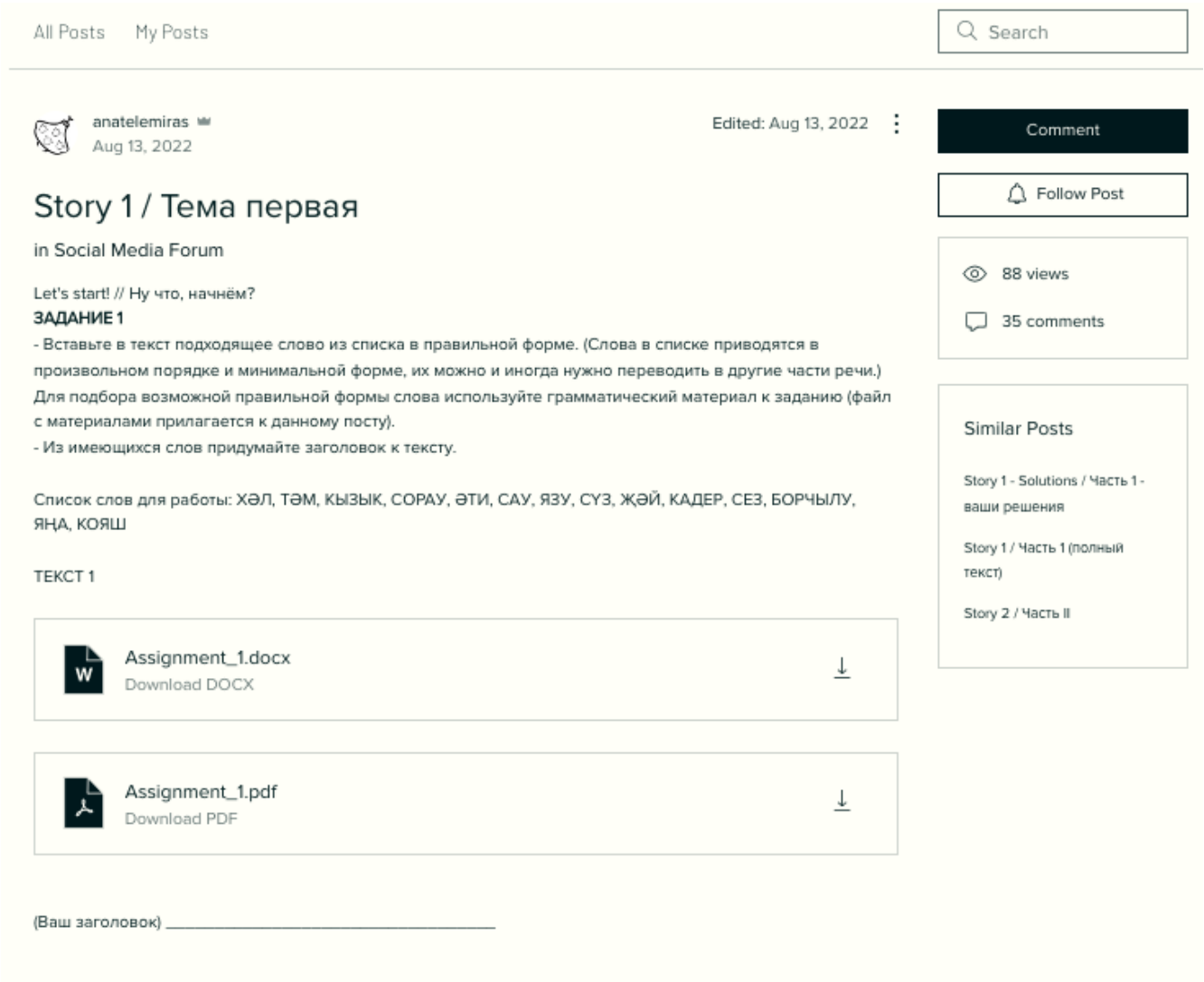
of the participants' feedback regarding assignment submission: those Students reported feeling more motivated to submit their assignments sooner when they saw that a number of the works had already been posted. In this case, the "chatbot" accounts were the first to declare that they had submitted their work thus motivating the peers to contribute too.

Figure 12. Wix Forum, Main Page.



According to the scenario, QE “submitted” works that were among the best: the completed assignment, however, contained a number of imperfections and small errors for other participants to practice detecting mistakes. Consequently, SR “submitted” slightly weaker-than-average works fulfilling the role of a less advanced student to support the morale of struggling learners.

Figure 13. Lesson 1, Assignment, beginning of Lesson 1 of the Forum.



In a discussion forum, each new topic usually creates a new thread (Figure 14). In our case, we considered it useful to make our Student-Chatbot accounts also create new threads publishing posts concerning Category 3 issues, and sometimes those belonging to Category 2, thus attracting the Students’ attention to specific aspects of the assignments (Table 3).

Figure 14.Lesson 1, Assignment, beginning of Chapter 1 of the Forum, part of discussion.

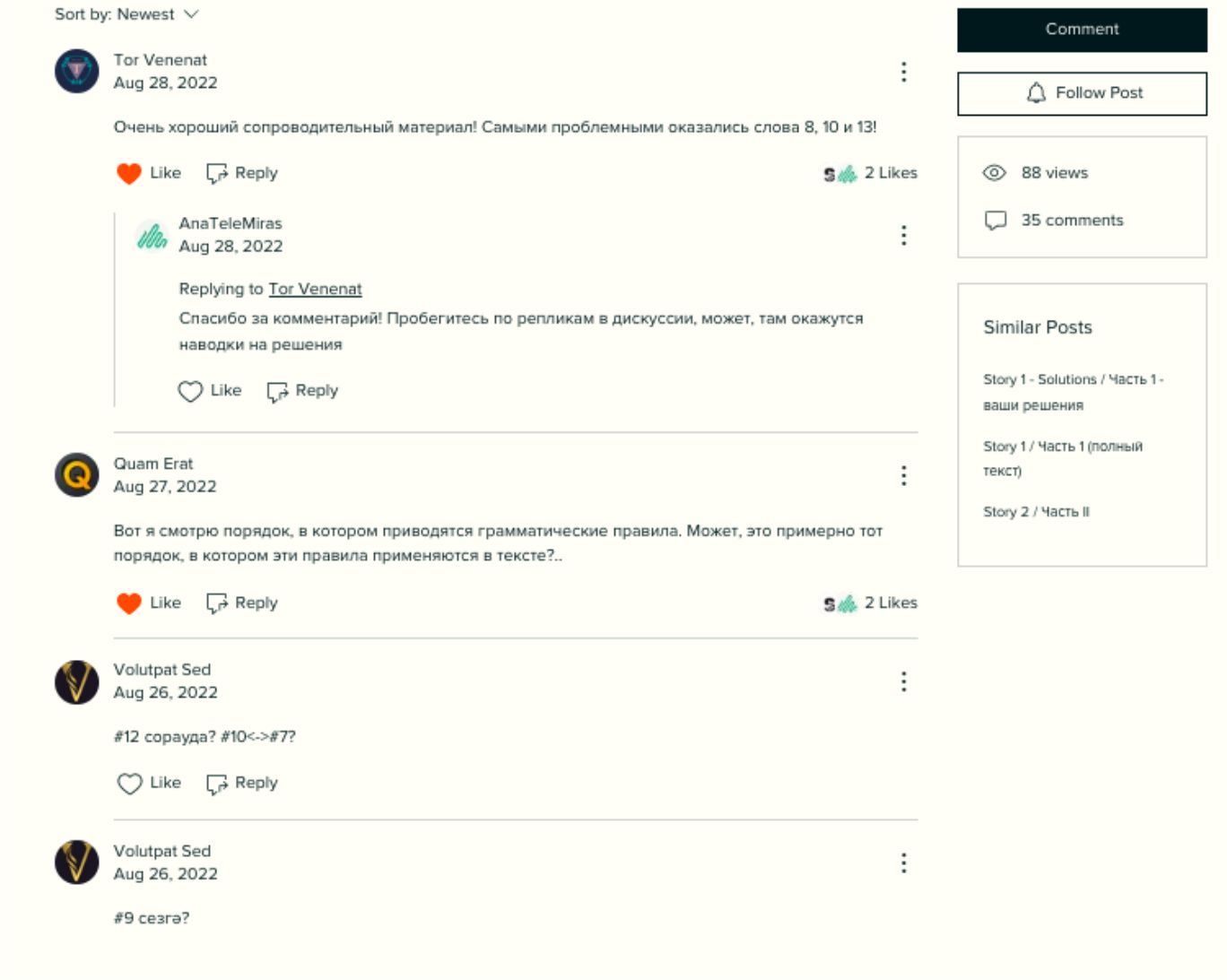


Table 3. Part I of the course: New threads in discussions (number of).

New threads in discussions by	Lesson 1	Lesson 2	Lesson 3
QE	**3**	**1**	**2**
SR	**3**	**2**	**-**
Students	**8**	**10**	**11**

While operating the fictitious accounts of our online class, we were able, as Wizards of Oz, to answer questions of other participants on the name of the peer-chatbots (Table 4). In those posts, again, the main goal was to use the fictitious accounts to direct the participants' discussion and search for solutions in the right way—an action, which would otherwise happen under the pressure of the teacher's authority.

Table 4. Answers and comments to posts in discussions (number of).

Answers and comments in discussions by	Lesson 1	Lesson 2	Lesson 3
QE	**5**	**4**	**1**
SR	**1**	**3**	**2**
Students	**10**	**12**	**13**

The Wizard of Oz technique allowed us to observe the conversation flow and to make decisions on the interaction management. In addition, Part I of our project provided us with the preliminary conclusions in relation to the goals of our work—to identify user-friendly software for educational peer-chatbots design; to try winning strategies for using peer-chatbots in the context of collective online learning; and to study the methods of integrating and operating those tools.

We consider this approach to be productive for the design of student chatbots, because its "engineering logic" dictates that we "anticipate the functionalities of a program, improve its ergonomics and the relevance of its field of application and this at a lower cost" (Alevêque, 2019). This technique allowed us to determine the terms of use and the linguistic functionalities of chatbots prior to their design.

4.3 Platform for Part II (Dzen content-sharing platform and Telegram bot accounts)

As described above, due to the design and technical peculiarities of the platform used for Lessons 1 to 3, we split the course in two. For the second part of the course (Lessons 4 and 5), we moved the Discussion Forum to another online platform. The reason for platform change was that the only chatbot plugins that Wix accommodated were commercial lead-generators with functions like greeting users, asking questions on the users' needs, and redirecting the users appropriately. Such chatbots appeared in a pop-out chat window and could not, therefore, be integrated as participants into the Discussion Forum.

A number of social and business forum platforms were examined (Discord, Snapchat, Workplace, Workspace, and Slack, among others) to determine if they could accommodate a collaborative online learning setting. We determined that, first of all, these platforms were visually overstimulating and overloaded with functionalities that were not required for our Discussion Forum. Secondly, the conversations on those platforms are more chat-like than forum: they are linear and do not branch out in the usual discussion-forum style; also, the threads are not easy to follow or cannot be created without leaving the page of the original discussion topic. Finally, the available chatbot plugins do not provide the functions promised—building a chatbot or a message bot that would post messages under a pseudonym and an avatar like a regular member. Having tried registering a profile for a chatbot and launching it, we regretfully discovered that the chatbot's posts in the discussion forum appeared under the brand name and the avatar of the corresponding chatbot application. Apparently, this option had never worked properly and the unhappy users discussed it at length on the corresponding software troubleshooting forums.

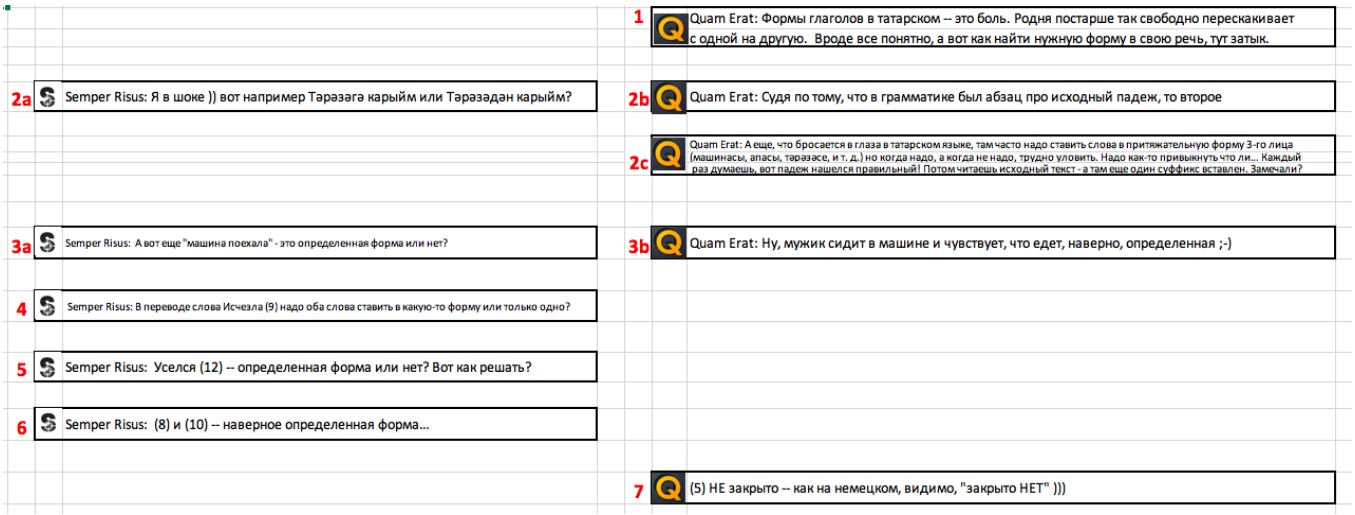
In addition, we researched the possibility of placing the Forum on teaching platforms (MOODLE, Coursera, Udemy, Teachable), but we did not discover any possibility of integrating a peer-chatbot option into their courses either, and some platforms do not provide an option of teaching through a discussion forum altogether.

A number of possible solutions were identified as to the use of messaging bots or scheduled bots: co-ordination between two compatible platforms—Twitter posts scheduling or timing Instagram messages to be posted on Facebook. Two major problems of those options are as follows: the scheduled post bots cannot act as regular discussion participants posting messages under chosen avatars, and the pages are overcrowded with visual stimuli that impair concentration. Finally, a number of the most popular social networking platforms are not accessible in some countries and cannot, therefore, be used for asynchronous teaching internationally.

The platform for our prototype at that stage had to meet the criteria of accessibility (free or low-cost, user-friendly, and accessible from any country), visual comfort (not over populated with stimuli, advertisement, and impractical widgets), and interoperability with other software (possibility of receiving and posting messages from another software).

We identified Dzen (Dzen.ru, former Yandex.zen[5]) as the optimal solution for Lessons 4 and 5. This content-sharing platform provides the following: a convenient space for posting texts that can be discussed; pinned posts for placing reference material and useful links; and an option for scheduled posts. We did not, however, use the Dzen's proprietary scheduled post option, as those posts would appear under the nickname and the avatar of the host account (the name of the particular account in Dzen and not of a participant). Another inconvenience of the platform is that it does not offer the Main Page with the list of topics. For our two lessons, however, these inconveniences did not play a dicisive role.

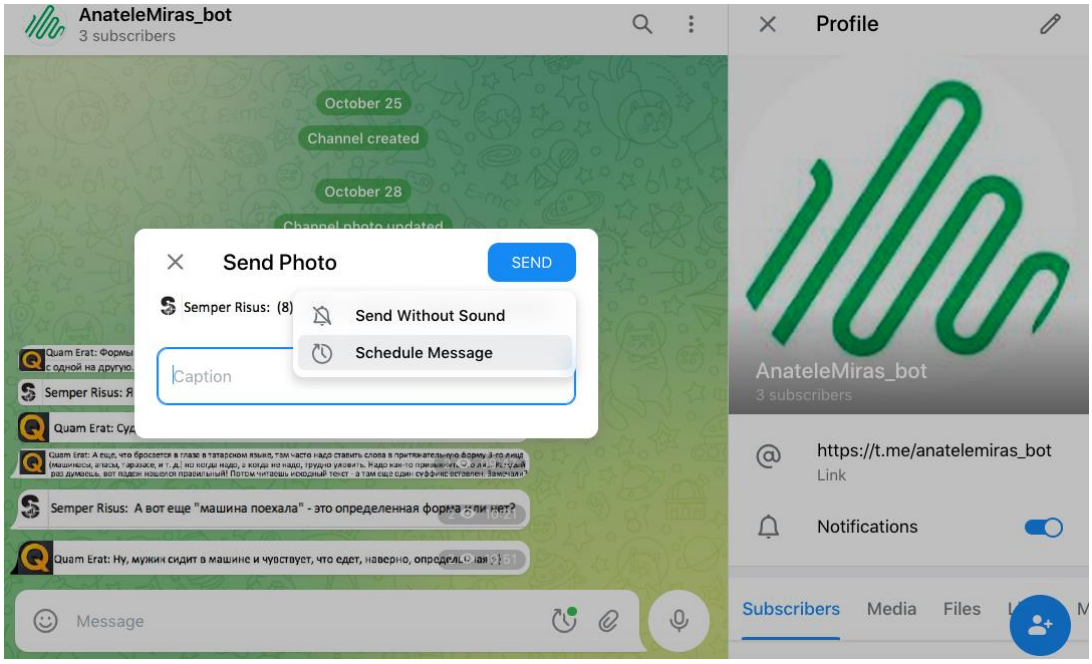
Figure 15. Scenario for the preprogrammed conversations and posts for the scheduled bots for Lesson 4.



As to the interoperability of Dzen with other software, we discovered that it is compatible with the Telegram Messenger that offers a variety of scheduled bots with an option of posting them directly on the chosen page in Dzen. We consider that scheduled bots can be used as restrained versions of rule-based chatbots: their pre-programmed messages (Figure 15 and Figure 16) can be scheduled to appear in the Dzen discussion. The major limitation of this solution is that such bots do not reply to comments or answer questions of human participants, unless, of course, such questions are previewed by the course developer and the answers are scheduled.

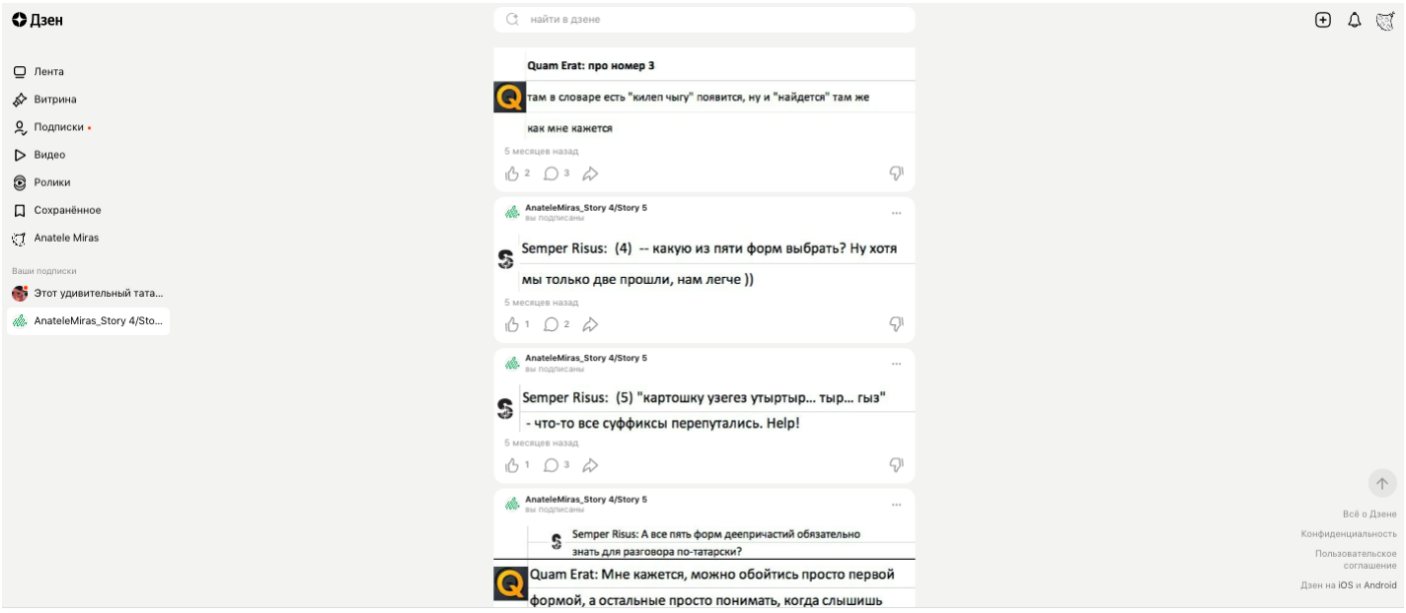
[5] https://www.searchenginejournal.com/yandex-opens-content-distribution-platform-yandex-zen/200620/#close (accessed on 2023-08-23)

Figure 16. Telegram scheduled bot posts for Lesson 4.



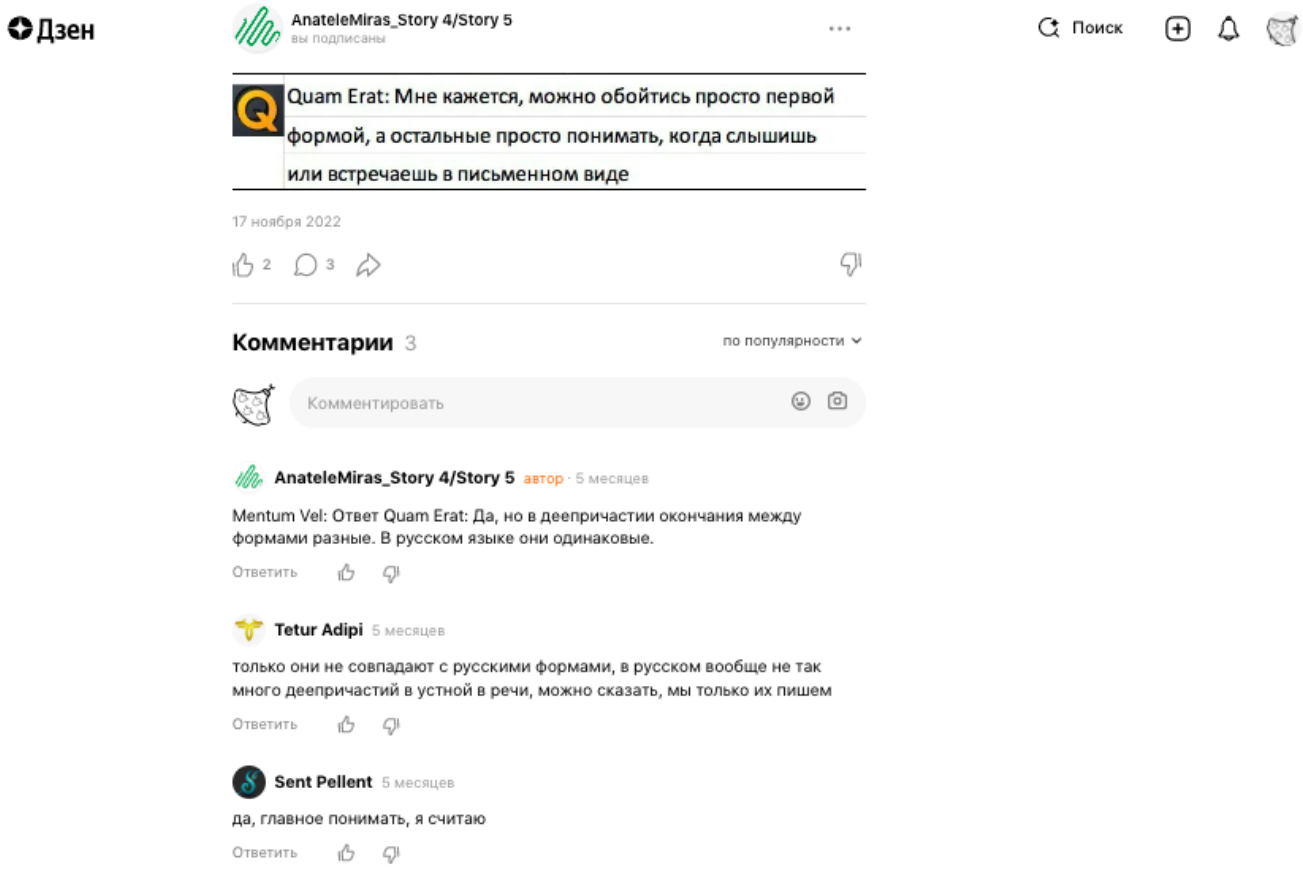
Below is how the scheduled Telegram message bot posts displayed in Figure 15 and Figure 16 look in the Discussion Forum of our online course placed on the Dzen content-sharing platform (Figures 17 and 18).

Figure 17. The Scheduled bots' posts in the Discussion Forum for Lesson 4, full screen.



For the purpose of our study, however, such scheduled bots successfully replaced the Researcher's Wizard-of-Oz-style posts used in Part I of the course. Once scheduled, the messages appear at the necessary moments in the discussion leaving the teacher with free time to work on other issues. Moreover, the preprogrammed "conversation" between two (or, possibly, more) fictitious accounts provide extra possibilities for the pedagogical intervention in the discussion.

Figure 18. The Scheduled bot's post and the Students' comments in the Discussion Forum for Lesson 4, excerpt.



It should be noted that contemporary open-source online technology offers a plethora of possibilities for a vast variety of projects. For our prototype, however, determining an appropriate platform proved to be a complicated task, as each considered one not only offered its advantages but also revealed its peculiarities inconsistent with the goals of the project: building a user-friendly online classroom with integrated automated accounts for peer-chatbots.

We consider it important to underline that, although the platform change brought additional difficulties to the project, in general, it proved to be a useful and informative experience. One of our goals being to determine which open-source online tools allow creation of similar online educational platforms, we gained additional information of the contemporary state of the user-friendly technology that allows innovation in the classrooms.

Importantly, the post-mortem feedback survey provided us with invaluable information on the Students' experience and opinion, as well as the Teacher-Consultants' assessment and remarks.

CHAPTER 5: **SURVEY RESULTS**

After the end of the course, we collected and analyzed the questionnaires completed by the participants: the Students and the Teacher-Consultants (TC). Survey, "the collection of information from a sample of individuals through their responses to questions" (Check & Schutt, 2012), was conducted post-mortem among the participants.

As mentioned above, in our online classroom, although peer-chatbots are at the centre of the study, it is the overall architecture, the sum of all elements—crowdlearning, course content, and artificial peers—that constitutes the prototype. We, therefore, considered it important not to attract participants' attention to the artificial nature of some of their peers' accounts. This allowed us to evaluate the participants' general satisfaction with the online learning process involving accounts that acted as peer-chatbots.

The survey allows us to collect information from the sample of individuals through their responses to questions organized in a questionnaire with regards to their experience and opinion (Check & Schutt, 2012). To determine the efficacy of the prototype, we consider the Students' opinion on convenience of access and work on the platform; on their level of motivation and emotional comfort while studying with peers; and on satisfaction with the study material and course organization. We consider the prototype a successful attempt to build an online educational platform with peer-chatbots, if both the Students and the Teacher-Consultants express overall approval of its elements (platform, course content, crowdlearning, peer-assessment) and general functioning of the course.

Most questionnaires were filled out in Russian and were translated into English by the Researcher.

5.1 Students

As described in section "2. 3. Participants: Recruitment," for the study, twelve participants—the Students—were recruited to take part in the course. Two of the participants were not able to join the course in due time and thus withdrew from the study. Ten Students, therefore, completed the course, following which they filled out the "Course Evaluation Questionnaire – Student" (APPENDIX 5).

All ten Students were recruited according to the criteria described in Subchapter "2. 3. Participants: recruitment" and, therefore, met the conditions to be: 1) an adult aged 18 or over; 2) able to speak Russian or English and know how to read and write using the Cyrillic script; 3) able to speak the Tatar language at the beginner-intermediate level; 4) willing to participate in the online course in collaboration with other learners.

It should be noted that not all Students participated in the discussions in a uniformly active manner due to their personal and professional commitments. Thus, a part of them switched their roles from Sender to Bystander and vice versa at different stages of the course. Bystanders followed the course by reading the discussion exchange and completing the assignments without actively participating in the forum. All ten Students filled out the survey.

Although the Students used pseudonyms in the Discussion Forum, we further anonymized their participation by not using their nicknames in publishing their comments in our paper. To achieve this, we numbered the participants with Arabic numbers from 1 to 10 preceded by letters "S" for "Student," for example "S1" or "S6."

Question 1—*How did you access the course?* in the survey for the Students was a multiple-choice question concerning the device they used to perform the work. Seven Students used computers, one used a tablet, and two used their smartphones.

Table 5. Comments on the devices used by the Students to access the course (Question 1).

Student	Comment
S6	The course was interesting and enriching. Working on a computer was optimal for studying.
S7	Computer is more comfortable for studies.
S8	Smartphone was not very comfortable for studies.

The survey covered four main topics: the platform, the online discussions among the Students (crowdlearning), the course content, and the peer assessment.

5.1.1 Platform

An important issue of ease of registration and login procedure on the platforms that we used for our prototype was touched upon in **Question 2**—*How easy was the registration and log in procedure on https://www.anatelemiras.org?* (for Wix web site https://www.anatelemiras.org/ for Lessons 1-3 of the course) and in **Question 3**—How easy was the registration and log in procedure on Yandex.Dzen channel https://dzen.ru/id/635b40a1ae0075313aaf5868? (for Dzen content-sharing channel for Lessons 4 and 5 of the course).

Table 6. Table 6. Students on registration and login procedures to both platforms (Question 2 and Question 3).

I found registration and login for this platform	**Easy**	**Rather easy**	**Having some problems**	**Complicated**
Wix web-site	**7**	**2**	**1**	
Dzen channel	**2**	**3**	**3**	**2 – did not register**

Overall, Part I of the course did not present major issues of technical nature. The difficulties for one of the participants were linked to the lack of experience of working with various online resources, and the technical problems for another Student were resolved with the help of the Administrator.

Table 7. Students' comments on registration and login for Part I of the course (Question 2—How easy was the registration and log in procedure on https://www.anatelemiras.org?).

Student	**Comment**
S1	Being not very young and due to lack of experience in using various types of software, I had technical problems: difficulty downloading files and forgetting how to log in the system.
S6	When I had technical issues, they were promptly resolved with the admin support.
S7	Easy to login.

Unfortunately, Part II of the course proved to be somewhat problematic as far as the registration and login are concerned. Some of the Students used the platform only in the reading mode using email for writing comments (to be posted in the discussion forum by the Administrator) and for submitting assignments.

Table 8. Students' comments on registration and login for Part II of the course (Question 3—How easy was the registration and log in procedure on Yandex.Dzen channel https://dzen.ru/id/635b40a1ae0075313aaf5868?).

Student	Comment
S3	There's a two-step login procedure, which takes time.
S4	I did not sign up, so I sent comments by email.
S5	Had problems with understanding how the channel works. Had problems with registration and then with changing the user name for the forum nickname. Managed to overcome the problems.
S7	Longer procedure to register.
S8	I was not able to figure out logging in from the phone.

Question 4—*How easy was it to work on https://www.anatelemiras.org/ (Parts 1-3)*? and **Question 5**—*How easy was it to work on Yandex.Dzen https://dzen.ru/id/635b40a1ae0075313aaf5868 (Parts 4-5)*? on how comfortable the Students found working on each of the two platforms revealed a somewhat similar picture: the Wix website proved to be more user-friendly.

Table 9. User-friendliness of the platforms according to the Students (Questions 4 and 5).

I found this platform	Easy	Rather easy	Somewhat problematic	Complicated
Wix web-site	**5**	**4**	**1**	
Dzen channel	**3**	**3**	**2**	**2 (did not register)**

Although the Wix website presented certain problems for some Students, overall, it proved to be a comfortable space for the Students' discussions and learning.

Table 10. Students' comments on user-friendliness of the Wix website (Question 4).

Student	Comment
S1	*Forgetting where things are on the site.*
S5	*Website was very easy to navigate and to post comments. Both platforms' content was similar in difficulty.*

The Dzen channel (used for Lessons 4 and 5) offered more functionalities (like accessing content without logging in), but proved to be more complex to work on, to navigate, and to access in general (**Question 5**—*How easy was it to work on Yandex.Dzen (Parts 4-5)?*).

Table 11. Students' comments on User-friendliness of the Dzen channel (Question 5).

Student	Comment
S1	*Problems downloading the files with material.*
S4	*It was good that I could read materials without logging in.*
S7	*Not as simple as the web site.*
S8	*Was not able to work from the phone.*

Technical issues notwithstanding, the Students, overall, were satisfied with the learning environment (**Question 6**—*Overall, how satisfied were you with the learning environment?*).

Table 12. The Students' satisfaction level with the learning environment (Question 6).

The course left me	**Satisfied**	**Mostly satisfied**	**Neither satisfied nor dissatisfied**	**Dissatisfied**	**Very dissatisfied**
According to the Students	**6**	**4**			

The Students found the atmosphere comfortable and the process well organized.

Table 13. The Students' comments on the learning environment in general (Question 6).

Student	**Comment**
S3	*Nice and relaxing.*
S6	*The learning process was logically organized; and the result is obvious.*
S10	*A lot of useful materials organized in a convenient manner.*

Overall, the prototype proved to be an appropriate setting for the online learning course, although the two different platforms used for the activity offered varied levels of convenience for the Students.

5.1.2 Crowdlearning

The next series of questions touched upon the learning methods on which the online course prototype was based upon. For us, it was important to learn if the Students felt comfortable learning from discussions with the peers and if they found the discussions helped them learn.

Asked if they found crowdlearning enriching, most of the Students approved of their studying through discussion with peers (**Question 7**—*Did you find it enriching to learn through discussion with your peers?*).

Table 14. The students on productivity of their crowdlearning experience (Question 7).

Crowdlearning was	**Enriching**	**Often enriching**	**Sometimes enriching**	**Not really**	**Counter-productive**
According to the Students	**3**	**5**	**1**	**1**	

Commenting on their experience, the Students explained their impressions on how discussions impacted their learning.

Table 15. The Students' comments on their crowdlearning experience (Question 7—Did you find it enriching to learn through discussion with your peers?).

Student	**Comment**
S3	Other students wrote useful comments.
S6	The discussion enriched my knowledge of Tatar. It was productive. It helped with assignments.
S7	Talking to peers is always good for learning.
S8	It was very interesting to see what other students write because the level is different.

The question on the usefulness of students' online interaction (**Question 8**—*How useful was the online interaction among students in this course?*), confirmed that overall the participants accepted this method of learning.

Table 16. The Students on how useful their interactions were (Question 8).

Online interactions among students were	**Useful**	**Rather useful**	**Hard to say**	**Not useful**	**Counter-productive**
According to the Students	**5**	**1**	**3**	**1**	

Although **Question 8**—*How often, according to you, your peers offered useful and interesting ideas?* covered a similar topic to that of **Question 7** (*Did you find it enriching to learn through discussion with your peers?*), the comments to it mostly expressed emotional acceptance of the interactive learning style.

Table 17. The Students' comments on how useful were their interactions (Question 8).

Student	Comment
S3	*It was nice to exchange opinions on various problems in the assignments.*
S6	*Communicating with peers was useful.*
S7	*Sometimes just a word from another person helps.*

Concerning useful and interesting ideas expressed by peers (**Question 9**—*Do you think that works and comments of the participants helped some of your peers to learn better?*), the participants observed that it had happened quite often.

Table 18. The Students' on useful and interesting ideas expressed by peers (Question 9).

I observed useful and interesting ideas from my peers	**All through the course**	**Often**	**Sometimes**	**Rarely**	**Never**
According to the Students	**2**	**6**	**2**		

The comments to Question 9 demonstrate that some Students valued the discussions logs, considering them to be part of the pedagogical content.

Table 19. The Students' comments on how useful were and interesting ideas expressed by peers (Question 9).

Student	Comments
S3	Before asking questions, I checked what other people wrote and there were some answers already.
S7	If you read all the comments, you will find a lot of useful ideas.

Asked if peers' works (completed assignments) and peers' comments helped them to learn better, the Students responded positively (**Question 10**—*Do you think you learned from some of your peers?*).

Table 20. Students on how helpful were works and comments of their peers (Question 10).

My peers' works and comments helped me	Definitely helped	Often	Sometimes	Rarely	Not really
According to the Students	**5**	**4**	**1**		

Table 21. The Student' comments on the usefulness of works and comments of their peers (Question 10).

Student	Comments
S3	*I did learn better (from the comments).*
S7	*If they (comments) helped me, then they helped others too.*

In general, as to the crowdlearning, the answers and the comments of the Students demonstrate the value and the potential of such a learning method.

5.1.3 Peer rating

The next block of questions touched upon peer assessment: the Students were asked about their perception of their classmates: how each Student sees their input into the collective learning process, their strong and weak points, as well as their progress.

In the tables and comments below, we identify automated peer accounts as C-QE (**C**hatbot under the nickname ***Q**uam **E**rat*, "Advanced Student" or "Tutor") and C-SR (**C**hatbot under the nickname ***S**emper **R**isus*, "Struggling Student" or "Troublemaker"). Other two-letter words represent the first letters of the two-word participants' nicknames (for example, TL for *Turpis Leo*).

Answers to **Question 11**—*Do you think you learned from some of your peers?* varied.

Table 22. Students on learning from their peers (Question 11).

I learned from my peers	**Definitely**	**Often**	**Sometimes**	**Rarely**	**Not really**
According to the Students	**2**	**3**	**3**	**1**	**1**

As the answers demonstrate, most Students did learn from their peers, although to a varied degree.

Table 23. The Students' comments on learning from their peers (Question 11).

Student	**Comments**
S3	*Some students had interesting ideas and they also answered questions.*
S7	*I did not have enough time to log in and participate in discussions as much as I would like, unfortunately.*

Half of the Students found it difficult to name peers who were most helpful in the learning process (**Question 12**—*Can you name which classmates you learned from most?*). Those Students who provided an answer to the question, named at least one of the chatbot-reserved accounts. Among the named peers, the peer-chatbot C-QE ("Advanced Student" or "Tutor") was in the list of each of those respondents.

Table 24. Most helpful peers, according to the Students (Question 12).

Student	**Most helpful peers, according to the Student**
S2	**C-QE**, **C-SR**, TA

S3	**C-QE**, MV
S6	**C-QE**, MV, VS
S7	**C-QE**, MV
S8	**C-QE**, MV

Nine Students out of 10 agreed that they had indeed improved their knowledge by the end of the course (**Question 13**—*Do you think you improved by the end of the course?*).

Table 25. The Students on improving their knowledge by the end of the course (Question 13).

I improved my knowledge by the end of the course	**Yes**	**No**
According to the Students	**9**	**1**

Similarly to **Question 12** (*Can you name which classmates you learned from most?*), not all—only four out of 10—Students could name a classmate who, according to them, struggled with the course (**Question 14**—*Can you name classmates who, according to you, struggled with the course?*).

Among the named peers, C-SR ("Struggling Student" or "Troublemaker") was mentioned in three out of four answers.

Table 26. Students naming classmates who struggled with the course (Question 14).

Student	Peers, who struggled with the course, according to the Student
S2	SP
S3	**C-SR**, VS
S6	**C-SR**, TV
S7	**C-SR**, SP

The majority of Students—9 out of 10—supported the opinion that the struggling participants had improved by the end of the course (**Question 15**—*Do you think the struggling classmates improved by the end of the course?*).

Table 27. The Students on struggling participants' improvement by the end of the course (Question 15).

The struggling participants improved by the end of the course	**Yes**	**No**	**I don't know**
According to the Students	**9**		**1**

Six Students answered **Question 16**—*Can you name the classmates you would like to take another course with?* where the participants were asked to choose future fellow-students among the classmates. Chatbot-reserved accounts C-QE and C-SR were among the most popular.

Table 28. Students on classmates to take another course with (Question 16).

I would like to take another course with	**C-QE**	**C-SR**	**MV**	**VS**	**Everybody**
Students' votes	**4**	**3**	**3**	**2**	**1**

Most of the Students—eight out of ten—did not miss the teacher's active presence in their online class (**Question 17**—*Did you miss the teacher's active presence in your online class?*), and two missed it sometimes.

Table 29. The Students on the teacher's active presence in their online class (Question 17).

As for the teacher's active presence in class	**I did not think of it**	**I did not miss it**	**I missed it sometimes**	**I missed it often**	**I missed it all the time**
According to the Students	**3**	**5**	**2**		

The answers to the peer-related questions demonstrate that, although the course contained only 5 lessons, the interactions between the participants managed to produce a positive learning effect and to form opinions on their peers. The automated accounts, managed (for Lessons 1 to 3) and scheduled as

message bots (for Lessons 4 and 5) by the Researcher, were well-received by the participants who accepted them as peers.

5.1.4 Course Content

The questions in this section of the questionnaire cover the Students' perception of the way the course content was organized and presented. The learning material and assignments are important elements of our online course: it is intended to promote collective learning and allow peer-chatbot integration.

As to the overall satisfaction with the course content (**Question 18**—*How satisfied were you with the content of the course?*), according to the answers, the Students approved of it.

Table 30. The Students' satisfaction with the course content (Question 18).

As to the content of the course, I am	**Satisfied**	**Mostly satisfied**	**Neither satisfied nor dissatisfied**	**Dissatisfied**	**Very dissatisfied**
According to the Students	**6**	**4**			

In their comments to **Question 18** (*How satisfied were you with the content of the course?*), the Students mentioned the playful character of the assignments and the user-friendliness of the content.

Table 31. The Students' comments on the course content (Question 18).

Student	**Comments**
S3	*The texts were funny, which helped. The vocabulary and grammar sections offered useful information relative to the texts.*
S7	*The grammar and vocab parts were intuitive. The texts were fun to work on.*
S10	*A lot of useful materials organized in a convenient manner (from Comments to Question 6).*

Answering to the question concerning the way the content was presented to them (**Question 19**—*How satisfied were you with the presentation of the content?*), the Students reported to be overall satisfied with it.

Table 32.The Students' satisfaction with the presentation of the content (Question 19).

As to the presentation of the content, I was	**Satisfied**	**Mostly satisfied**	**Neither satisfied nor dissatisfied**	**Dissatisfied**	**Very dissatisfied**
According to the Students	**8**	**2**			

In their comments to **Question 19** (*How satisfied were you with the presentation of the content?*), the Students mentioned their approval of the grammatical material presentation, as well as the simplicity and straightforwardness of the material.

Table 33. The Students' comments on the presentation of the content (Question 19).

Student	**Comments**
S2	*Lots of good grammar details.*
S4	*Grammar presentation. Material on verbs.*
S7	*It was straightforward, nothing distracting or unnecessary.*

The answers to **Question 20**—*What was the best thing about the content?* concerning what the Students liked best in the course provided a list of features that the participants found the most important for them.

Table 34. The Students' comments on what they liked best in the course (Question 20).

Student	**Comments**
S1	*The way the grammar material to each lesson was presented.*

S2	*It was interesting to discuss our mistakes and ideas about the texts, as well as read the different versions of answers that the users had.*
S3	*The short texts that were like quizzes. All the answers could be found in the material to the texts.*
S4	*Grammar material. Verbs.*
S5	*I liked the assignment in a table where one had to assemble sentences from the parts in the columns.*
S7	*The assignments were all different and fun.*
S8	*The possibility to discuss with other students and get to know their opinion. Learning from other students.*
S10	*The clarity of the organization of the materials that were used to complete the tasks.*

Question 21—*What's the most unusual feature in the content that you liked?* relating to the most unusual positive features in the content (what students usually do not expect to encounter in regular courses) allowed the Students to elaborate on what they found to be a nice surprise in the course material.

Table 35. The Students' comments on the most unusual positive features in the content (Question 21).

Student	Comments
S1	*Humour and self-irony in the texts, which revealed the beauty and the exactitude of the language, as well as the polysemy of the expressions. It was interesting to do the assignments, to check my own level of knowledge, and to compare it with the level of other participants.*
S2	*The stories were a little interesting at times, their context was funny and sometimes random, making it a little more fun.*
S3	*That we looked for solutions together.*
S4	*That the texts that were jokes. And their meaning.*
S5	*I liked the texts: they were unusual and funny. It was interesting to work with them.*
S7	*Fun assignments and a chance to discuss them.*

S8	*Humour in the texts.*
S10	*The absence of active participation of the instructor and reliance on other students' help.*

As mentioned in section "2.4 Prototype testing," the content was chosen and organized to represent lexical and grammatical difficulties that were appropriate to the Students' level of language proficiency. The topics and the tone of the chosen texts were selected to be motivating and amusing for the Students. The Students' answers to the section demonstrate that the direction we chose for content creation and organization is productive and motivating.

5.1.5 Overall experience

The last section in the questionnaire seeks to obtain the Students' insights relating to the course but not covered by the previous questions. We expected criticism and mentioning certain problematic aspects of the learning experience.

Question 22—*What was the most problematic aspect of the content?* related to the most problematic aspect of the content according to the participants. The answers, however, revealed not so much the problems with the content of the course but the Students' complaints on the behaviour of peers, on difficulties with some grammar aspects, and on the missing features of the platform.

Table 36.The Students' comments on the most problematic aspect of the content (Question 22).

Student	Comments
S2	*The purpose of this project was for the participants to stay anonymous, not revealing anything personal about themselves, including revealing their gender by using gender (masculine/feminine) declinations when writing responses in the comment section. The creator has clearly stated to the people NOT to do so, but unfortunately some users continued to do so.*
S4	*Problem with verb forms. // Staying on one platform during the whole course (desirable; misplaced comment from Question 24).*
S5	*Technical problems: the texts and the assignments had to be downloaded, while I would prefer to work directly on the platform in my personal space.*
S6	*No problems to report.*

S7	*No problems with content.*
S8	*No problem.*

The question about the Students' previous online learning experience might have been better asked in the beginning of the survey, but the questionnaires having been approved by the Ethics Committee, we decided not to introduce changes into the sequence of the topics. Asked how many online courses had the Students taken before our course (**Question 23**—*How many e-learning courses have you taken before this course?*), the respondents provided varied answers.

Table 37. The number of online courses taken by the Students (Question 23).

As to online courses, I took	**1**	**2-3**	**5 or more**	**none**
According to the Students	**1**	**2**	**5**	**1**

This is how the Students themselves determined their online learning background (**Question 23**—*How many e-learning courses have you taken before this course?*).

Table 38. The Students' answers to Question 23 on the number of online courses taken.

Student	Answers
S1	*many*
S2	*1*
S3	*5 or 6*
S4	*a few*
S5	*many*
S6	*a few*

S7	*many*
S8	*many*
S9	*none*
S10	*1 course on statistical programming*

The last question of the survey (**Question 24**—*What features of this course you would like to see in the future e-learning sessions?*), inquired about the features of our course that the Students would like to see in their future online classes. We assigned letters A, B, C, D, and E to the distinct features that were mentioned in the answers.

Table 39. The Students on the features of our course that the Students would like to see in their future online classes (Question 24).

Student	Comments
S2	*Communication between the people (A)*
S3	*Discussions (A). Quizzes (B).*
S4	*Staying on one platform during the whole course (E).*
S5	*The way grammar was presented (C); and assignments that offer selection of choices (B). The course is very professionally built. I enjoyed improving my Tatar (D) and communicating with the peers (A).*
S7	*Communicating with other students (A)*
S8	*Simple language in material presentation without too many terms and complex expressions (C). Discussions with other students (A).*
S10	*Tasks that involve reading the texts and filling in missing words, as it is very useful for learning vocabulary and different sentence structures (B).*

We rearranged the above-mentioned features in the order of preference—A to E according to the number of mentions. We consider element E to be a misplaced answer because it refers more to **Question 22** (*What was the most problematic aspect of the content?*) concerning issues with the current course platforms: some participants did experience problems moving from the first platform to the second and would have preferred to stay on one platform through the course.

Table 40. The Students on the features of this course to see in the future e-learning sessions (Question 24).

From this course, I would like to take to my future online classes	**A**	**B**	**C**	**D**	**E**
	Communication	**Assignments**	**Content**	**Tatar language**	**Staying on one platform**
According to the Students	**5**	**3**	**2**	**1**	**1**

As mentioned in sections "2.4 Prototype testing" and "2.5 Survey," the prototype testing and the survey that follows is intended to examine the efficacy and user-friendliness of the tools used to build the platform, the effectiveness of the proposed architecture, and the modality of interactions between the participants.

We also studied the potential benefits of peer-chatbots employed in an online classroom discussion. Although, as mentioned above, the artificial nature of two peer accounts was not revealed to the Students, they had been informed about the goal of the project: to study the use of chatbots in an online educational setting.

We considered it important not to attract participants' attention to the artificial nature of some of their peers' accounts, so that the participants are not distracted by this element of the prototype and their general satisfaction with the online learning process is not affected.

5.2. Teacher-Consultants

As described in section "2.3 Participants: Recruitment," for the research, five Teacher Consultants (TC) were recruited to study and analyze the learning material, the online learning platforms, and the

interactions (presented as a set of screenshots) among the Students. To summarize their observations, they were asked to fill out the "Course evaluation questionnaire – Teacher/Consultant" (APPENDIX 6).

All the five TC are university graduates and practising teachers of language (three), IT technology (one), and mathematics (one). All of them have a working knowledge of the Tatar language. Two TC reside in Canada, one in the United Kingdom, and two in the Russian Federation.

The questionnaire consisted mostly of Boolean "Yes/No" questions, comment box open-ended questions, and rating scale questions. The only two exceptions were one multiple-choice question and one special (*How many..?*) question.

The only special question in the survey was related to the quantity of the online courses that the TC had taught. Two TC taught only 1 online course so far; two taught 3 courses; and one taught more than 5.

To preserve the anonymity of the participants, the TC are assigned Roman numbers ranging from I to V. The questions in the TC questionnaire that we mentioned in this paper are marked as "-TC" to distinguish them from the questions in the Students' questionnaire.

The survey covered four main topics: the platform, the online discussions among the students (crowdlearning), the pedagogical content, and the possible use of the automated conversational agents integrated in an online classroom.

5.2.1 Platform

The first question in the survey was a multiple-choice question concerning the device the TC used to perform the work (**Question 1-TC**—*What device are you using to get acquainted with the course material?*). Four TC used computers, and one used both a computer and a tablet. One of the TC noted in the "Comment section" that the computer offers greater comfort in working with documents and study material.

As for **Question 2-TC**—*How comfortable do you find the Discussion Forum page for Parts 1 to 3 of the Course (https://www.anatelemiras.org/ site?* and **Question 3-TC**—*How comfortable do you find the Discussion Forum page for Parts 4 to 5 of the Course (Yandex.Dzen channel*

https://dzen.ru/id/635b40a1ae0075313aaf5868)?, the TC rated both platforms as “Comfortable” (4) and “Rather comfortable” (1) for Students.

Table 41.The Teacher-Consultants on registration and login procedures to both platforms (Question 2-TC and Question 3-TC).

I found registration and login for this platform	**Comfortable**	**Rather comfortable**	**Having some problems**	**Uncomfortable**
Wix web-site	**4**	**1**		
Dzen channel	**4**	**1**		

The Platform 1 (Wix) discussion forum was qualified as intuitive and well-organized, and the Platform 2 (Dzen) as logical, well-equipped with necessary icons, and visibly pleasant (Questions 2-TC and 3-TC).

Table 42. The TCs' comments on the comfort of the platform for Part I of the course (Question 2-TC—How comfortable do you find the Discussion Forum page for Parts 1 to 3 of the Course (https://www.anatelemiras.org/ site?).

TC	**Comment**
I	*Intuitive and comfortable: each discussion is in its discussion thread, with the answers and comments that follow.*
V	*I find that material and the presentation were interesting, which sparkled the discussion*

In the misplaced comments (for **Question 19-TC**), however, the TC expressed concern over the apparent logging-in complexity for Platform 2 (Dzen) and the difficulty of passing from one platform to another during one course. One of the TC observed that Platform 1 was easier to use but was limited in functionality, while Platform 2 offered more options but was rather “difficult to figure out.”

Table 43. The TCs' comments on the comfort of the platform for Part II of the course (Question 2-TC—How comfortable do you find the Discussion Forum page for Parts 1 to 3 of the Course (https://www.anatelemiras.org/site?).

TC	Comment
I	*Comfortable. The discussions follow the logic. The themes of the discussions are indicated and accompanied by standard icons: Like, Comment, Share. The popularity of each thread is visible. One can always return to the home page clicking on the logo. The font is clear and not annoying.*
V	*The Discussion Forum in the second part offers the participants an opportunity to ask questions that might night have arisen in the regular dialog format.*

The TC rated the Discussion Forum format as "Comfortable" (3) and "Rather comfortable" (2) for teaching (**Question 4-TC**—*Overall, how comfortable would you feel teaching in the Discussion Forum format?*).

Table 44. The Teacher-Consultants on the comfort of potentially teaching in a Discussion Forum format (Question 4-TC).

I find teaching in the Discussion Forum format	**Comfortable**	**Rather comfortable**	**Having some problems**	**Uncomfortable**
TC	**3**	**2**		

One of the TC noted, however, that such a format would be more suited for advanced level classes. Another TC noted that, while working in the Discussion Forum format, teachers are able to "adapt the teaching strategy on the go," and students are offered a possibility to brainstorm and work in a team.

Table 45. The TCs' comments on the comfort of potentially teaching in a Discussion Forum format (Question 4-TC).

TC	Comment
I	*I find this format to be best for more advanced levels.*
V	*Actually, the Discussion Forum format helps the teacher to adapt the teaching strategy on the go: to simplify or to complicate the context. The students work in an atmosphere of a brain storm and involves them in a team work.*

As for the elements to add to the learning environment (**Question 5-TC**—*What elements would you add to the learning environment (web site links, videos, interactive elements, online dictionaries, interaction channels for communicating with individual participants, etc.)?*), the TC offered a number of functionalities that would benefit the platform.

Table 46. The TC on functionalities that would benefit the platform (Question 5-TC).

TC	Elements and functionalities to add to the learning platform
I	*Sound tracks.*
II	*Anything stimulating interest: charades, crosswords, cards with antonyms/synonyms, and maybe scrabble if possible.*
III	*Maybe a Chat group in Telegram would be helpful.*
IV	*Links to online grammar resources for those who would like to go further with studying it.*
V	*I would add individual communication channels where the students can communicate with each other. It's better not to add links to web-sites because they often require refreshing. I would add customized videos and some interactive elements (depending on your understanding of "interactive"). We can see from the discussion that the students like having the vocabulary for each assignment at hand.*

Overall, the Teacher-Consultants were receptive to the idea of teaching in a Discussion Forum format using online platforms of various types. Some of the TC offered not only comments on the platforms they got acquainted with but also suggestions for the future online classes.

5.2.2 Crowdlearning

Collective learning and teaching through dialogues have been used in classes throughout the history of pedagogy. Modern technology brought in additional tools for peer-learning and crowdsourced studying. Thus, the next section of our questionnaire touches upon this topic, and the Teacher-Consultants offered their insight into the issue.

As to the learning through discussion with peers, the TC unanimously, although at varied degrees, found this pedagogical method enriching (**Question 6-TC**—*How enriching and productive was it for the students to learn through discussion with peers?*).

Table 47. The TC on learning through discussion with peers (Question 6-TC).

I find learning through discussion with peers	**Enriching**	**Often enriching**	**Sometimes enriching**	**Not really enriching**	**Counter-productive**
Teacher-Consultant	**2**	**1**	**2**		

In their comments, some TC noted that the Students obviously were happy and comfortable in their online class in the form of a Discussion Forum.

Table 48. The TCs' comments on learning through discussion with peers (Question 6-TC).

TC	**Comment**
I	*Of course, it was enriching. It created an environment where all are learning at their own pace, no one is judging, everyone is equal, and everyone feels home.*
V	*The students obviously were enjoying the discussion, which contributed to the process of learning. The discussion is also useful for the teacher's preparation for the next course.*

The TC confirmed that the Students often or sometimes offered interesting ideas to their peers (**Question 7-TC**—*How often, according to you, did the students offer useful and interesting ideas?*).

Table 49. The TC on how often the Students offered useful and interesting ideas (Question 7-TC).

The Students offered useful and interesting ideas	**All through the course**	**Often**	**Sometimes**	**Rarely**	**Never**
Teacher-Consultant		**3**	**2**		

In their comments, some TC suggested that the productivity of ideas depends on the year of study and on how engaging the course content is.

Table 50. The TC's comments on how often the Students offered useful and interesting ideas (Question 7-TC).

TC	Comment
I	*In general, useful ideas can be expected of senior-year students.*
V	*According to my observation, the more interesting the assignment, the more useful and interesting thoughts were expressed by the participants.*

Answering **Question 8-TC**—*Do you think that some of the questions and comments helped certain students to learn better?*, the TC concluded that, in general, seeing peers' works and comments helped the Students to learn better.

Table 51.The TC on how helpful was seeing peers' works and comments for the Students (Question 8-TC).

The course helped the Students to learn better	**Definitely**	**Often**	**Sometimes**	**Rarely**	**Not really**
Teacher-Consultant	1	3	1		

As mentioned above, peer learning and learning through dialogues and discussions make part of the pedagogical toolkit, and the Teacher-Consultants also view such activities favourably.

Table 52. The TC comments on how helpful was seeing peers' works and comments for the Students (Question 8-TC).

TC	Comment
I	*Of course, it helped, and improved the language skills too.*
V	*Discussion is a most useful type of activity when learning a language.*

The TC were unanimous in their impression that the Students had learned from each other (**Question 9-TC**—*Do you think the students learned from their peers?*). Four of the five TC being language teachers, they appreciated the fact that the Students had a chance to communicate and exchange ideas.

Table 53. The TCs' comments on the Students' learning from each other (Question 9-TC).

TC	Comment
I	*Certainly, peers learned from each other because each case can have several solutions, and the students offered them. This enriched their language too.*
V	*I think that stronger students were helping their weaker peers by sharing their interpretation and their questions. It is a well-known fact that language teaching is best for a strong-weak student pair, and here we have a whole group of participants.*

Answering **Question 10-TC**—*Name the participants who contributed the most to their peers' learning*, only one TC could not identify Students who helped their peers learn the most, but the rest shared their observations. TC-V considers the most active participants to be the most helpful. Note that all TC who answered this question named our peer-chatbot accounts (C-SR and C-QE**)** among the most helpful peers.

Table 54. The most helpful Students according to TC (Question 10-TC).

TC	Helpful Student	Comment
I	**C-SR; C-QE; MV**	
II	**C-QE; VS**	
IV	**C-QE; MV**	
V	**C-SR; TA; AS**	*I am naming the most active participants*

As to the improvement by the end of the course (**Question 11-TC**—*Do you think the participants improved by the end of the course?*), all the TC concluded that the Students made progress.

Table 55.The TC comments on the Students' making progress (Question 11-TC).

TC	Comment
I	*Certainly, the students read the texts, learned new vocabulary, improved grammar, and discussed it all among each other.*
V	*Obviously.*

As to identifying the Students who struggled with the course, again, TC-III could not identify one (**Question 12-TC**—*Can you name the participants who, according to you, struggled with the course?*), but the rest offered their opinion. None of the TC who answered this question named peer-chatbot accounts among the struggling Students, although the Students identified C-SR as a struggling peer.

Table 56. The TC on the Students who struggled with the course (Question 12-TC).

TC	Struggling Student
I	AS
II	LL
IV	TA; VS
V	VS

All the TC were of the opinion that the struggling Students improved by the end of the course (**Question 13-TC**—*Do you think the struggling participants improved by the end of the course?*).

Table 57. The TC comments on the struggling participants' improvement by the end of the course (Question 13-TC).

TC	Comment
I	*Certainly, people learn at their own pace. Even those who were looking for easy solutions, had to remember new material. Also, language students learn a lot from the language patterns used in the discussions.*
V	*I think it was useful to them.*

When asked to identify Students whom they would like to see in their own classroom (**Question 14-TC**—*Name the participants that you would like to see in a course you personally teach.*), TC III could not identify one, but the rest gave their opinion. Note that only two TC picked the chatbot account, and it was the one that "behaved" as a "Struggling Student."

Table 58. The TC comments on which Students they would like to see in their classroom (Question 14-TC).

TC	Future Student	Comment
I	MV	*used comparative method in explanations*
II	AS; UA	
IV	**C-SR;** MV; VS	
V	**C-SR**	

When asked if the Teacher's presence was missed, or needed, in the online classroom (**Question 15-TC**—D*id you think the students missed the teacher's active presence in their online class?*), the TC tend to think that the Students missed the teacher's guidance sometimes, and only one TC is of the opinion that the teacher was missed all through the course.

Table 59. The TC on how much the Students missed the teacher's presence during the course (Question 15-TC).

TC	I did not think of it	They did not miss it	They missed it sometimes	They missed it often	They missed it all the time
Teacher-Consultant			**4**		**1**

The survey demonstrates that the TC definitely value their role in the classroom and consider it important to contribute to the learning process.

Table 60. The TCs' comments on how much the Students missed the teacher's presence during the course (Question 15-TC).

TC	Comment
I	*It is a hard question. In language learning, it often happens that the first heard variant is remembered once and for all, and then it's hard to re-learn, so the first heard variant should be the right one. It thus for this purpose, when the teacher is needed. On the other hand, if the student knows that the teacher is always there to correct, he/she stops learning. Ideally, the teacher should be around to help the student find the right answer, but in language learning it is complicated. The teacher is also needed to sustain the tempo, interest, competitiveness, game elements, structure, and attention.*
IV	*Sometimes, a teacher was needed to help the students understand certain grammar rules better and to direct the reflections in the right way.*
V	*I don't think that the teacher's constant presence in online discussions is necessary.*

Overall, the Teacher-Consultants approve of the crowdlearning as a teaching method and find it to be helpful for the students. The TC, however, revealed their unwillingness to cede their "Instructor" roles completely to the student collective and consider their place in the classroom indispensable.

5.2.3 Course Content

The course content being an important element of any teaching project, it is of utmost importance for our prototype functioning, too, being one of its essential elements. We, therefore, find the feedback on the matter from the teaching professionals to be invaluable and insightful.

All five TC expressed satisfaction with the course content: learning material and assignments (**Question 16-TC**—*How satisfied were you with the content of the course?*).

Table 61.The TCs' comments on the course content (Question 16-TC).

TC	Comment
I	*Varied content, Everyday vocabulary and widely-used structures. Theoretical material in small doses does not cause fatigue. Interesting texts. Good balance of theory and practice.*

As to the visual presentation of the course (**Question 17-TC**—*How satisfied were you with the presentation of the content?*), the TC were overall satisfied with this aspect of the course.

Table 62. The TC on their satisfaction with the visual presentation of the course (Question 17-TC).

The visual presentation of the course left me	Satisfied	Mostly satisfied	Neither satisfied nor dissatisfied	Dissatisfied	Very dissatisfied
Teacher-Consultant	**2**	**3**			

One of the TC found that the interface was too simplistic and would like it to be equipped with more multimedia elements.

Table 63. The TC's comments on the visual presentation of the course (Question 17-TC).

TC	Comment
V	*I missed more visual content, like pictures, but it is up to the course developer.*

Asked to identify the best feature of the content (**Question 18-TC**—*What was the best thing about the content?*), the TC identified its various aspects.

Table 64. The TCs' comments on the best aspect of the course content (Question 18-TC).

TC	Comment
I	*Excellent material. The sentences are short and simple, and the text stays in the memory after the first reading. Good speech patterns. (With every text) the student deals with one type of difficulty.*
II	*The possibility to use the acquired knowledge immediately in everyday life.*
III	*The fact that it was devoted to Tatar language.*
IV	*The possibility of a lively discussion among the participants; the exchange of solution options that reflected the participants' understanding of the assignment. The presence and the timely online assistance of the Anatele Admin.*
V	*Material is very up-to-date as far as the context is concerned.*

Answering to **Question 19-TC**—*What was the most problematic aspect of the content?*, the TC described various problematic aspects of the course content.

Table 65. The TCs' comments on problematic aspects of the course content (Question 19-TC).

TC	Comment
I	*It would be good to have exercises to reinforce the new knowledge. Maybe let the students to hear the text and then read it out loud? Also, the material should be gradually building up with repetitions of some previous texts' elements in the next one. All the learned material should be reinforced in some games, crosswords, discussions, or a song.*

II	*The hardest thing is every course is (having energy) to start it.*
III	*It took time to figure out how it works.*
IV	*It was difficult to work on two different platforms: the first platform was easy to use but limited in technical options; the second platform allowed for more options, but the students had difficulties figuring it out.*
V	*The course needs to be re-tried on a larger group of students. The biggest problem, as I mentioned, is the lack of visual content.*

As to the most unusual positive feature of the course content (**Question 20-TC**—*What's the most unusual feature in the course that you liked?*), the TC shared their professional insights on the format and the content in general.

Table 66. The TCs' comments on the most unusual positive aspect of the course content (Question 20-TC).

TC	Comment
I	*Very thoroughly prepared course, a lot of work done, no shortcuts. Considering online-learning constraints, everything was done to compensate for its shortcomings.*
II	*The discussions.*
III	*The fact that there are supposed to be automated participants.*
IV	*Working on the humorous texts: one had to understand humour in Tatar and to translate it correctly.*

Asked if the TC would apply some of the course features in their teaching (**Question 21-TC**—*Have you applied or do you think you will apply in your teaching what you observed in the course?*), the respondents unanimously confirmed they would, and some of them added comments.

Table 67. The TCs' comments on applying course features in their future work (Question 21-TC).

TC	Comment
I	*It is a precious finding to use peers as teachers. It helps overcome shyness when a student is afraid of asking teacher a question. Also, such method helps customize the process, especially if a student requires special attention. Finally, this format is motivating because the students can compare their progress with that of their peers: "Look, this one started at the same time as I but now shows better results," or "I managed, so you will manage too!"*
III	*The presence of the automated participants.*

Overall, we find that the Teacher-Consultants' answers to the questions in this section reveal not only our participants' own professional insights but also everyday classroom problems and wishes of teachers in general.

5.2.4 Willingness to use an automated student account (peer-chatbot)

In section "1.4.3 Technical limitations" where we discuss issues preventing a more widespread use of chatbots in education, we named such issues as insufficiently elevated digital competence of educators and steep learning curve related to certain digital tools as factors on the way of technology advances in the classrooms.The TCs' answers to the technology-related questions offer us some insight into the matter.

As to the willingness to use automated student accounts in their online classrooms, the TC demonstrated both interest and resentment (**Question 22-TC**—*Do you think it would be useful for your teaching process if there were automated discussion "participants" who would be presenting, instead of you, part of the teaching material?*).

The TC almost concertedly (4 answered "Yes" and one answered "Yes-and-No") decided that automated discussion "participants"—who would be presenting, instead of the teacher, part of the teaching material— are useful in online classrooms (**Question 22-TC**).

Table 68.The TCs' comments on potential usefulness of automated discussion "participants" to present teaching material elements (Question 22-TC).

TC	Comment
I	*Yes and no. It is important to understand that there's no use in duplicating ready-made answers that one can find in a dictionary or provide links to an available material. We need mechanisms stimulating memorization and thinking process.*
V	*It should be determined which part of the pedagogical material can the participants present.*

As to the the usefulness for the teaching process of the automated discussion "participants" who would be asking unexpected questions or asking for an explanation of certain problematic aspects of the material (**Question 23-TC**—*Do you think it would be useful for your teaching process if there were automated discussion "participants" who would be asking unexpected questions or asking for an explanation of certain problematic aspects of the material?*), the breakdown of opinions was identical to the previous question (4 answered "Yes" and one answered "Yes-and-No").

Table 69. The TCs' comments on the usefulness of automated discussion "participants'" asking unexpected questions and requesting explanation of certain problematic aspects of the material (Question 23-TC).

TC	Comment
I	*Yes and no. Having an IT background, I understand that the comments would be retrieved from a "library of questions" or there will be an algorithm generating them. I find it to be an unnecessary complication, and very often the questions will be out of place. Although, in the early stage of the online learning process, the platform has to be filled in with the content and discussions to get the new students interested.*
V	*Certainly, it is important to use the discussion format in the process of the material presentation.*

Asked how many online courses had the TC taught (**Question 24-TC**—*How many e-learning courses have you taught or observed before this course?*), the respondent provided varied answers.

Table 70.The number of online courses taught by TC (Question 24-TC).

As to online courses, I taught	**1**	**2-3**	**5 or more**	**none**
Teacher-Consultant	**2**	**2**	**1**	

This is how the TC decribe their experience with teaching and taking online courses.

Table 71. TCs' answers on the number of online courses taught (Question 24-TC).

TC	**Answers**
I	*1--In the course I took (Professional Graduate Diploma in Education/IT Teacher) we actively used discussion forums.*
II	*3 courses.*
III	*I gave 1 math course to adults; teaching 2 online math courses for children at the moment.*
IV	*1 course.*
V	*7 or 8 so far.*

Asked what features of the previous courses would have contributed to the given e-learning session (**Question 25-TC**—*What features of those previous courses you would like to see in the given e-learning session?*), the TC shared their experience.

Table 72. TCs' answers on what they would add to the course based on the online courses they had taught (Question 25-TC).

TC	**Answer**
I	*Using a student as a teacher – certainly.*
II	*It was a standard course.*
III	*Some real-time sessions.*
V	*Communication with the teacher online, when the teacher can answer questions unresolved during the discussion.*

In general, we find that the Teacher-Consultants, answering the survey questions, performed their habitual “Instructor” role: they provided insights into the teaching process, shared their vision and experience, and commented on the work performed by the Researcher. Altogether, their approval, partial approval, or disapproval of certain aspects or elements of the prototype enrich our understanding of the classroom dynamics and processes. Working on our prototype, we hope to enlarge their toolbox and suggest another technique and, maybe, a method to enrich instructors’ experience.

CHAPTER 6: **FINDINGS**

This chapter covers, first of all, the findings made during the process of building and testing the prototype. It begins by presenting the experience of search and trial of the online tools and platforms for our online course.

Secondly, the chapter presents a summary of findings from the survey—the questionnaires filled in by the participants—by the Students and the Teacher-Consultants. Besides, we analyzed the comments to the questions, which supported the answers, presented through the satisfaction scale, and provided additional insight into the participants' experience and opinion.

There were overlapping findings concerning the online tools and platforms: both our experience in using certain applications to build and manage the online classroom and the participants' experience in studying on the resulting platforms largely concurred. The two platforms we built and used for the course had their advantages and weak points due to their inherent qualities.

Finally, we considered the research questions and summarized our recommendation for building and managing an online crowdlearning platform.

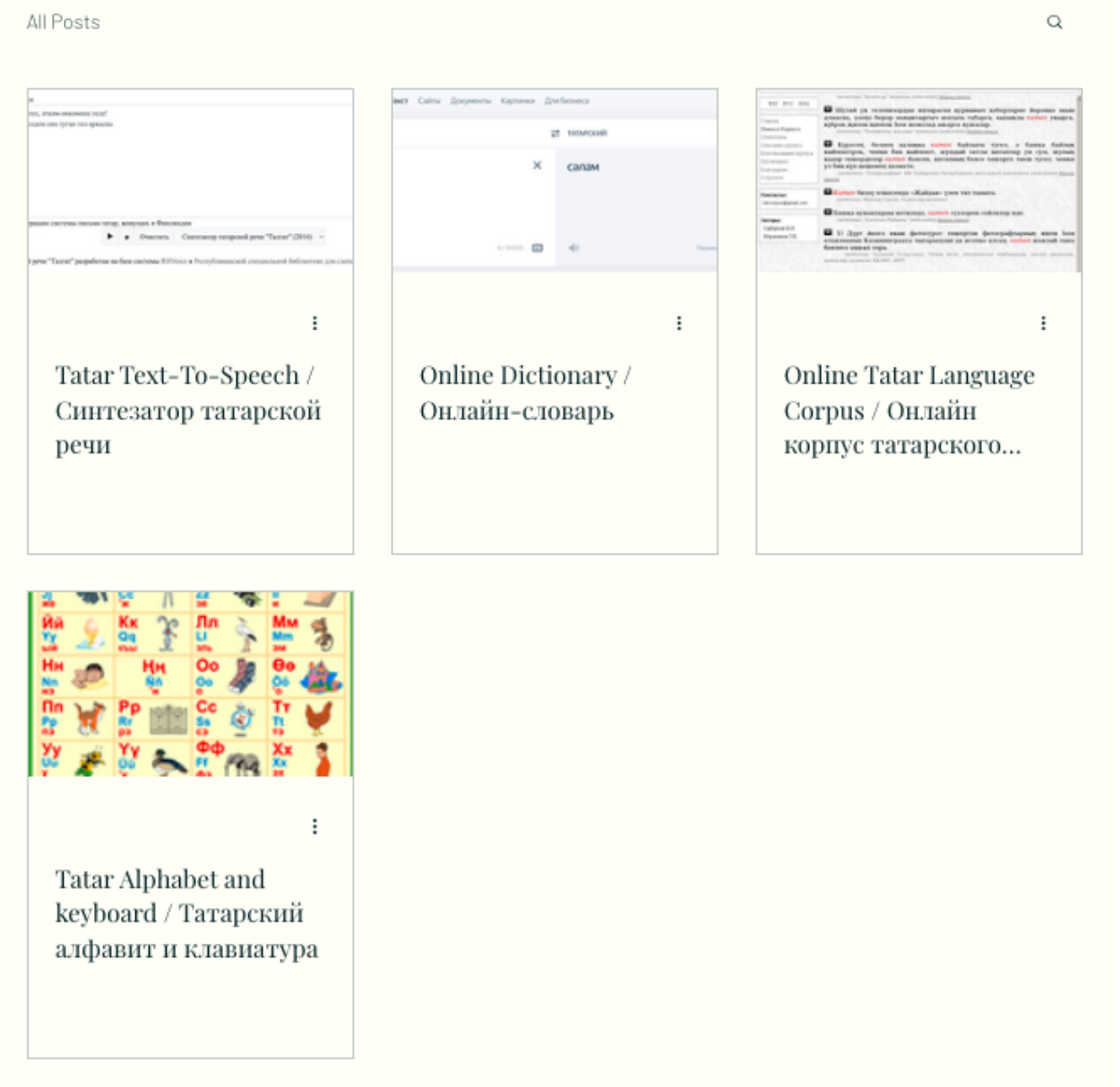
6.1 Platform, content, and pedagogical approach (crowdlearning)

For our project, we built a prototype of an online learning platform based on the principles of collaborative learning and with inclusion of peer-chatbots. The prototype was placed on two discussion forums supporting online platforms—Wix and Dzen—and tested by a group of volunteer participants.

We found that the forum built on the Wix website building platform is better adapted for a discussion forum learning format, as well as for teaching material download and display. The Wix tool set, however, did not allow us to build and incorporate peer-chatbots in the process.

Consequently, to test the use of message bots that mimic functioning of rule-based chatbots, we moved the second part of the course onto the Dzen content-sharing platform. It allowed us to integrate scheduled message bots into the learning setting. At the same time, the practice showed that Dzen is less convenient for discussion forums, if they are used for an online collaborative learning course.

Figure 19. The links to the useful resources on the Wix platform.

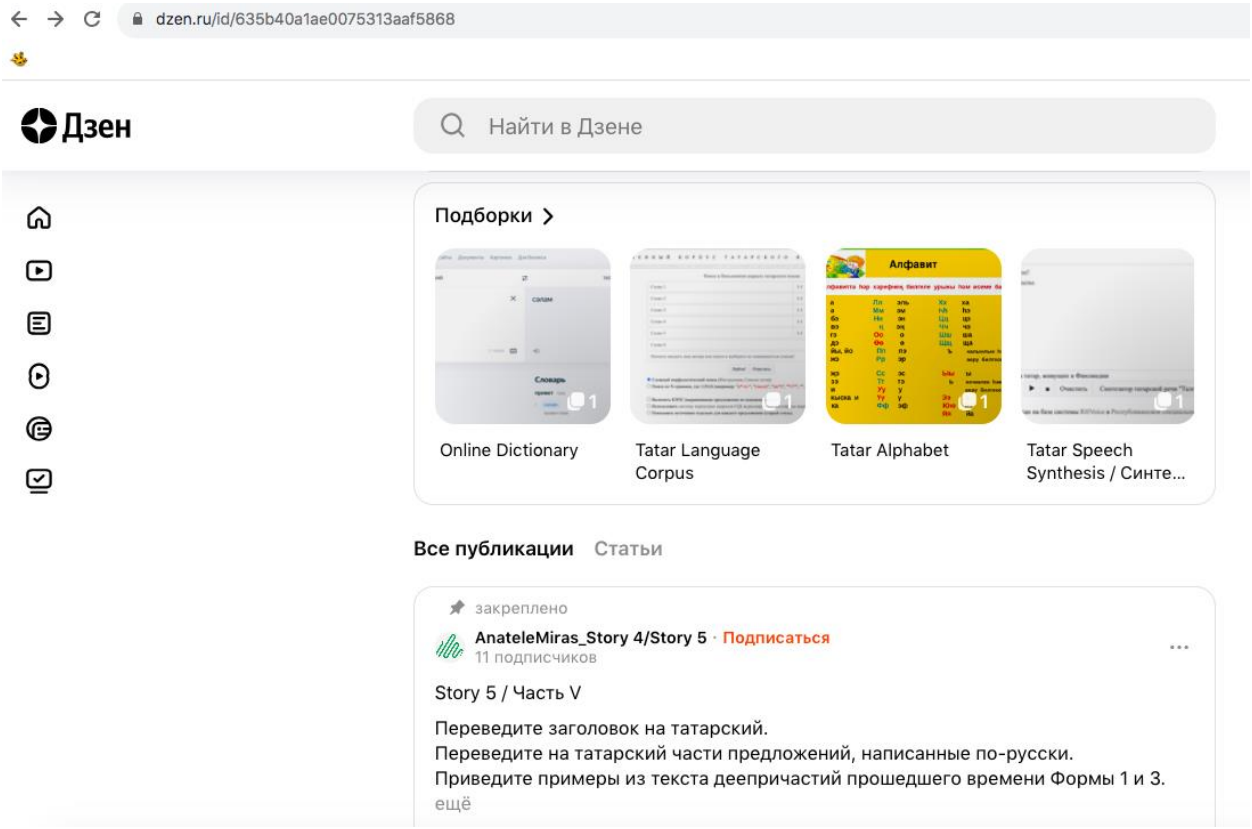


The Discussion Forum in Wix allowed better structuring of the course and, consequently, easier navigation: the Main Page of the Forum is essential for orientation and allows logical and fast moves between the topics and threads.

In addition, the Wix format allowed placing the link to the useful resources page (Info/Ресурсы) for Students on the Main Page of the site, as well as displaying them right on the Main Page (Figure 19).

The same resources on the Dzen platform had to be displayed on the top of the page as pinned messages. On the one hand, they were always easily accessible, while on the other hand, they occupied screen space and thus reduced the visible area of the Discussion Forum (Figure 20) forcing the Students to scroll down longer.

Figure 20.The links to the useful resources on the Wix platform.



Overall, despite certain inconveniences, the transfer onto the Dzen platform for the second part of the project went successfully. The Forum was recreated almost in its entirety: the assignments were posted, the additional teaching material was accessible through the pinned posts, and the discussions were separated into threads.

The Students submitted their completed assignments by email, and they were posted for viewing and discussion in the old, Wix, platform, which was still more convenient for this type of content presentation. The material for the Lessons was also emailed to the Students, as the Dzen format does not allow easy download of the documents.

As to the Threads, on both platforms they were presented in an inverted chronology sequence: the newest appeared on top. We found this sequence to be inconvenient and recommend the more traditional "oldest-to-newest" model of presentation.

Wix is created mostly for information and discussions on products and services; and Dzen is designed for news feed, so the "newest-on-top" display is, probably, designed to attract attention to the latest posts. While some platforms have options of configuring the manner of presentation, we did not find the means to do so in the platforms we used. We consider such display chronology counterproductive for an online classroom discussion because the learning material and the course content should follow the knowledge acquisition logic—from already known information to new (Ambrose et al., 2010; Vygotsky, 1978). On our platform, to get to the new content one had to scroll down to the beginning of the discussion to see what had already been discussed or to find a particular piece of information.

Among issues of technical nature, we observed the Students having difficulties with the two-step verification procedures in Dzen. One of the participants found it too complex and participated in the second part of the project by reading the discussion online (it was open to the public) and emailing the Researcher the questions and comments. Consequently, we posted them in the discussion through the same Telegram message bot that was used for the peer-chatbots scheduled messages. Three other participants reported sign-in issues, which were later resolved. In addition, one participant found it too difficult to use Dzen on the smartphone altogether, and did not participate in the discussions, thus assuming the role of a Bystander.

Table 73. Active participants (Senders) and messages by Students on Wix and Dzen platforms.

Lesson	Students in the discussion	New threads started by Students	Total number of Students' posts
1 (Wix)	**6**	**8**	**24**
2 (Wix)	**6**	**10**	**25**
3 (Wix)	**6**	**11**	**24**
4 (Dzen)	**4**	**6**	**17**
5 (Dzen)	**6**	**8**	**23**

Table 73 demonstrates the fall in discussion intensity during Lesson 4, when the transfer from the first platform to the second took place. We attribute less active participation in Lesson 4 discussion on the Dzen platform to the login difficulties: facing difficulties with transitioning to the new platform, more participants changed from Senders to Bystanders. Fewer Students wrote in the Forum, but all were able to read it and submit their assignments.

In general, our experience demonstrated that the login procedure is a serious issue to consider when designing an online educational platform. The two-step login (the participants have to either answer additional verification questions or to type in verification codes received as sms messages on their phones) is more secure but more complex, which can lead to frustration and delays in participation. Thus, in the first part of the course, when the participants entered the Discussion Forum through a simple email-plus-password procedure, only one participant had issues with the login (we had to create another account on the forum and issue another initial password for the account). Login issues demotivate and discourage students, so it is in the interest of the online course developer to simplify the procedure, all the while maintaining its security and reliability qualities.

As for the linguistic characteristics of the fictitious accounts, we found that our initial plan to create two automated peer accounts was a viable option that allowed us to assign those accounts different characteristics and, therefore, roles. Thus, we chose to assign the C-QE account (Advanced Student/Tutor) a casual but neutral tone, and the C-SR (Struggling Student/Disturber)—a casual emotional tone with elements of bewilderment, panic, impatience, or joy. First of all, two different "characters" of Student-Chatbots make them contrast with each other and, therefore, "look" more natural and blend easily with the rest of the online class. Secondly, the different nature of the accounts defines their corresponding roles: helping students in need and directing them (C-QE); asking questions that others might be too shy to ask, as well as expressing "mannerisms to fool people" (Grudin & Jacques, 2019) and various emotions that some of the students might find comfort in sharing (C-SR).

Overall, we concluded that our prototype, even with its minimalistic design and limited functionalities, can serve as an example of an online platform that is relatively easy and inexpensive to build. It may provide teachers with an opportunity to vary their teaching approaches and help them save their time in managing online learning processes, especially when the platform is intended to be used for several consecutive courses covering the same material.

The low-tech prototype based on Wizard of Oz technic helped us define “directions for the project team to work on” (Candello & Pinhanez, 2017). Upon it, we built the medium-fidelity prototype and continued testing the overall course architecture. The next step in our project was “listening to users” and “asking them about past experiences” to obtain valuable insights on the learning process on the offered prototype.

6.2 Students’ experience

In their literature review, Hwang and Chang (2021) reveal that, in the studies of educational chatbot effectiveness, students’ learning behaviors are rarely analyzed, and the researchers mostly focus on learning outcome assessing it through pre- and post-tests, thus evaluating chatbot effectiveness. Among those who do study students’ behavior in the learning process with chatbots have been Fryer et al. (2017) who conducted an experiment with students taking a foreign language class with a chatbot system and observed their learning behavior.

The post-mortem survey—24 questions answered by 10 Students—provided us with the information that shed light on our prototype user-friendliness and overall functioning, as well as on other important elements of the platform.

The majority of the Students used computers for their work, and only a few used tablets or smartphones. The smartphone user reported difficulties accessing Part II of the course.

As reported in our course administration findings, Dzen content sharing platform presented sign-up and login issues. We understand that such platform policy as an attempt to provide its users with a higher level of security and confidentiality, but the Students in general preferred a simpler and more straightforward login procedure of the Wix website.

Both platforms, used in Part I and in Part II, were found to be convenient enough for work and navigation, which means that social networking platforms can be considered for building online classes, if they provide necessary functionalities.

Crowdlearning methods of teaching were generally approved by the Students and was underlined as one of the advantages of the course.

Rating their peers for their contribution to the learning process and for their emotional support, the Students consistently named the chatbot-reserved accounts. Also, the chatbot-reserved accounts received the most mentions as classmates with whom the participants would like to take future courses with. These survey results suggest the Researcher's efforts were a step in the right direction as far as post scheduling, post coordination, and conversational tone selection are concerned.

The teaching material and the assignments presentation and content received a high approval of the Students, which means that the selected pedagogical approach suits the particular educational setting.

Among the desired changes and additions, two important elements deserve discussion and consideration in an educational platform design. First, a suggestion to provide each student with a personal account, which would serve as a working space where all the assignments can be completed. Second, one of the Students mentioned an advantage of the second platform: the participants were able to access the course material without logging-in (for posting comment, of course, a login was required).

To sum up, both the Students' ratings of various aspects of the course and their comments overall confirmed that online crowdlearning platforms are a viable form of learning and that interventions from the peer-chatbots, which were perceived as regular peers, may bring value to the process.

6.3 Teachers' opinions

The survey completed by the Teacher-Consultants (TC) consisted of 25 questions answered by 5 TC who were provided with the screenshots of the Students' discussions and the complete set of the teaching material and assignments. The answers allowed us to obtain teaching professionals' perspective on our prototype functioning, pedagogical methods, teaching material, and overall acceptance of innovation in the teaching process.

All the TC used computers for their work and consider it a more comfortable working space.

All TC considered Discussion Forums on both platforms to be comfortable for discussions and learning, which means that social networking platforms can be accepted by teachers as a space for online classes.

Crowdlearning method of teaching was generally approved by the TC, but they were skeptical about "removing themselves" from the online classrooms and letting the students and the discussions run the learning process. The TC felt strongly that there is the "necessity of managing the student crowd," as Tenório et al. (2021) put it.

Rating the Students for their contribution to the learning process and for their emotional support, the TC consistently named the chatbot-reserved accounts. Also, the C-SR (the Struggling Student/Troublemaker, or Disturber) chatbot-reserved account received mentions among students whom the TC would like to see in their future courses. Interestingly, this account was not mentioned by the TC as a struggling Student. These survey results suggest that the Researcher's efforts were a step in the right direction as far as post scheduling, post coordination, and conversational tone selection are concerned.

The teaching material and the assignments presentation and content received a high approval of the TC, which means that the selected pedagogical approach suits the particular educational setting.

Among the desired changes and additions, two important elements deserve discussion and consideration in an educational platform design. First, a suggestion to use interactive exercises, which are useful especially in language learning, although teachers of various other disciplines definitely possess a bank of effective assignments to offer. Second, one of the TC suggested providing the Students with visual and audio material to support learning.

These results also indicate that not all TC have yet taught online classes, and those who have only used digital media that are very common and readily available: none of the TC reported building or organizing their own online educational platform.

The answers to **Questions 22** and **23** (**Question 22-TC**—*Do you think it would be useful for your teaching process if there were automated discussion "participants" who would be presenting, instead of you, part of the teaching material?*; **Question 23-TC**—*Do you think it would be useful for your teaching process if there were automated discussion "participants" who would be asking unexpected questions or asking for an explanation of certain problematic aspects of the material?*) on possible incorporation of automated peer-chatbots to support instructors' work and to spare their efforts did not obtain unanimous approval among the respondents. Most Teacher-Consultants would be willing to try new tools to enrich their experience, but they had reservations, enunciated in their comments.

Overall, the survey results demonstrated that the Teacher-Consultants recognized the effectiveness of collective learning and expressed interest in promoting classroom discussions. The Teacher-Consultants, however, were not entirely convinced that allowing students to learn exclusively "from each other and with each other" without constant or regular presence and intervention of their teacher would be a good pedagogical choice. Finally, the Teacher-Consultants found that digital assistants, such as automated accounts, would be useful additional tools, albeit under certain conditions.

6.4 Research questions answered

Summarizing our findings, we formulated the answers to Research Questions that guided our work.

Research Question 1: **What are the advantages and shortcomings of chatbots used in an online educational setting?**

Having studied literature on the use of chatbots in education, we identified such advantages of this technology as its versatility, its potential to be adapted to any setting and to stimulate students' interest in learning, as well as its capability to accumulate extensive knowledge and its 24/7 readiness to provide assistance. At the same time, integrating chatbots into an online classroom is still associated with the limitations of linguistic and emotional nature, as well as with the technical difficulties related to its design, which hinder its wider use for teaching online.

As a result of the above-mentioned difficulties and complexities, the scope of chatbot use in education is still rather modest when compared to the proliferation scale of this technology in resource-rich business and commerce. Education sphere, nevertheless, may apply innovation and creativity to design architecture of systems that makes use of available open-source applications and platforms and demands less funds and workforce.

Research Question 2: **Does a crowdlearning-based online educational platform have a potential for reinforcing chatbots' advantages and mitigating their shortcomings?**

Investigating the possibility of integrating chatbots into an online classroom, we built and tested its prototype and determined that such an approach as crowdlearning, organized as a discussion forum, allows peer-chatbots to play an effective role in an online classroom. Such architecture requires the course

material and assignments designed and presented in a way that promotes discussion and provides all necessary content within the space of the online classroom. Finally, we determined that current online open-source platforms and tools allow building, free of charge or at low cost, a crowdlearning-based online classroom with chatbots.

It goes without saying that certain academic disciplines may require their own techniques and approaches, but it can be argued that there is a place for a group discussion, a dialogue, or a question-answer period in practically any classroom during any kind of academic course. When held online, such discussions in their written forms (chats, forum, discussion boards) can be organized in a way that allows the use of peer-chatbots to enrich the learners' experience. And, of course, the content of such courses should be tailored to fit the format and the platform of the teaching.

Research Question 3: **What are the winning approaches to peer-chatbot integration into a crowdlearning-based online platform? What do we learn from the students' experience and potential teachers' opinions?**

Having launched our prototype and observing its functioning, we studied the participants' general impressions of it. The responses of the participants (course students and teachers-consultants) to the post-mortem survey revealed the overall positive perceptions of the discussion forum as a classroom: level of comfort, effectiveness, and satisfaction were reported as mostly satisfactory. The participants not only shared their observations and experience but also contributed their suggestions as to the online classroom improvement.

The summary of our findings allowed us to formulate recommendations for the design of online crowdlearning platforms with peer-chatbots. The recommendations vary from general (overall organization and visual design) to specific relating to such disciplines as language learning and, possibly, translation.

6.5 Recommendations

The process of building the platform, creating the course content, conducting the course, and administering the survey helped us summarize recommendations for designing online learning platforms based on crowdlearning with integrated peer-chatbots.

6.5.1 Platform

In their literature review, Tenório et al. (2021) lament lack of suitable platforms that support the collective learning process. As to our research, however, having worked through the process of planning, designing, building, and testing our prototype, we summarised our experience as follows: even when no user-friendly platform equipped with all the desired functionalities is immediately available, one should consider off-hand low-tech solutions to build a stimulating online classroom for collective learning that still ensures learners' fruitful collaboration and implements teachers' pedagogical practices. As Nass et al. (1994) note, "low-overhead agents can be easily produced and can generate a wide range of social responses."

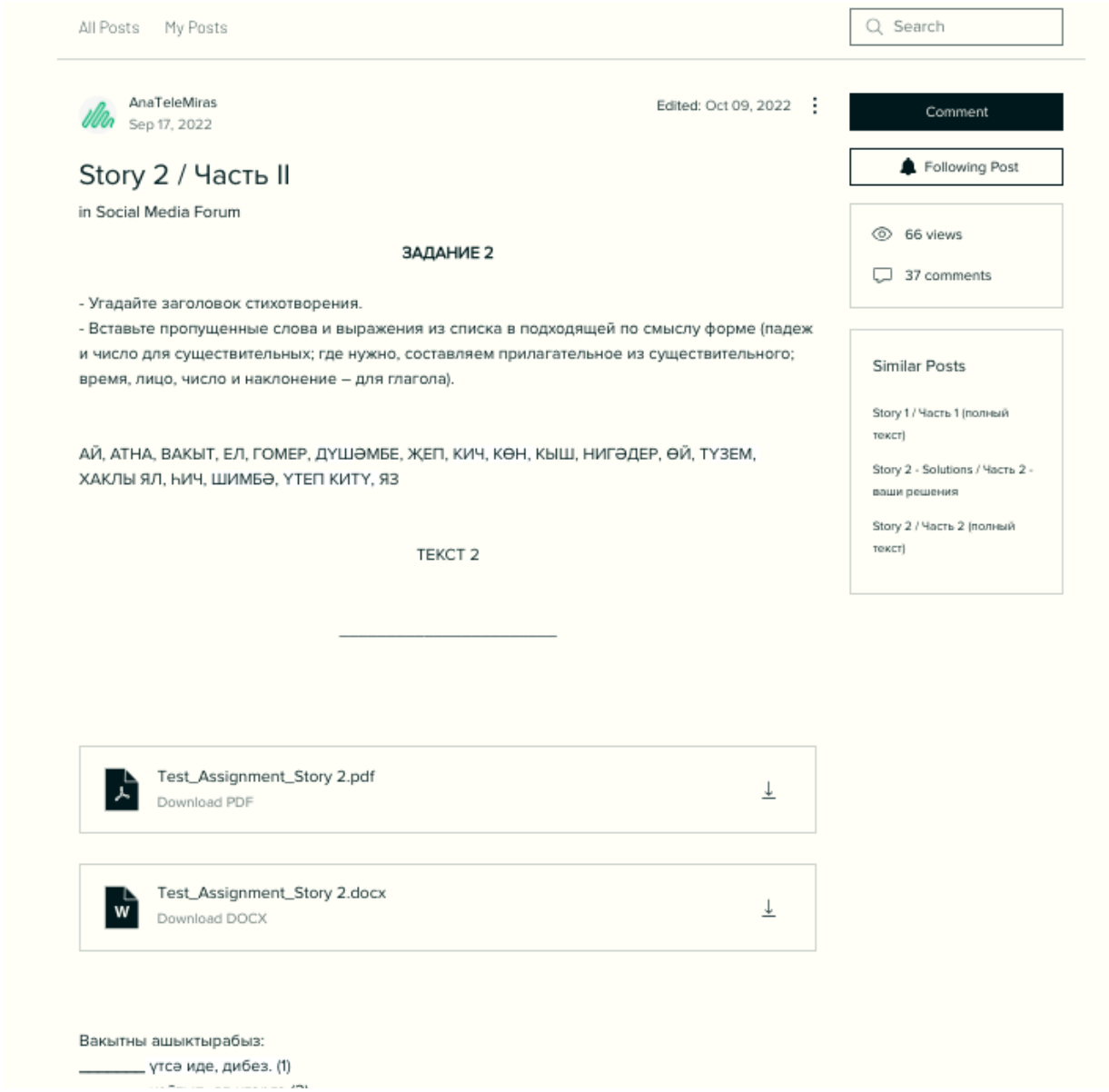
In the light of the above, we recommend that, firstly, the platform hosting the online classroom be straightforward in navigation and minimalistic in design. Simple, one-step sign-up and login processes provide accessibility for students of various ages and computer literacy levels, and a transparent, intuitive, navigation ensures that the users are not demotivated.

We consider it to be useful to prepare in advance a library of participants' profiles with neutral avatars, nicknames (see *Figure 11. Part of the participants list: examples of nicknames and avatars*), and starter passwords for registration procedure. All these can be recycled as the platform hosts another course.

Clean design with a minimum of distracting features (Moodle being a good example) also contributes to keeping the learners on task. Thus, describing the effective visual design principles for online learning platforms, Bader and Lowenthal (2021) suggest applying the "Less is More" approach: "there must be enough information presented without it being overwhelming." Both functionality and aesthetics are important and must balance each other.

Below is a screenshot of Lesson 2 Main Page of our course (Figure 21). It does not contain any distractive elements and displays only crucial information: the title, the text of the assignment, downloadable material in Word and PDF formats, and links to the resources; further down the page is the Discussion space.

Figure 21. Example of Lesson 2 Main Page (Platform 1)



It is important that the platform is placed on a server easily accessible to students in the targeted regions, so that any person, even overseas or travelling, does not run into a problem of failing to sign-up or to login to a site because it is blocked on the given territory.

The platform should be adapted to various devices and offer a user-friendly interface on personal computers, tablets, and smartphones.

6.5.2 Content

As to the content of the course, our main recommendation is self-sufficiency of the material provided for the students for a given lesson. It is important for the course builder to be an expert in the field and to make sure that the material addresses the most difficult issues of the material. For example, In Tatar, like in all Turkic languages, verbs present a particular issue especially for people who are more comfortable using languages from the Indo-European family. In the responses to our survey, many participants noted that the material on verbs was well presented, which means we correctly identified the main issues of the lessons.

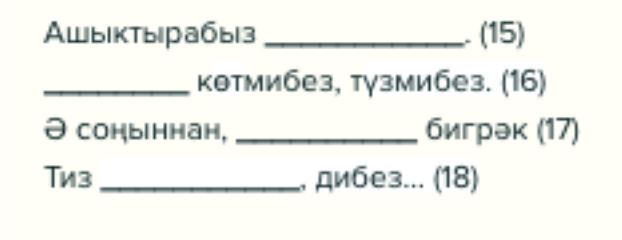
Another advantage of the learning material self-sufficient nature is allowing students to stay in the online classroom and to keep working or participating in the discussions without the need to go on other sites or offline searching for reference.

As Barak (2012) notes, when working on the material for an online class, teachers should be prepared "to engage students the same way they were engaged in face-to-face classes, and even more." The assignments, therefore, should match the pedagogical approach and take into account the online nature of the class. If the group discussion is chosen to be the main teaching method, the types of assignments must invite and promote group conversation.

It is important to prepare the material and the assignments with tagged elements, which serves two significant purposes: to be used by participants as reference in the discussion (*What about #1 of the assignment?)* and to be applied in programming the chatbot's interventions. In such programming, the chatbot accounts would use tagged elements of the assignments ("#2-Insert the verb in the suitable form of gerund"), their mention in the discussion (*How did you solve #2?*), and the relevant learning material ("Grammar section of the learning material: (#2) Gerunds of type 1.").

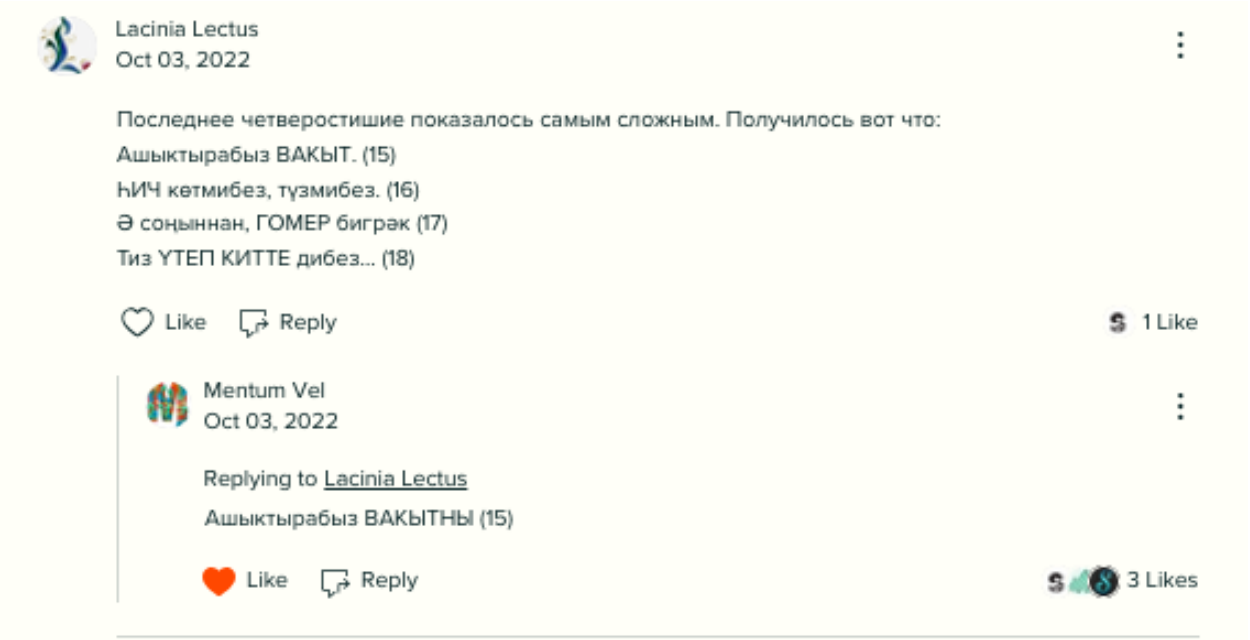
Below (Figure 22) is an example of how tagged elements are used in the assignment and the discussion (Lesson 2): each empty space in the assignment that has to be filled is numbered:

Figure 22. Example of tagged elements in the assignment (Lesson 2, Platform 1)



As we see in the discussion (Figure 23), the participants use this numbering in their exchange:

Figure 23. Example of tagged elements in the discussion (Lesson 2, Platform 1)



To draw more benefits from the marked texts, the tagged assignment elements may be divided into three parts ranging from easy to complex. Thus, the most difficult third of the mini-tasks may be used as the basis for the planned posts of the conversational agents, which allows the instructor to attract students' attention to the problematic parts of the material without excercising top-down pressure on learners.

6.5.3 Peer-chatbots: roles and scenarios

When planning scenarios for the peer-chatbots, it is important to model them as exhibiting different "characters" and "knowledge levels," which allows developing varied scenarios of interactions. As

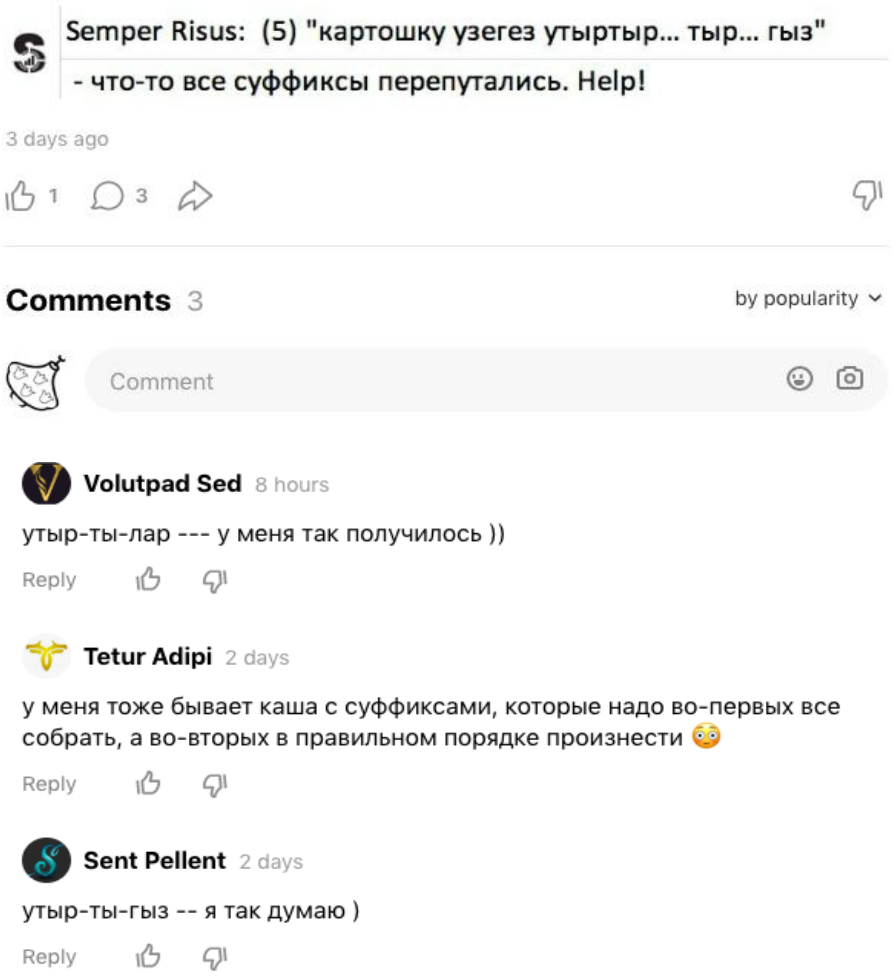
Cameron et al. (2018) note, the chatbots' interventions should be consistent with their personalities, and "can use humour and emotion to improve the user experience."

In our case, the two chatbots represented a Stronger Student and a Weaker Student. We argue, however, that, if needed, a chatbot-equipped educational platform can be populated with a number of chatbots with different characters following their own scenarios to support discussion in a classroom with just one human student.

Before the lesson started, we had scheduled several messages for both peer-chatbots covering the most difficult elements. The rationale behind this decision was that if the bots' messages happenned to duplicate questions from the actual Students, they would be simply answered again—a situation typical for human discussions—and it would only serve to reinforce the knolewdge of certain parts of the material.

Below (Figure 24) is an example of the "Weaker Student" Chatbot asking for help -- Lesson 5 (Platform 2): three days into the lesson, the automated account *Semper Risus* asks for help concerning element 5. It is one of the most difficult elements, and we would like to attract the Students' attention to it. In the demonstrated example, element 5 has not yet been mentioned in the discussion by Students, which means that the peer-chatbot intervention is timely. The "Student" complains of being confused and "cries for help."

Figure 24.Example of Weaker-Student Chatbot asking for help (Lesson 5, Platform 2)



We see that one of the Students (*Volutpad Sed*) offers an answer to the Chatbot's question (Figure 24), but it is not a correct one. Another Student (*Tetur Adipi*) complains that he/she is also confused. Finally, the third Student (*Sent Pellent*) offers a correct version.

The above example is a demonstration of how instuctors can attract learners' attention to certain elements of the material without exercising authority. Peer-chatbots here help stimulate cooperation, emotional relief, and exchange of information.

As to the chatbot scheduling, having tested the prototype, we drew a ballpark schedule for peer-chatbots in a crowdlearning discussion forum (Table 74). To better describe it, we take as an example a 2-week lesson period and divide the period into 10 slots (assuming that 2 weeks consist of 10 working days). We

leave Day 1 for the students who are anxious to start working on the assignment and feel emotionally satisfied to be the first ones to do so. The first peer-chatbot posts, therefore, start within 24-36 hours (Day 2 or 3) from the moment the assignment and the material for a particular lesson is posted. The second "wave" of peer-chatbot posts takes place mid-session, on Day 5 or 6. The third period of peer-chatbots' posting materializes closer to the end, on Day 8 or 9. It should be noted that the numbering is purely symbolic and the division into ten days can signify the division into ten parts of any other—longer or shorter—period.

Table 74. Ballpark schedule of message bots activation during a 10-day crowdlearning session.

Day	Peer-Chatbots actions
1	
2	**Questions on Cat. 3 issues. Answers to the questions.**
3	
4	
5	**Questions on Cat. 3 and 2 issues**
6	**Answers to the questions**
7	
8	**Questions on Cat. 2 issues**
9	**Answers to the questions**
10	

This approximate scheduling of chatbot interventions are supposed to touch upon important topics (issues of Category 3 and/or 2) that teachers usually find most important to concentrate on. In scheduling peer-chatbots according to the teachers' pedagogical strategies, we take advantage of the fact that human-computer collaboration is by "no means an equal partnership, but software works autonomously around the clock on our behalf" (Grudin & Jacques, 2019).

It should be noted that in formulating our recommendations, we did not compare our platform in its entirety to any other described in our literature review, as we did not encounter any description of a similar architecture (albeit there may exist one or several). Thus being said, individual aspects, features,

and approaches used in our prototype all separately relate to the research carried out by the authors whom we cited and to whom we are grateful.

Thus, as Cunningham-Nelson et al. (2019) note, chatbots "are not designed to be a sole resource that functions in isolation." Chatbots in education are a support tool helping to deal with large student groups and, at the same time, individualise education. The chatbot functioning still requires supervision and maintenance, and the role of teachers and course designers is crucial.

6.5.4 Empowering teachers

The research may be useful for teachers who are motivated and express interest to learn to develop their own platforms, to adapt existing platforms for specific teaching needs, and to integrate peer-chatbots in order to increase effectiveness of the students' interactions and to obtain themselves more time and energy for creativity and innovation.

Numerous research papers, however, suggest that teachers do not get enough training in technology. Grenon et al. (2019), for example, conducted a study aiming to describe techno-pedagogical skill development among university instructors taking Web conferencing tools as an example and came to the conclusion that a significant effort is still needed in this field. Research by Dewi et al. (2022) demonstrated that, presented with a user-friendly chatbot building tool, only a minority of teachers were able to independently modify or create a chatbot based on the course they teach. The teachers who build their online courses must, therefore, be assisted in determining the best resources and tools for their class, so that they can "reduce time spent on learning how to use the educational technologies properly" (Barak, 2012).

Thus, our survey revealed the Teacher-Consultants' reservations against allowing students to learn from each other with minimal supervision: they insisted that there should be more teacher's presence in the course. Also, the Teacher-Consultants expressed their willingness to try new tools in their classrooms, but under certain conditions.

We argue, however, that teachers may feel empowered when they are personally involved in the creation of their own platforms and chatbots.

It would be advantageous for teachers to collect and summarize observations of their online classes, and, based on the collected material, they can build, launch, and administer several parallel courses with peer-chatbots. This way teachers would manage more classes with less effort, and students would learn not only from the material provided, but also from asynchronous discussions on a forum always populated with actors whose anonymity ensures a safe and friendly environment.

Our platform can serve as a tool for teachers or educational institutions who may still be intimidated by digital technologies, which they find expensive or requiring a steep learning curve. By this work we, therefore, demonstrate that there exists a variety of online tools allowing to set up a functional course, even in the situation where a teacher is not an expert in digital technologies.

As we pointed out, chatbots have improved over the past five decades and humans are increasingly using them in an educational setting. The potential role of chatbots in inspiring learner curiosity and making learning more efficient therefore deserves further consideration.

CHAPTER 7: **CONCLUSIONS AND CONTRIBUTION TO KNOWLEDGE**

7.1. Conclusions

We developed our educational platform as a user-friendly tool for teachers and course designers wishing to adapt digital technology to collaborative learning settings. The three elements of our platform—crowdlearning, appropriate teaching material, and peer-chatbots—were intended to reduce the workload of the teacher and to contribute to the productivity—improved knowledge acquisition for the students—and, possibly, the profitability of the digital learning platforms.

The learning setting we used for this study was based on the familiarity of our participants with social networking sites, online discussion forums, and content-sharing platforms.

The participants took part in the online course, after which they completed questionnaires to report their perceptions and opinions. From this survey, the most positive rated words were: *Easy to use*, *Fun to study*, *Comfortable*, *Helpful*, and *Interesting*. The most negative terms related to the technical peculiarities of the platforms that we used for the course were *Hard to sign in*, *Complex*, and *Difficult to figure out*.

In addition, a group of teachers was recruited as consultants to give their opinion of the platform and the process. In their survey, the most positive assessment was expressed in the following terms: *Comfortable*, *Productive*, and *Satisfied*. The most negative rating assessment expressions were: *Teacher's presence not sufficient*, *Need more interactive content*, and *Machines cannot substitute humans*.

Since chatbot is an application created to conduct a conversation with humans, it is often considered by some researchers as a tool specifically for second language teaching (Dale, 2016; Fryer, 2018; Winkler & Doellner, 2018): "the most natural and potentially powerful application of chatbots, however, is in line with their fundamental nature: language practice" (Fryer, 2018). However, as Chan and Baskin (1988) note, a chatbot as a learning companion can be introduced in any field. It should, therefore, be noted that, although our system was designed for language learning, we built it as a collaborative learning platform that may be used in any area of education.

This research was intended to make two main contributions located at the crossroads of computer science (HMI, ITS, digital learning environment) and cognitive science (education and collaborative learning). First, the role of conversational agents in human learning computing environments was studied and, subsequently, an unconventional application of chatbots was proposed and tested. As a result of the research, practical recommendations for designers of online courses in the form of a crowdlearning platform with peer-chatbots were summarized. Second, we tried to demonstrate how in such an educational setting the advantages of chatbot technology contributes to the success of the course and how the shortcomings of chatbots may be mitigated by the same educational setting.

The process of building the prototype of the platform, its testing, and the post-mortem survey all served the task of formulating answers to the Research Questions specified in section 2.1.2.

First of all, we identified the advantages and shortcomings of chatbots used in an online educational setting. Extensive literature on the subject helped us to conclude that major benefits of chatbot technology are its versatility, its adaptability to any setting, its learning stimulating quality, its capability to accumulate the necessary knowledge, and its over-the-clock readiness to provide assistance to students.

Chatbots in an online classroom, however, still present problems of linguistic and emotional nature, and various technical difficulties require considerable funding and efforts. Due to the above-mentioned issues, chatbots in education are not used as widely as they are employed in business and commerce. In education, therefore, applying innovation and creativity and making use of available open-source applications and platforms may open many productive directions in the design of systems, including those that employ chatbots, that demand less funding, efforts, and familiarization.

Secondly, we investigated the possibility of using a crowdlearning-based online educational platform as a setting that promotes chatbots' advantages and mitigates their shortcomings. Our prototype allowed us to test such an approach on a platform, organized as a discussion forum that allowed peer-chatbots to play an effective role in an online classroom. The prototype testing revealed that such an architecture required the course material and the assignments designed and presented in a specific way to promote discussion and to provide all the necessary content for the online classroom setting. In addition, we determined that current online open-source platforms and tools do allow building, free of charge or at low cost, a crowdlearning-based online classroom employing chatbots.

Finally, we suggested and tested approaches to peer-chatbot integration into a crowdlearning-based online platform, and we summarized the findings we obtained from the students' experience and potential teachers' opinions, expressed in the survey. The responses of the participants (both students and teachers-consultants) revealed their generally positive perceptions of the discussion forum as a classroom. The participants found that the level of comfort and effectiveness of the platform was appropriate, and the participants were overall satisfied with their experience. In addition, the participants offered their suggestions related to the online classroom improvement.

The first part of our project was, therefore, a process of building a prototype of the envisaged platform, followed by its testing by a group of volunteers. As mentioned above, in our crowdlearning setting, the Students were interacting with each other and with their two fictional peers—accounts controlled by the Researcher. Thus, during the first stage of the prototype testing, we applied the Wizard of Oz paradigm (using fictitious accounts mimicking interactions of human participants) to study the modalities of interaction between the Students and to investigate productive interventions. This allowed us to identify the situations and the discussion stages where Student-Chatbots might be the most useful, to decide which linguistic approaches are preferable., and to apply the acquired knowledge in the second stage of the prototype testing.

The second part of the project consisted of the survey in the form of questionnaires that the participants completed and the results of which were then collected and analyzed.

The third part of the project was formulating the conclusions and recommendations, laying groundwork for future projects.

As a result of our prototype building and testing, we were able to formulate recommendations for the design of online crowdlearning platforms with peer-chatbots. The recommendations we offered are both general (on overall organization and visual design) and specific (concerning language learning and translation).

Overall, this study has shown that, in the context of online learning, a discussion forum setting based on crowdlearning and involving peer-chatbots offers a potentially effective and creative form of online teaching that can be both implemented in large-scale course management systems (MOODLE) and built individually by teachers for online course in various disciplines.

7.2. Limitations of the Study

Being a university-trained language instructor with years' of teaching experience, we were certainly aware of constraints and limitations that prevented us from realizing the full potential of the prototype that we built. It is important, however, to recognize that both objective (time and resources constraints) and subjective (ethical considerations preventing certain types of communication and use of additional media) limitations did not preclude us from bringing the project to its fruitful end. The recognition and reporting of the limitations is, however, an important element of our work.

The most influential limitation of this study was the small sample size. Although ten participants represent a regular language study group, to test a digital learning platform with definitive results, a more significant number of participants taking part in a dozen of courses across varied disciplines would be required. At this stage, therefore, it would be premature to claim that the approach is transferable to other learning fields or academic settings.

Concerning the content of the course, it was our intention to conduct both the pre-test and the post-test to measure the Students' learning progress, but the time constraints did not allow this to be administered in due time.

Also, due to the participants' evident lack of disposable time, the discussions were not as active as that of a regular school or university class (where learning is the participants' primary occupation). We, however, are grateful to the Students for all their time and efforts that they contributed to the project.

Despite the fact the prototype is easy to replicate, at this stage, it would be premature to claim that the approach is easily transferable to other learning fields or academic settings.

With most chatbots being developed specifically for language learning, the goal of our study was to experiment with a chatbot-equipped educational platform that would be suitable for various disciplines. One of the most important characteristics of our system is its inherent generalization, its ease of replication, its availability, and its user-friendliness. This configuration of the educational platform will, therefore, have to be tested in other disciplines.

The limits of a research often result from a specific educational situation and a specific group of participants. Thus, Fryer (2018) admits that his study on educational chatbots was conducted in a single educational context and with a single demographic group: a convenience sample of students and not a random sample for the institution. Therefore, the external validity of the results of this research should be further tested. As for our study, the participants were a random group of language learning enthusiasts who study it at their leisure. Therefore, the applicability of the proposed approach needs to be tested in an institutional educational setting.

7.3. Future Studies

The misconception that online education means simply using technology leads some to believe that online teaching is as simple as making material available on a website. The possibility to access content online, however, "does not automatically expand student's knowledge and the availability of information does not inherently promote their thinking skills" (Barak, 2012). Online education means gaining skills and knowledge in a specific setting filled with specific content and with the help of a vast variety of digital tools, of which one of the most promising is offered by the chatbot technology.

Fryer et al. (2017) observe that the prevalent strategy applied in the chatbot-equipped educational setting is "guided learning": the teacher requests that the students perform a task using the suggested software. Hwang and Chang (2021) insist that such learning strategies as "peer assessment, video sharing, synchronous sharing, issue-based learning, computers as Mindtools (e.g. concept mapping), project-based learning, and inquiry-based learning, generally aim to engage students in peer interactions and higher order thinking" and require, therefore, future research on how to improve the chatbot-based learning designs. In general, building interactive bots, "we discover much about ourselves and how we work, the range of our knowledge and curiosity, the subtlety of language, and the number and complexity of the tasks we routinely handle" (Grudin & Jacques, 2019).

As to the choice between chatbots overtly presented as automated accounts and chatbots disguised as humans, it is up to the course designer or the teacher to decide. We chose to hide the message bot behind a participant's avatar so that the students are not distracted by a desire to explore how the chatbots react to specific situations. In general, we find that in an online classroom with peer-chatbots this approach is more productive. The experiments by Nass et al. (1994), however, demonstrate that "individuals' interactions with computers are fundamentally social" and "are not the result of conscious beliefs that

computers are human or human-like." More research is, therefore, needed to explore the users' interaction with both human and automated interlocutors in an educational setting involving collective learning.

It can be argued that there is a place for a group discussion in practically any classroom during any kind of academic course. Therefore, a chatbot-equipped educational platform is worthy of being tested in other disciplines too.

Importantly, the potential role of chatbots in empowering instructors deserves further consideration. It would be informative to survey teachers who themselves design a course and manage its chatbots or other digital tools: the question would be if they feel more involved and in control.

Certainly, the exploration of the educational possibilities of ChatGPT-like tools and AI technology in general should continue.

Finally, considering that the scope of prior studies relevant to our approach is limited, this prototype can be a starting point for further development and research.

APPENDIX A

RECRUITEMENT LETTER

1) LETTER TO HEADS OF TATAR CULTURE CENTRES AND TATAR LANGUAGE CULB TEACHERS

RESEARCH PRESENTATION AND THE ROLE OF TEACHER

Hello, I am a PhD candidate based in Montreal (Canada), and I invite you to take part in the online project in a role of a teacher of an online course based on crowdlearning (collaborative learning via an online platform). The goal of the project is to test a set of specific teaching/learning modes and to determine the best practices in the educational process and platform organization. You will play four roles in the process: selecting a group of students possessing an appropriate proficiency level for the course; collaborating with the researcher in developing the course material; monitoring the course flow and providing help to the participants; and providing a detailed feedback on the experience.

WE ARE LOOKING FOR PARTICIPANTS

1) Who is 18 y.o. or older;
2) Who speaks Russian or English (and are able to read and write in Cyrillic);
3) Who can speak Tatar at the beginner-intermediate level;
4) Who is willing to study online with a group of co-learners and chatbots presented as learners.

ПРЕЗЕНТАЦИЯ ИССЛЕДОВАТЕЛЬСКОГО ПРОЕКТА И РОЛИ ПРЕПОДАВАТЕЛЯ

Здравствуйте, я аспирант из Монреаля (Канада), и я приглашаю вас принять участие в онлайн проекте в роли преподавателя онлайн курса, основанного на методе краулёрнинг (crowdlearning -- коллаборативное обучение на онлайн платформе). Цель проекта – протестировать определённые методы в преподавании/обучении и определить лучшие подходы к образовательному процессу и к организации самой платформы. Ваша роль предполагает четыре действия: подбор группы студентов с подходящим уровнем готовности к курсу, сотрудничество с исследователем в разработке материала курса, наблюдение за течением курса и оказание помощи участникам, а также описание вашей оценки всему эксперименту.

ТРЕБОВАНИЯ К УЧАСТНИКАМ

1) Возраст -- 18 лет или старше;
2) Владение русским или английским языком (+ умение писать и читать а кириллице);
3) Владение татарским языком на средне-начальном уровне;
4) Желание пройти онлайн курс с группой однокурсников и с чатботами, представленными как однокурсники.

2) LETTER FROM HEADS OF TATAR CULTURE CENTRES AND TATAR LANGUAGE CULB TEACHERS TO FUTURE PARTICIPANTS

INVITATION TO PARTICIPATE IN AN ONLINE COURSE

Hello, I am your Tatar language teacher and the organizer of the Club of the Tatar language enthusiasts. I am recruited by a researcher, a PhD candidate based in Montreal (Canada), who is currently looking for adult learners, beginner-intermediate speakers, to participate in an online Tatar language course.

The study consists of two equally important parts: the collaborative learning session and an individual survey on your learning experience that will follow. This questionnaire will provide the researcher with the data that will help advance digital teaching practice and cognitive informatics science. In addition, the texts produced during the course will serve as a contribution to the Tatar Language Online Corpus.

For the study, a two-part course will be developed. You can sign up for the first part of the course, the second part, or for both. Participation in this project requires you to spend at least 20 minutes a day, 3-4 times a week during the course, performing learning activities as a member of the online class.

The class will be organized as a discussion forum where the learners receive assignments, discuss the solutions and the works posted by other participants, and rate the final works of the peers.

The platform will offer you a safe and stimulating learning and communication environment where innovative teaching material and chatbots (software that conducts online conversations) will be tested and improved.

Your presence on the platform will be marked by your virtual avatar and a pseudonym, which guarantees your anonymity.

At the end of the course, you will be asked to fill in a questionnaire that will provide the researcher with a valuable information on your learning experience.

You are not offered any compensation for your participation, but the results of the study will be shared with you.

If interested, please contact me via this group messenger. Thank you for your interest and help!

ПРИГЛАШЕНИЕ ПРИНЯТЬ УЧАСТИЕ В ОНЛАЙН КУРСЕ

Здравствуйте, я ваш преподаватель татарского и организатор Клуба любителей татарского языка. Я сотрудничаю с исследователем, аспирантом из Монреаля (Канада), которая в настоящее время подбирает студентов – взрослых, владеющих татарским языком на начально-среднем уровне, для участия в онлайн курсе татарского языка.

Проект состоит из двух одинаково важных частей: коллаборативное обучение и заполнение опросника о ваших впечатлениях от процесса. Данная анкета предоставит исследователю данные, которые помогут развитию обучающих методов и сделают вклад в когнитивную информатику. Вдобавок, тексты, которые вы напишете в течение курса, послужат вкладом в Онлайн корпус татарского языка.

Для данного проекта будет разработан курс из двух частей. Вы можете принять участие в первом, во втором или в обоих. Ваша задача в рамках проекта -- участвовать в обучении в онлайн классе от 20 минут в день 3-4 раза в неделю в течение курса.

Занятия в классе будут организованы как дискуссионные форумы, где студенты получают задания, обсуждают способы их решения и работы, выставленные сокурсниками, а также выставляют оценки работам своих коллег

Обучающая платформа – безопасная и стимулирующая среда, где представлены обучающий материал и чатботы (программы, имитирующие онлайн беседу), которые будут протестированы и оптимизированы.

На платформе вы будете представлены вашим виртуальным аватаром и псевдонимом, что гарантирует вашу анонимность.

По окончании обучения вам предложат заполнить анкету с вопросами от исследователя; ваши ответы по пройденному курсу – важная часть исследования.

Ваше участие в проекте не оплачивается, но результаты исследования будут вам предоставлены.

Если вам интересно к нам присоединиться, пишите мне в мессенджер. Спасибо за ваше время и поддержку!

APPENDIX B

CONSENT FORMS

1) CONSENT FORM:STUDENT

UQÀM | Université du Québec à Montréal

Университет Квебека в Монреале

CONSENT FORM

Письменное согласие

Research project title / **Название научно-исследовательского проекта** *Plateforme d'apprentissage collaboratif avec des chatbots-étudiants /* ***Обучающая коллаборативная платформа с применением чатботов*** « Collaborative learning platform with student-chatbots »

Student-researcher **/ Студент-исследователь** *Gulnara Shaydullina /* ***Гульнара Шайдуллина*** *Doctorat en informatique cognitive-DIC, UQAM /* **Аспирант кафедры когнитивной информатики, УКаМ** ***(Университет Квебека в Монреале)*** *514-487-4411; shaydullina.gulnara@courrier.uqam.ca*

Research supervisor **/ Научный руководитель***Dr. Roger Nkambou /* ***Профессор Рожэ Нкамбу*** *Département d'informatique, UQAM /* ***Факультет информатики, УКаМ (Университет Квебека в Монреале)*** *514-987-3000.8395; nkambou.roger@uqam.ca*

Research co-supervisor **/ Научный со-руководитель***Dr. Maude Bonenfant /* ***Профессор Мод Бонанфан*** *Département de communication sociale et publique, UQAM /* ***Факультет общественной и государственной коммуникации, УКаМ (Университет Квебека в Монреале)*** *514-987-3000.3392; bonenfant.maude@uqam.ca*

Preamble **/ Преамбула**

You are invited to participate in a research project that involves learning Tatar language online on a platform organized as a discussion forum. Before accepting to participate in this project, please take the time to

understand and carefully consider the information that follows. **Вам предлагается принять участие в исследовательском проекте по изучению татарского языка в рамках онлайн платформы, организованной как дискуссионный форум. Прежде чем дать согласие на участие в проекте, пожалуйста, внимательно и детально ознакомьтесь с нижеизложенной информацией.**

This consent form explains the purpose of the study, the procedures, the benefits, the risks and disadvantages as well as the people to contact if necessary. **Настоящий документ содержит информацию о целях исследования, этапах его проведения, потенциальной пользе, рисках, возможных неудобствах, а также предоставляет вам информацию, если таковая понадобится, для контакта с вовлеченными лицами.**

The present form might include words that you may not understand. Please do not hesitate to ask the researcher any questions you may have. **Настоящий документ может содержать непонятные вам термины. Не стесняйтесь задавать исследователю любые вопросы по данному проекту.**

Description of project and its objectives **/ Описание проекта и поставленных целей**

The objectives of the research projects are developing and testing an innovative online learning environment: formulating the criteria for appropriate educational material, selecting winning teaching strategies, organizing an online collaborative learning platform, as well as developing and integrating chatbots (software that conducts online conversations) to enrich the learning environment.

Цель проекта – разработать и протестировать инновационное обучающее онлайн пространство: сформулировать критерии для оптимального образовательного материала, выбрать наиболее подходящие обучающие методики, организовать коллаборативную обучающую онлайн платформу, а также разработать и интегрировать в данную платформу чатботы (приложения, способные вести онлайн дискуссию) в целях создания наиболее благоприятного обучающего пространства.

Nature and duration of your participation **/ В чем заключается ваше участие в проекте**

During the two-part online course that will each last about 5 weeks, you will be participating in the collaborative learning process: completing the assignments and posting them on the discussion forum, discussing the assignments, your work, and works of your peers, as well as rating your fellow-students' solutions. Two extra accounts will be added to the list of participants; these accounts will be used by the researcher to mimic the actions of chatbots or to employ actual chatbots that will participate in your learning activities and enrich your course environment.

В течение онлайн курса из двух частей примерно по 5 недель каждый, вы примете участие в коллаборативном учебном процессе. Вы будете выполнять учебные задания и размещать их на дискуссионном форуме, где вы будете обсуждать эти задания, ваши работы, работы ваших однокурсников, которым вы также будете выставлять оценки. К группе участников добавятся две учетные записи исследователя для изучения возможностей использования чатботов или для подключения чатботов, которые будут принимать участие в учебной деятельности и улучшать учебное пространство.

We expect you join the online class at least 4-5 times a week at a convenient time, complete the assignments at your own pace, and participate in the discussions. **Предполагается, что вы будете заходить в ваш онлайн класс 4-5 раз в неделю в удобное для вас время, выполняя задания в удобном для вас темпе и участвуя в обсуждении.**

The researcher and the professor will analyse the development of the course: the discussions, the comments, and the submitted works. **Исследователь и научный руководитель проанализируют работу курса: дискуссии, комментарии, завершенные и размещенные на форуме работы.**

Upon completion of the course, you are to participate in an individual survey on your learning experience. This questionnaire will provide us the data that will help advance digital teaching practice and cognitive informatics science. **Завершив курс, вы заполните анкету с вопросами о ваших впечатлениях от учебного эксперимента. Этот опросник позволит нам улучшить практику цифрового преподавания и внести научный вклад в когнитивную информатику.**

Benefits associated with participating in the present study/**Потенциальная польза от участия в данном проекте**

Participation in this research gives you an opportunity to improve your written and spoken Tatar, to contribute to the Tatar Language Online Corpus, and to explore new ways of studying that you can later apply to other disciplines. Also, you will contribute to the advancement of cognitive informatics science: the study of the role of chatbot software in human learning, the formulation of recommendations for the online course developers, and creation of a user-friendly digital platform for professors wishing to apply collaborative methods of teaching. **Участие в проекте даст вам возможность улучшить ваши разговорные и письменные навыки в татарском языке, внести вклад в «Корпус татарского языка онлайн», а также опробовать новые методы обучения, которые вы можете в будущем использовать в изучении других дисциплин. Вдобавок, вы внесете вклад в развитие когнитивной информатики: в изучение роли чатботов в обучении людей, в формулировании рекомендаций для разработки онлайн курсов, а также в создание цифровых платформ,**

удобных для преподавателей, которые хотели бы применить коллаборативные методы обучения.

Risks associated with participating in the present study / **Возможные риски, связанные с участием в проекте**

Participation in this research is not associated with any risk. You can sign out of the platform at any time.

Участие в данном исследовательском проекте не связано с никакими рисками. Вы можете прекратить работу на платформе в любое время.

Confidentiality / **Конфиденциальность**

Your personal information will only be known to the above-mentioned researcher and the course teacher and will not be revealed when the results are disseminated. In addition, the researcher will not be able to determine which avatar is used by a given participant. The after-study questionnaires will be numbered, and only the researcher will have the list of participants and the number assigned to them. All documents relating to your participation will be kept under lock and key for duration of the study. All documents will be destroyed 5 years after the last scientific communication.

Ваши персональные данные будут известны только вышеуказанному исследователю и преподавателю курса и не будут включены в результаты исследования. К тому же, исследователь не сможет определить, как соотносятся аватары и имена участников. Анкеты с вопросами о впечатлениях от курса будут пронумерованы и только исследователь будет иметь доступ к с списку участников и номерам анкет. Во время исследования все документы, имеющие отношение к вашему участию в проекте, будут храниться под замком и кодом. Через пять лет после последнего отчета о результатах исследования все документы будут уничтожены.

Voluntary participation and right to withdraw / **Добровольность участия и ваше право выйти из проекта**

Your participation in this project is entirely voluntary. You may refuse to participate or you may withdraw from the study at any time without the need to justify your decision. If you decide to withdraw from the study, you only need to verbally inform *Gulnara Shaydullina;* in this case, all data concerning you will be destroyed. **Ваше участие в проекте совершенно добровольно. Вы можете отказаться участвовать и можете выйти из проекта в любое время без объяснений вашего решения. Если вы решите**

выйти из проекта, вам нужно только сообщить об этом Гульнаре Шайдуллиной; в этом случае все данные о вашем участии будут уничтожены.

Compensation / **Вознаграждение**

No compensatory allowance is provided for participation in this research.

Данные проект не предполагает денежного вознаграждения за участие в исследовании.

Questions concerning the research project? / **Вопросы, относящиеся к проекту?**

If you have any further questions concerning your participation or the study itself, you may contact the people responsible for the project: Gulnara Shaydullina; *shaydullina.gulnara@courrier.uqam.ca*
Any questions concerning your rights? The research ethics review committee involving human subjects (CERPE) has approved this research project in which you are involved. If you have any ethical concerns or complaints about your participation in this study, and want to speak to someone who is not on the research team, please contact the coordinator of CERPE : cerpe4@uqam.ca or 514-987-3000, poste 6188.

Если у вас имеются вопросы, касающиеся вашего участия в проекте или самого исследования, вы можете задать их самому исследователю -- Гульнаре Шайдуллиной, связавшись с ней по электронной почте *shaydullina.gulnara@courrier.uqam.ca*

Acknowledgements / **Благодарность**

Your collaboration is essential to the realization of our project and the research team wishes to thank you.

Ваше сотрудничество с исследователем очень важно для данного проекта, и исследовательская группа вам очень благодарна.

Consent / **Согласие**

I acknowledge having read about and understood the present research project, including the nature and extent of my participation as well as the potential risks and disadvantages to which I will be exposed, as indicated in this consent form. I have had the opportunity to ask questions concerning the various aspects of the study and to receive answers to my satisfaction.

I, the undersigned, voluntarily consent to participate in this study. I understand that I can withdraw at any time without prejudice of any kind. I certify that I have been given the time needed to make my decision. A signed copy of this consent form will be given to me. **Я подтверждаю, что прочитал(а) и понял(а) описание данного проекта, включая условия и степень моего участия в нем, а также**

возможные риски и неудобства, связанные с участием в проекте и описанные в данном формуляре. У меня была возможность задать все интересующие меня вопросы по различным аспектам исследования и получить удовлетворившие меня ответы на вопросы.

Я, нижеподписавшиӣся (нижеподписавшаяся), даю свое добровольное согласие на участие в исследовании. Я понимаю, что могу прекратить своё участие в проекте в любое время без объяснения причин. Я подтверждаю, что мне было предоставлено время для принятия данного решения. В моём распоряжении останется подписанная мноӣ копия данного формуляра.

_____ First Name, Surname / **Имя, фамилия**

_____ Signature / **Подпись**

_____ Date / **Дата**

Declaration by the researcher / **Официальное заявление исследователя**

I, the undersigned, hereby declare that: / **Я, подписавшаяся, настоящим заявляю что**
(a) I have explained the terms of this form to the signatory; / **я объяснила подписавшему (подписавшеӣ) все пункты данного формуляра;**

(b) I have answered the questions he has asked me in this regard; / **я ответила на все заданные вопросы в связи с данным формуляром;**

(c) I have clearly indicated to him/her that he/she is free to terminate his/her participation in the research project at any time, as described above; / **я объявила участнику/участнице, что участие в проекте может быть прекращено в любоиӣ момент, как описано выше;**

(d) I will give him a copy of this form, signed and dated. **/ я предоставлю участнику/участнице копию пописанного формуляра с проставленноиӣ датоиӣ.**

_____ First Name, Surname / **Имя, фамилия**

_____ Signature / **Подпись**

_____ Date / **Дата**

2) CONSENT FORM: TEACHER-CONSULTANT

UQÀM | Université du Québec à Montréal

Университет Квебека в Монреале

CONSENT FORM (teacher- consultant)

Письменное согласие (преподаватель-консультант)

Research project title / **Название научно-исследовательского проекта**

*Plateforme d'apprentissage collaboratif avec des chatbots-étudiants / **Обучающая коллаборативная платформа с применением чатботов:*** « Collaborative learning platform with student-chatbots »

Student-researcher **/ Студент-исследователь:** *Gulnara Shaydullina / **Гульнара Шайдуллина***

*Doctorat en informatique cognitive-DIC, UQAM / **Аспирант кафедры когнитивной информатики, УКаМ (Университет Квебека в Монреале);** 514-487-4411; shaydullina.gulnara@courrier.uqam.ca*

Research supervisor **/ Научный руководитель:** *Dr. Roger Nkambou / **Профессор Рожэ Нкамбу***

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Research co-supervisor **/ Научный со-руководитель:** *Dr. Maude Bonenfant / **Профессор Мод Бонанфан;** Département de communication sociale et publique, UQAM / **Факультет общественной и государственной коммуникации, УКаМ (Университет Квебека в Монреале);** 514-987-3000.3392; bonenfant.maude@uqam.ca*

Preamble **/ Преамбула**

You are invited to participate in a research project that involves teaching Tatar language online on a platform organized as a discussion forum. Before accepting to participate in this project, please take the time to understand and carefully consider the information that follows.

Вам предлагается принять участие в качестве преподавателя в исследовательском проекте по изучению татарского языка в рамках онлайн платформы, организованной как дискуссионный форум. Прежде чем дать согласие на участие в проекте, пожалуйста, внимательно и детально ознакомьтесь с нижеизложенной информацией.

This consent form explains the purpose of the study, the procedures, the benefits, the risks and disadvantages as well as the people to contact if necessary.

Настоящий документ содержит информацию о целях исследования, этапах его проведения, потенциальной пользе, рисках, возможных неудобствах, а также предоставляет вам информацию, если таковая понадобится, для контакта с вовлеченными лицами.

The present form might include words that you may not understand. Please do not hesitate to ask the researcher any questions you may have.

Настоящий документ может содержать непонятные вам термины. Не стесняйтесь задавать исследователю любые вопросы по данному проекту.

Description of project and its objectives **/ Описание проекта и поставленных целей**

The objectives of the research projects are developing and testing an innovative online learning environment: formulating the criteria for appropriate educational material, selecting winning teaching strategies, organizing an online collaborative learning platform, as well as developing and integrating chatbots (software that conducts online conversations) to enrich the learning environment.

Цель проекта – разработать и протестировать инновационное обучающее онлайн пространство: сформулировать критерии для оптимального образовательного материала, выбрать наиболее подходящие обучающие методики, организовать коллаборативную обучающую онлайн платформу, а также разработать и интегрировать в данную платформу чатботы (приложения, способные вести онлайн дискуссию) в целях создания наиболее благоприятного обучающего пространства.

Nature and duration of your participation **/ В чем заключается ваше участие в проекте**

You will be offered the a complete file of the online Tatar course: the course material, the assignments, and the screenshots of the Students' discussions on the website of the online classroom. You are to examine and access the collaborative learning process, the online platform, and the course material.

Вам будет предоставлен материал онлайн курса татарского языка: учебные тексты, задания и скриншоты онлайн дискуссий студентов с сайта курса. Ваша задача -- проанализировать коллаборативный учебный процесс: как студенты обсуждают учебные задания и свои работы; каково качество онлайн платформы и учебного материала.

Two extra accounts will be added to the list of participants; these accounts will be used by the researcher to mimic the actions of chatbots or to employ actual chatbots that will participate in your learning activities and enrich your course environment.

К группе участников добавятся две учетные записи исследователя для изучения возможностей использования чатботов или для подключения чатботов, которые будут принимать участие в учебноŭ деятельности и улучшать учебное пространство.

Upon completion of your study, you are to participate in an individual survey on your teaching experience. This questionnaire will provide us the data that will help advance digital teaching practice and cognitive informatics science.

Завершив анализ курса, вы заполните анкету с вопросами о ваших впечатлениях от вашего участия в качестве преподавателя в данном учебном эксперименте. Этот опросник позволит нам улучшить практику цифрового преподавания и внести научный вклад в когнитивную информатику.

Benefits associated with participating in the present study/**Потенциальная польза от участия в данном проекте**

Participation in this research gives you an opportunity to help your students to improve their written and spoken Tatar, to contribute to the Tatar Language Online Corpus, and to explore new ways of teaching that you can later apply to other courses. Also, you will contribute to the advancement of cognitive informatics science: the study of the role of chatbot software in human learning, the formulation of recommendations for the online course developers, and creation of a user-friendly digital platform for professors wishing to apply collaborative methods of teaching.

Участие в проекте даст вам возможность помочь вашим студентам улучшить разговорные и письменные навыки в татарском языке, внести вклад в «Корпус татарского языка онлайн», а также опробовать новые методы преподавания, которые вы можете в будущем использовать в проведении других курсов. Вдобавок, вы внесете вклад в развитие когнитивноŭ информатики: в изучение роли чатботов в обучении людей, в формулировании

рекомендацию для разработки онлайн курсов, а также в создание цифровых платформ, удобных для преподавателей, которые хотели бы применить коллаборативные методы обучения.

Risks associated with participating in the present study / **Возможные риски, связанные с участием в проекте**

Participation in this research is not associated with any risk. You can sign out of the platform at any time.

Участие в данном исследовательском проекте не связано с никакими рисками. Вы можете прекратить работу на платформе в любое время.

Confidentiality / **Конфиденциальность**

Your personal information will only be known to the above-mentioned researcher and will not be revealed when the results are disseminated.

Ваши персональные данные будут известны только вышеуказанному исследователю и не будут включены в результаты исследования.

All documents relating to your participation will be kept under lock and key for duration of the study. All documents will be destroyed 5 years after the last scientific communication.

Во время исследования все документы, имеющие отношение к вашему участию в проекте, будут храниться под замком и кодом. Через пять лет после последнего отчета о результатах исследования все документы будут уничтожены.

Voluntary participation and right to withdraw / **Добровольность участия и ваше право выйти из проекта**

Your participation in this project is entirely voluntary. You may refuse to participate or you may withdraw from the study at any time without the need to justify your decision. If you decide to withdraw from the study, you only need to verbally inform *Gulnara Shaydullina;* in this case, all data concerning you will be destroyed.

Ваше участие в проекте совершенно добровольно. Вы можете отказаться участвовать и можете выйти из проекта в любое время без объяснения вашего решения. Если вы решите

выйти из проекта, вам нужно только сообщить об этом Гульнаре Шайдуллиной; в этом случае все данные о вашем участии будут уничтожены.

Compensation / **Вознаграждение**

No compensatory allowance is provided for participation in this research. / **Данные проект не предполагает денежного вознаграждения за участие в исследовании.**

Questions concerning the research project / **Вопросы, относящиеся к проекту**

If you have any further questions concerning your participation or the study itself, you may contact the people responsible for the project: Gulnara Shaydullina; *shaydullina.gulnara@courrier.uqam.ca*

Any questions concerning your rights? The research ethics review committee involving human subjects (CERPE) has approved this research project in which you are involved. If you have any ethical concerns or complaints about your participation in this study, and want to speak to someone who is not on the research team, please contact the coordinator of CERPE : cerpe4@uqam.ca or 514-987-3000, poste 6188.

Если у вас имеются вопросы, касающиеся вашего участия в проекте или самого исследования, вы можете задать их самому исследователю -- Гульнаре Шайдуллиной, связавшись с ней по электронной почте *shaydullina.gulnara@courrier.uqam.ca*

Acknowledgements / **Благодарность**

Your collaboration is essential to the realization of our project and the research team wishes to thank you.

Ваше сотрудничество с исследователем очень важно для данного проекта, и исследовательская группа вам очень благодарна.

Consent / **Согласие**

I acknowledge having read about and understood the present research project, including the nature and extent of my participation as well as the potential risks and disadvantages to which I will be exposed, as indicated in this consent form. I have had the opportunity to ask questions concerning the various aspects of the study and to receive answers to my satisfaction.

Я подтверждаю, что прочитал(а) и понял(а) описание данного проекта, включая условия и степень моего участия в нем, а также возможные риски и неудобства, связанные с участием в проекте и описанные в данном формуляре. У меня была возможность задать все интересующие меня вопросы по различным аспектам исследования и получить удовлетворившие меня ответы на вопросы.

I, the undersigned, voluntarily consent to participate in this study. I understand that I can withdraw at any time without prejudice of any kind. I certify that I have been given the time needed to make my decision.

A signed copy of this consent form will be given to me.

Я, нижеподписавшаяся, даю свое добровольное согласие на участие в исследовании. Я понимаю, что могу прекратить своё участие в проекте в любое время без объяснения причин. Я подтверждаю, что мне было предоставлено время для принятия данного решения. В моём распоряжении останется подписанная мной копия данного формуляра.

_____

First Name, Surname / **Имя, фамилия**

_____

Signature / **Подпись**

_____

Date / **Дата**

Declaration by the researcher / **Официальное заявление исследователя**

I, the undersigned, hereby declare that: / **Я, подписавшаяся, настоящим заявляю что**

(a) I have explained the terms of this form to the signatory; / **я объяснила подписавшему (подписавшей) все пункты данного формуляра;**

(b) I have answered the questions he has asked me in this regard; / **я ответила на все заданные вопросы в связи с данным формуляром;**

(c) I have clearly indicated to her that she is free to terminate her participation in the research project at any time, as described above; / **я объявила участнику (участнице), что участие в проекте может быть прекращено в любой момент, как описано выше;**

(d) I will give him a copy of this form, signed and dated. **/ я предоставлю участнику (участнице) копию подписанного формуляра с проставленной датой.**

_____

First Name, Surname / **Имя, фамилия**

_____

Signature / **Подпись**

_____

Date / **Дата**

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