ARTIFICIAL INTELLIGENCE AT UNIVERSITIES IN POLAND

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Abstract: Artificial intelligence (AI) technologies are one of top investment priorities in these days. They are aimed at finding applications in fields of special value for humans, including education. Chatbots are one of those AI-driven solutions that support learning and teaching processes also in higher education institutions. In this paper there are presented two cases of chatbot technology implementation at Polish universities. Chatbots develop students' technical and programming skills, but also provide the possibility of gaining linguistic expertise. However, a chatbot's teaching mastery depends also on its users. That is why it is important to get students to truly understand AI systems and feel responsible for the conversation. But above all, we should ensure that chatbots respect human and civil rights.

Keywords: artificial intelligence (AI), chatbot, intelligent tutoring system (ITS).

Artificial intelligence will reach human levels by around 2029.
Follow that out further to, say, 2045, we will have multiplied the intelligence,
the human biological machine intelligence of our civilization a billion-fold
Ray Kurzweil

1. Introduction

Artificial intelligence (AI) is the inevitable future of business and is predicted to fundamentally alter the nature of society by the year 2040 (Paterson, 2017). According to a Gartner report, AI technologies will be in almost every new software product by 2020; consequently, it will be one of the top five investment priorities for more than 30% of CIOs (Gartner, 2017). Investment in AI start-ups was already estimated at 6-9 billion USD in 2016 (up from 415 million USD four years previously) (Paterson, 2017). In 2016, with 133 million USD, the UK showed the highest level of venture capital and seed funds investment in AI solutions of all the European countries (Stanusch Technologies, 2017). The level of AI investment in Poland is comparable to that of Sweden's venture capital and seed funds

investment in AI of more than 10 million USD in 2016 (Stanusch Technologies, 2017). Experts anticipate that AI augmentation will generate 2.9 trillion dollars in business value in 2021 and recover 6.2 billion hours of worker productivity (Gartner, 2017), as users will save time due to AI-powered tools.

AI technologies are aimed at finding applications in fields of special value for humans, such as individual transportation (self-driving cars), healthcare diagnostics, and targeted treatments, as well as in physical assistance for the elderly (Stanford University, 2016). To date, we have, however, noted considerable AI advances in education at all levels, especially as it allows personalized education at scale. This paper focuses on AI solutions implemented in education in Poland, which is one of the fastest growing post-Soviet countries in Central and Eastern Europe.

2. Artificial Intelligence in education

Artificial Intelligence is said to be "that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment" (Nilsson, 2010, p. xiii). However, this definition is still ambiguous, as machines (computer technology) develop at an incredibly rapid pace and their current functioning comprises far more than it did a few years ago. Generally, AI is "concerned with the development of computers able to engage in human-like thought processes such as learning, reasoning, and self-correction" (Kok, et al., 2002, p. 1096) and tries to imitate intelligent behavior by means of computer programs; that is, thinking and acting like humans, as well as thinking and acting rationally (Kok, et al., 2002).

The relationship between AI and cognitive processes allowed the wide use of AI technologies in education, especially since contemporary globalized education requires a new approach to pedagogical practices. Growing demands for enrolment in higher education are associated with the need for quality teaching and learning processes. Moreover, technological advances accelerate the development of new forms of direct and distance learning (UNESCO, 2007). Some of the modern technological solutions incorporated into teaching processes are, in fact, AI-powered ones.

Schools use intelligent tutoring systems to assist teachers in the classroom, as well as students at home. Teaching robots can familiarize students with coding and with reasoning deductively (e.g. while they configure robots to dance), as well as teaching them how to use visual programming language (to create simple actions for iOS and Android applications) (Stanford University, 2016). Intelligent tutoring systems (ITSs) use human-machine dialog to solve scientific problems, provide foreign language trainings (including the recognition of language errors and providing correction), as well as to support human teachers in many fields

(e.g. mathematics, medical diagnosis, physics, and chemistry) by giving students useful hints with specific feedback based on their questions and provided answers (Stanford University, 2016). Today, applications imitate human behaviors increasingly perfectly, as they offer avatar-based trainings that can adjust to users with different cultural backgrounds, or whose mastery of learning and problem-sequencing patterns differs (Stanford University, 2016). AI-driven, massive open online courses (MOOCs), which are sophisticated learning management systems that provide synchronous and asynchronous education, including assessment tools (the automated grading of multiple choice and fill-in-the-blank tests), even support distant learning (onlineuniversities.com, 2014) (Foko, and Amory, 2005). These online courses are also very useful for data collection, which could be used for learning analytics that could make a vital contribution to improving the quality of educational process, including the student engagement, behaviors, and outcomes, as well as issues related to cognitive processes (such as comprehension, knowledge acquisition, and memory) (Stanford University, 2016).

However, according to a Stanford University report, "school and universities have been slow in adopting AI technologies primarily due to lack of funds and lack of solid evidence that they help students achieve learning objects" (Stanford University, 2016, p. 31). This remark seems to contradict what we observe: a clear transition from traditional paper handbooks to digital and audio media as tools that enhance the educational process. Moreover, the use of modern technologies allow artificial intelligence to be linked to virtual reality techniques that allow students to participate in simulation – trial and error – a critical part of learning. Generally, AI tools offer students an opportunity to learn in a relatively judgment-free environment, especially if AI tutors offer suggestions for improvement. All of these options make the educational process less intimidating (onlineuniversities.com, 2014).

Above all, AI implementations in education have blurred the line between formal classroom education and self-paced individual learning, thus making it available to all (Stanford University, 2016). Chatbots are well-developed AI-driven solutions that successfully enhance processes in schools and universities; we describe them in the subsequent section.

3. Chatbot technology

Chatbots, also called as chatterbots, talkbots, conversational agents, virtual agents or virtual assistants, intelligent assistants or dialogue systems[1] are computer applications that interact with users by using natural languages (Abu Shawar, and Atwell 2007a) in text and/or

[1] According to chatbots.org there are 161 synonyms for the word "chatbot"! Retrieved from: https://www.chatbots.org/synonyms/#all, 2017.12.14.

by means of a voice. Chatbots were developed to "provide a conversational interface to a software program that performs tasks or services for an individual user or groups of users" (Buxton, et al., 2016, p. 5).

A chatbot comprises three modules: a user interface, interpreter, and knowledge base (Wallace, 2004). In some cases, their function is based on a fixed set of rules, and they only respond if a user applies the exactly correct command, which is a great technical limitation to imitating human conversation. However, chatbots are currently mostly machine learning (ML) systems that can learn without being explicitly programmed (Samuel, 1959). They collect users' inputs and transform them with the use of natural language processing (NLP) into appropriate outputs (Uliyar, 2017). Both of these solutions (ML and NLP) are artificial intelligence (AI) fields and their emergence over the last few years had an impact on chatbot technology development by changing it into AI-powered technology.

Joseph Weizenbaum developed the first chatbot – ELIZA –in the 1960s (1966) and imitated a psychotherapist's "active listening" strategies in a clinical treatment setting. This text-type application, which was initially regarded as fun and part of an "imitation game" (Turing, 1950), used a keyword-matching technique. If a user's input contained a keyword, ELIZA provided a suitable answer according to a programmed rule. In another case, the chatbot would try to obtain more information by encouraging a patient to continue the dialogue and to eventually indulge in reflection and introspection, which are part of standard therapy. Although some people believed they were talking to a real psychologist (Weizenbaum, 1976)[2], ELIZA was not a perfect imitation, as it could not converse with true understanding (Shah, et al., 2016). Nonetheless, ELIZA became an inspiration for new generations of chatbots.

Kenneth Colby developed the next and more advanced chatbot, PARRY (also called as "ELIZA with attitudes") (Colby, et al., 1972). PARRY imitated a paranoid schizophrenic's behavior and obtained interesting results from the Turing test (only 48% of psychiatrists identified PARRY as a machine, which is consistent with random guessing). In 1972, PARRY had a discussion with ELIZA, but their conversation seemed rather fruitless and ridiculous (Cerf, 1973).

The subsequent development of chatbot technology included the application of machine learning. Rollo Carpenter developed Jaberwacky in 1988 (www.jabberwacky.com/j2about), which was systematically improved in 1997 and launched on the Internet. In 2008, its name was changed to Cleverbot (www.cleverbot.com). Cleverbot can retain all conversations and reuses users' statements to make appropriate responses by matching the contexts of patterns. Consequently, "[i]t can be taught slang English, word games, jokes and any other form of identifiable language trait. Everyone contributes, so everyone can enjoy chatting – you could say it's a conversational Wikipedia" (www.jabberwacky.com/j2about).

[2] See more about ELIZA effect – the tendency of assign human behaviors to computers. Source: Hofstadter, 1996.

ALICE (Artificial Linguistic Internet Computer Entity) is another famous chatbot that Richard Wallace created in 1995 (Wallace, 2009). Although ALICE does not save a conversation's history and its responses originate from the knowledge domain stored in its database (does not learn) (Abu Shawar, and Atwell, 2007a), it uses Artificial Intelligence Mark-up Language (AIML) files to store pattern knowledge in three categories: atomic, default, and recursive. AIML, which a worldwide free software community developed, supports most chatbot platforms and services currently in use.

Modern chatbots can understand human natural language (written and spoken), as well as commands; they constantly improve their answers during interactions with users, store, assess, and categorize the information they receive to use it appropriately again in the future (Pratt, 2017). Today, we expect chatbots to display a wide array of functions and divide them into three groups (after Samsonnet, et al., 2006):

- Dialogic agents, which can interpret meaning (comprehension function). When provided with a textual or oral input, they analyze it with natural language processing tools to generate appropriate responses.
- Rational agents, which have access to an external base of knowledge and common sense (e.g. via corpora of data) (competence function). They can answer users' questions competently and can store context-specific information (e.g. a user's name).
- Embodied agents, which usually have a human-like avatar form (presence function), in order to build trust with users and entertain them.

Currently, chatbots' human-like reactions include voice intonation (Massaro, et al., 2001), avatars' face expressions, and their body posture (Lee, and Lacey, 2003), personality (Nguyen, et al., 2017), and sense of humor (Pilato, et al., 2008).

Virtual Personal Assistants (VPAs), which focus on userbased data, are one of the most popular types of chatbots (Imrie, and Bednar, 2013). Leading IT companies like Google (Google Assistant), Apple (Siri), Amazon (Alexa), and Microsoft (Cortana) have created most of the competitive and often compared VPAs.

There are many chatbot applications, as they can be useful for information retrieval, business, e-commerce, and education (Abu Shawar, and Atwell, 2007a). Chatbots help commuters find an appropriate transport connection (e.g. Instalocate, Tfl TravelBot), can forecast weather (e.g. Poncho), facilitate the making pf friends (e.g. Zo or Foxsy), and are helpful with scheduling fitness exercises (e.g. GymBot, FitBot) and other routines (e.g. MeditateBot) (Cahn, 2017). They can also improve the customer service of finance institutions (e.g. Eno), insurance (e.g. ABIe), and other fields (e.g. Marriott International's chatbot), as well as be modern message autoresponders (e.g. bots for Skype). A chatbot may be your opponent, a chat partner in a discussion game (e.g. Façade), your health assistant (e.g. GYANT), and even a therapist (e.g. WoeBot).

Above all, chatbots are also useful tools in education.

4. Chatbots for education

Chatbots are modern technological solutions that can increase students' motivation, stimulate essential learning behaviors, facilitate information absorption and communication processes, as well as imitate personal relationship during learning (Gulz, 2004). According to Knill et al. (2004), using chatbots in teaching processes may help teachers identify specific students' problems based on frequently asked questions or log files. Moreover, some systems even detect hesitance in a student's first response (Forbes-Riley, and Litman, 2011). This hesitance could indicate fields that should be thoroughly explained.

Bots are, for instance, used in foreign language learning, as they speak in a perfect, educated accent and could help students include private, emotional issues in a conversation, especially young students who treat a chatbot as a friend (and not as a teacher) (Jia, 2004a). Bots also make students feel more relaxed and comfortable when using a foreign language than when speaking to a person. A well-designed chatbot supports complex learning by improving spelling and vocabulary, but also listening and speaking skills. Bots also provide an easy self-analysis and self-evaluation if a students can access a transcript of the conversation (Fryer, and Carpenter, 2006). A good example of a well-developed chatbot when learning English is a Computer Simulator in Educational Communication (CSIEC) (Jia, 2004b), which is a web-based, human-computer communication system that uses natural language, imitates human emotions and personalities, and absorbs acoustic inputs (not only keyboard ones). In this case, conversations are not limited to a specific subject. However, it is very important to implement developed technologies, because chatbots based on keyword matching have failed to work as a teaching assistant program for foreign language learning. Their responses were predictable and lacking in personality; they also failed to detect spelling errors and grammar errors (Jia, 2004a; Chantarotwong, 2005). Above all, conversing with a chatbot (even a very simple one) may increase the quality of later interactions with a real language teacher and may lead to better effects on students' affection, cognition, and behavior in the context of a discussion (Goda, et al., 2014).

Learning foreign languages is not the only teaching field where a chatbot may be useful. Sofia (Knill, et al., 2004), a chatbot developed at Harvard University, can help with teaching mathematics, can solve simple mathematical problems, as well access more information about students' progress, their learning strategies, and frequent mistakes. VPbot (Webber, 2005) is used to increase medicine students' competences by imitating patients' answers during a premedical interview. ITSPOKE (Forbes-Riley, and Litman, 2011), which is an automatic tutoring system based on spoken dialogue, helps students learn physics. Chatbots are also applied to teach basic computer science concepts (Benotti, et al., 2014), including artificial intelligence offered as an online course that by Jill Watson – a chatbot that Ashok Goel developed – conducts (Goel, and Joyner, 2016). All these bots are the result of scientific

endeavors to create modern educational agents that can help improve learning outcomes and adapt to individual learners' needs (Kerlyl, et al., 2007).

There are also some solutions that use chatbots in assessment processes as a part of developed e-learning. Geoffrey Crisp and colleagues (2010) suggest conducting this process in a virtual world application, such as Second Life. They argue that "the collaborative and distributed nature of the internet have provided new opportunities to redesign assessment tasks so that students can be more creative in their responses and to provide evidence of deep and holistic learning" (p. 2). In their initial work, they applied the Pandorabot and showed that it is possible to present students with a simple set of assessment tasks within the Second Life environment.

Chatbots are also present in higher education institutions, only not necessarily in the teaching processes, as they also play a vital role in communication between universities and their students (Putz, 2017). These chatbots are designed to serve as students' personal university advisors (Ghose, and Barua, 2013), for example, during the admission process (Polatidis, 2011). Moreover, they support librarian work by providing responses to e-mail inquiries, by answering general questions, and by referring searches to the library catalog and other databases (McNeal, and Newyear, 2013).

5. Chatbots in Poland

The first Polish commercial chatbot was created in 2003. It was a static text-based program with limited knowledge and responsiveness (Kuligowska, 2015). Currently, 142 chatbots are recognized at chatbot.org (www.chatbots.org/country/pl) as originating from Poland. Most of them are virtual assistants and advisors at government institutions (e.g. the labor offices, town halls, civil registry offices), commercial companies (e.g. telecommunication and electricity distribution companies, the IT industry, online bookstores, insurance companies, commercial banks, real estate agencies, hotels, auction services, etc.), and even NGOs (promoting public benefit organizations' activities and the cultural heritage). One Polish chatbot is a part of a platform supporting a research project developed during a discussion on biopsychology and cognitive science; it is an attempt to construct a conversation based on neural networks (S.I.N.K.) (sink.anabot.pl). The Institution of Robot Control at Lodz University of Technology, together with Stanusch Technologies (a leading chatbot producer in Poland), is realizing another research and development project called TEPSON. This project aims to build a robot for the largest Polish telecom operator (www.chatbots.org/chatterbot/tepson).

Polish chatbots provide users with information on, for instance, legal, banking, marketing, and medical issues. They inform customers about an offer, the ways invoices can be paid,

the complaints procedures, are virtual shop assistants, and can conduct online surveys, as well as collect opinions. Bots also navigate, provide information about a location, and can schedule and explain procedures. Most of them use Polish, although some use English, and one even Russian.

In 2015, Karolina Kuligowska scrutinized the Polish market for commercial virtual assistants and compared six chosen chatbots that different companies had developed (Kuligowska, 2015). She evaluated the quality of the components, such as the appearance, the form of the implementation on the website (whether it was a floating window, pull-out side tab, a flexible combination, or something else), the knowledge base (basic and specialized knowledge), the speech synthesis unit (the uniqueness of the voice, the possibility to choose a voiceless option), the bot's conversational abilities (including its language skills and context sensitiveness), its personality traits, its personalization options (e.g. whether the gender of the chatbot's visualization could be changed, whether the chatbot could recall the user's name, and could recognize a browsed subpage of a web page or website). Some of the evaluated bots showed specific reactions to unexpected situations, such as ignorance, made typos and misspellings, insulted users, or humiliated them. Some of them could recognize foreign languages, or even translate English words into Polish. They also presented their knowledge in various forms, for example, by means of special functional buttons (e.g. "Help," "Info," "?"), by autonomously and dynamically loading new subpages, and making interactive connections to an external database. In her research paper, Kuligowska (2015) evaluated only one virtual assistant operating in education, namely KAREN, a virtual guide on the Skarbek Graduate School of Business Economics' website. KAREN answers questions about the school, provides information about studying opportunities, and possible career developments (www.chatbots.org/virtual_assistant/karen).

According to chatbots.org, five virtual assistants support higher education institutions (HEIs) in Poland. Besides KAREN, there are also:

- WINCENT, a virtual advisor on the University of Economics in Katowice's website, helps users find information about knowledge engineering and provides information related to semantic web issues (about chatterbots, ontology, Web 3.0, etc.) (www.chatbots.org/virtual_agent/wincent).
- ANIA, a virtual assistant on the Graduate School of Personnel Management's website discusses any topic related to the school's offer: the studies, specializations, additional activities, the study methods, recruitment stipulations, e-learning methods, admission procedures, and possible career development (www.chatbots.org/virtual_assistant/ania2).
- ANIA, again the name of a virtual guide at the Warsaw School of Social Sciences and Humanities' website, converses on any topic related to the school's offer: the courses, specializations, additional activities, study methods, international cooperation,

admission procedures, and the feasibility of being recruited (www.chatbots.org/chatbot/ania_fido).

- Ad@m, a virtual secretary of the Viessmann Academy of the School of Modern Heating System Techniques, explains how to apply to the school, provides information about the degrees and certificates, gives the secretariat's telephone numbers, and answers the most frequently asked questions (www.chatbots.org/virtual_assistant/adam).

Most of the above-mentioned chatbots in Polish academic institutions aim at facilitating contact with students or candidates, thus acting as office desk assistants. However, one Polish IT company offers a well-developed e-learning platform with an AI-powered virtual teacher that students can consult at any time; it can clarify vague contents, discuss a specific part of the course content, and even conduct oral exams (www.stanusch.com/?q=fact_1008287). The pilot implementation of this solution was at the University of Economics and Humanities in Bielsko-Biala.

All the virtual assistants discussed in this section have only been presented from users' perspective (including their needs, preferences, and expectations), as well as their general usability in education (which is common practice when evaluating chatbot technology) (Abu Shawar, and Atwell 2007b). In the following section, we discuss the adaptation of chatbots at two Polish universities, which includes the analysis of the user inputs and statistics, and the role of university stakeholders in developing the technology.

6. Research method

Prior literature reveals the application of the case study method in many research papers on chatbots (see for instance Kowalski, et al., 2013; Goda, et al., 2014), as this "enables a researcher to closely examine the data within a specific context. Case studies, in their true essence, explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions, and their relationships" (Zainal, 2007, p. 1-2). This method is also used to present commercial institutions' chatbot issues (e.g. PwC n.d.; VentureHarbour n.d.).

We therefore use a multiple descriptive case study in order to describe the natural phenomena occurring within a relevant case. The researchers describe what occurred (Yin, 1984).

Two cases represent the chatbot technology implemented at Polish higher education institutions (HEIs) to not only provide general information about the universities' offer and admission procedures, but to also help students gain and develop knowledge about AI-related issues. We examined the functioning of these bots in order to:

- identify the chatbots' knowledge base categories,
- analyze the types of frequently asked user questions and the chatbots' responses.

The two cases describe the chatbot implementation that the same commercial company, Stanusch Technologies (www.stanusch.com), developed. They both use Polish. The analysis is based on not yet published data that their developer provided and on the diploma thesis of a student who helped with the implementing and adopting of a chatbot at one of the universities (case 1).

7. Case 1: KLAUDIA

KLAUDIA is a virtual assistant created for the Signal Processing Group at AGH University of Science and Technology, which a student adapted to provide information about and promote university-related issues. This prototype was tested with users' participation in a pilot phase from May 1 to December 1, 2013 – see http://www.dsp.agh.edu.pl.

7.1. Specialized knowledge base content

A specialized knowledge base, specific for the chatbot, was implemented in order to promote the university's offer and provide information on issues related to the research that the Signal Processing Group conducted. The knowledge base was divided into four categories (Jaciów, 2014):

- AGH University, covering facts about its structure, recruitment process, scholarships, other forms of financial aid, student associations, and student traditions.
- Signal Processing Group, providing information about research projects at the unit, the unit member, the unit resources and product, and the content available on the unit's website.
- Acoustical Engineering, providing descriptions of the academic course, its program, candidate requirements, graduates' professional perspectives, subjects, a list and descriptions of available specializations, laboratory infrastructure, and other course-related details.
- Signal processing and speech technologies, providing explanations of basic concepts in these knowledge domains.

Although the implemented chatbots' main purpose was to answer users' questions requiring specialized knowledge, only a minority of the produced answers was university-related. 66% of the answers only used the general knowledge base (Jaciów, 2014).

7.2. Frequently asked questions and given answers

During the analyzed period (7 months) 4,815 conversations there were conducted, which generated 35,280 user questions and chatbot answers (Jaciów, 2014). The questions (user inputs) and answers (chatbot outputs) were grouped into categories (some phrases could be included in more than one category), which table 1 and table 2 present. No examples of questions and answers are included, as they were formulated in Polish and some of them cannot be easily translated into English.

Table 1.
Inputs classification for the KLAUDIA chatbot at the AGH University of Science and Technology (www.dsp.agh.edu.pl)

Category	Subcategory	Frequency of occurrence
Greetings		249
	Formal	219
	Informal	30
Goodbye expression		65
	Informal	40
	Formal	25
Anthropomorphic questions		1782
	About its name	165
	About its age	172
	About its appearance (e.g. height, wearing)	139
	About its relationships (e.g. boyfriend, kids, husband)	236
	About its feelings (e.g. happiness, mood)	86
	About its preferences	206
	Compliments	171
	Proposals (e.g. to meet, date)	70
Questions about chatbot technology		236
General facts (e.g. about the current time or weather)		231
Mathematical calculations (e.g. 2+2)		151
AGH University related questions		499
Signal Processing Group-related questions		91
Acoustical Engineering course-related questions		302
Signal processing and speech technologies-related questions		181
Questions about specific persons (e.g. faculty members)		169
Input with information about a user (e.g. “I’m stupid”, “I’m having a meal now”		229
Other questions (e.g. “does God exist?”)		1322
Requests		315
	for action (e.g. “smile”, “wave your hand”)	148
	for a general discussion	44
	for a specific action (e.g. “tell a joke”)	78
	to end the conversation	29
Obscene phrases		925
	Insults	217
	Sexual harassment	238
	Intimate questions	208
	Single vulgar word	262
Feedback		320
	Positive	171
	Negative	149
Random typing		103
Nonsense statement		139

Source: based on (Jaciów, 2014, p. 31-32).

The discussed case study reveals that inputs are usually questions about anthropomorphic issues. Users also prefer to use informal language while chatting with the bot, which suggests that the virtual assistant is perceived as a peer. It also shows that KLAUDIA was used more for entertainment than as a source of specific knowledge.

Table 2.
Outputs classification for KLAUDIA chatbot at the AGH University of Science and Technology (www.dsp.agh.edu.pl)

Category	Frequency of occurence
Acceptance, confirmation	573
Refusal, denial	333
Expression of comprehension	86
Encouragement to continue	21
Regret	16
Refusal to provide information	7
Output in foreign (English) language	63
Expression of laughter	94

Source: based on (Jaciów 2014, 32).

A total of 1,796 KLAUDIA outputs were identified. Most of them were simple confirmations or denials. However, the system is able to express "active listening," strategy, and emotions (by laughing) (Jaciów, 2014).

KLAUDIA is not an AI-based chatbot and does not develop its knowledge base during conversations. However, if it were possible, it should develop its competences regarding informal communication rather than use professional language.

Besides being a useful desk office assistant and a kind of glossary, KLAUDIA also became a research subject. Paweł Jaciów, who has completed his engineering thesis, participated actively in the process of implementing the chatbot's specific knowledge base. During his research project, Jaciów developed the application of the chatbot technology, which a commercial company had provided. Involving students of engineering and/or IT technologies in chatbot developmental processes could be a crucial part of their education. The KLAUDIA project, which has been terminated, confirms that it is an example of a good practice in this field.

8. Case 2: WINCENT

WINCENT is a virtual advisor completed for the University of Economics in Katowice to provide a professional explanation of concepts in the knowledge engineering field. IT is described on the separate website that promotes the topic for students: http://inzynieriawiedzy.pl.

8.1. Knowledge base content

A knowledge base was implemented that comprised 190 facts divided into 13 categories, such as: chatterbots, data/information, engineering knowledge, engineer knowledge, configuration, ontology, about the project, personality, knowledge representation, Knowledge Engineering course, knowledge organization systems, knowledge, and knowledge management.

In the period from January 1, 2014 to October 1, 2017 (45 months) WINCENT participated in 1856 conversations and its users generated 9094 inputs (the bot could not find an appropriate answer for more than 13% of these). More than 28% of the total chatbot outputs required the specialized knowledge base.

8.2. Frequently asked questions and given answers

The most frequently asked questions that users asked (including their comments, requests, and statements) WINCENT during conversations in 2017 are presented in table 3.

Table 3.
Inputs classification for WINCENT chatbot at the University of Economics in Katowice (inzynieriawiedzy.pl)

Category	Subcategory	Frequency of occurence
Greetings		71
	Formal	6
	Informal	65
Goodbye expression		6
	Informal	3
	Formal	3
Anthropomorphic questions		87
	About its name	26
	About its age	18
	About its origin (e.g. creator,)	16
	About its relationships (e.g. boyfriend, kids, husband)	17
	About its feelings (e.g. happiness, mood)	4
	About its preferences	6
Questions about chatbot technology (e.g. knowledge base, AIML, Watson, etc.)		47
General facts (e.g. about the current weather)		13
Knowledge management-related question (e.g. about knowledge, data, ontology)		52
University-related questions		22
Knowledge Engineering course-related questions		30
Questions about specific persons (e.g. the dean)		7
Input with information about a user (e.g. “I have 1250 PLN”)		3
Requests		34
	for a location	9
	for a telephone number	3
	for general explanation or justification (e.g. “why”)	22
Obscene phrases		28
	Insults	6
	Intimate questions	3
	Single vulgar word	19

User's attitude		157
	User's acceptance or confirmation (e.g. "ok", "for sure")	91
	User's refusal or denial (e.g. "no", "so not",	31
	Expressing user's willingness to discuss (e.g. "what's up?")	22
	Expression of user's emotions (e.g. laugh, confusion)	13

Source: based on internal non-published data of Stanusch Technologies

Most of the users' inputs were confirmations or denials. The specific way of conducting a conversation with chatbots encourages the discussants to continue the dialogue by also asking questions. In this case, people were also more interested in WINCENT as an embodied technology (they often asked anthropomorphic questions). Nevertheless, the percentage of obscene phrases was lower this time.

Table 4.
Inputs classification for WINCENT chatbot at the University of Economics in Katowice (inzynieriawiedzy.pl)

Category	Description	Frequency of occurrence
Knowledge management theory	explanation of basic concepts such as knowledge, data, ontology, presentation of knowledge classification, etc.	179
Knowledge engineering theory	explanation of specialized notions, such as semantic network, expert system, XML, RDF, agent system, data warehouse	185
Knowledge Engineering course	information about subjects, types of potential employers, future career opportunities for graduates, knowledge engineering as a profession, advantages of studying	35
Chatbot technology theory	explanation of notions such as a chatbot, knowledge base, AIML, presentation of the evolution and applications for this technology	82
WINCENT	*(usually as an answer to anthropomorphic questions)*	84
	general information about WINCENT's activity, usability, purpose	37
	answers to questions about WINCENT's age	32
	answers to questions about WINCENT's creators	15
Other		162
	list of specialized topics	67
	user's name recognition	42
	statement used if no answer was in knowledge base	53

Source: based on internal non-published data of Stanusch Technologies

The 73 output phrases that were most frequently generated in 2017 were classified into six categories. Three of them, which are of a theoretical nature, were frequently used, because the main purpose of the analyzed chatbot is to support the learning process. WINCENT is focused on knowledge management-related topics and tends to list them quite often. Information about the Knowledge Engineering course, which is a type of educational promotion, did not appear in many conversations.

Despite the significant number of facts in his knowledge base, WINCENT could sometimes not find a correct answer. This occurred 53 times During this research session. In this case, the system generates an output that encourages the user to continue, or to again have a discussion with the chatbot later. The following few phrases are examples *(translated from Polish)*:

- *I don't have any information about this at the moment. Come back later. I'll try to find out.*
- *I know many things, but I don't know anything about this right now. However, I can suggest something.*
- *I don't know much as I'm still young. But I learn from my discussants each day. Come back some time, I will be wiser.*

The results presented above were from the WINCENT project, which was part of a still running inter-organizational project at the University of Economics in Katowice financed by EU funds. Its main objective is to create new academic courses that can implement new media and knowledge technologies in teaching programs and fulfill labor market needs.

A similar chatbot was implemented for the whole university and is available at its main website: https://www.ue.katowice.pl/. Although it looks exactly the same as WINCENT, it has a larger facts base (900) and uses other categories. This system is focused on promoting the university and its educational offer, but displays a similar personality to WINCENT when answering anthropomorphic questions or insults.

9. Research limitations

The conducted research is focused on just two cases of chatbot implementation in higher education institutions in Poland. The general conclusions derived from them are limited, since incorporating artificial intelligence in the teaching process should also include pre-academic education levels. Moreover, both cases are based on chatbots that the same company provided, and they therefore use similar technological solutions and language patterns. In addition, only two public universities offering AI-related courses (acoustic engineering and knowledge engineering) were involved. The research process should therefore be extended and combined with other science fields, such as the humanities or social sciences. Nevertheless, the presented cases could be an inspiration for a continued discussion on the role of AI in developing contemporary education.

10.Conclusions and Lessons from the Cases

The Chatbot market in Poland seems to be developed. Virtual assistants, guides, or secretaries mostly help commercial companies and public office with promotions and customer service processes. Polish universities also implement this modern technology to present their educational offer, or treat chatbots as an alternative to an information desk.

This specific chatbot application field is due to chatbots being better able to inform than to discuss, since "conversations are hard to sustain for non-humans, and once a computer loses track of where it is in a two-way interaction, [the] results can quickly break the "magic" of the whole situation" (Porcellana, 2018). That is why the boundaries should be set and defined for a chatbot function, as it is impossible to implement a chatbot that can react appropriately in every single situation.

Despite chatbots usually being used for marketing processes, the presented cases are good examples of incorporating a chatbot into a teaching process. Adding appropriate phrases to a virtual assistant's knowledge base not only develops technical and programming skills, but also provides the possibility of gaining linguistic expertise. However, a chatbot's teaching mastery depends on its users, who are responsible for enhancing the communication process. In each cases we find that users provided insults, intimate questions, vulgar words, and other topics that are irrelevant in the educational process. If there is no control of human-chatbot interaction, there is a risk of losing sight of this interaction's goal. First, it is important to get people to truly understand AI systems, to intentionally participate in their use, as well as to build their trust, because "[t]he measure of success for AI applications is the value they create for human lives" (Stanford University, 2016, p. 33). Providing conversations with a chatbot should be like raising children – within defined borders and according to shared values. Not doing so, could create a bot that is a neo-nazi supporter, like the Microsoft Twitter bot (Wakefield, 2016). Consequently, society needs to adapt to AI applications if it is to extend its benefits and mitigate the inevitable errors and failures. This is why it is highly recommended to create new AI-powered tools for education that are the result of cooperation between AI researchers and humanities' and social sciences' researchers, who can identify cognitive processes and human behaviors.

The chatbots examined in the presented cases could play the role of a learning assistant if they contained specialized knowledge bases and could easily recall a list of academic, course-related topics. Such learning assistants could help a human tutor focus on in-class moderated discussions based on real cases, while the chatbots could automatically provide the theoretical fundamentals, or simple exercises (perhaps even automatically assessing the level of information absorption). However, the changes required to chatbots to conduct educational processes also require significant changes to curricula (NSW, 2017). Moreover, education institutions would also need to ensure that that they have an appropriate infrastructure, as well as the safety and credibility of AI-based systems. Ultimately, the law and policies need to adjust to the rapid pace of AI development, because the formal responsibility for appropriate learning outcomes will in future be divided between a teacher and a machine. Above all, we should ensure that chatbots respect human and civil rights.

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