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**HOW TO EMPOWER TEACHER PRACTICE WITH ARTIFICIAL INTELLIGENCE
BY INTEGRATING PEDAGOGICAL AGENTS AS EFFECTIVE ASSISTANTS**

MA thesis

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Abstract

This study explores how pedagogical agents (PA) can serve as assistants to empower secondary teachers' practice and lesson planning. Using a qualitative approach, ten teachers from Lithuania with different cultural backgrounds were interviewed to get their insights in two broader themes: how they perceive the idea of having AI as an efficient tool in education and the potential usage of pedagogical agents to empower their practice. The findings of this study were that, overall, the participants are open to incorporate AI and pedagogical agents in their practice. Furthermore, this thesis proposes five different teachers' profiles based on participants' different points of view on how PA could be used: innovators, improvers, doubters, executors and conservators.

Keywords: Artificial Intelligence, Pedagogical Agents, teaching practice, teachers' assistants, educational technology

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Introduction

The main goal of this study was to understand how pedagogical agents may empower teachers' lessons in secondary school. To that end, ten teachers from the International Secondary School in Lithuania were interviewed. During the interview, teachers answered 13 questions aiming to get their insights in three main topics: pedagogical agents' role during a lesson, how to effectively implement the pedagogical agents into the existing learning plans, and which concerns and hassles teachers foresee when implementing pedagogical agents into their practice.

The pedagogical agent concept appeared several decades ago. According to Johnson et al. (2000) pedagogical agent is a combination of animated interface agents, which gave new opportunities to conduct a human-computer interaction simulating a face-to-face communication (Nagao & Takeuchi, 1994) and knowledge-based learning environments, which is an artificial intelligent software with opportunity to adapt to the individual learning needs of the students (Wenger, 1987). The first idea of an animated pedagogical agent as the combination of these two approaches was put forward by Lester et al. (1997).

Artificial intelligence made possible for PA to quickly become of interest in educational situations. They could be suitable for different ages, experience, and domains in education (Wang et al., 2008). Moreover, different parts of the lesson such as introduction, explanation, feedback may also be shared with pedagogical agents (Edwards et al., 2018).

The motivation of this thesis comes from understanding teachers' opinions about PA technology, and to discover meaningful ways pedagogical agents could be integrated into teachers' practice deeper and in more detail.

Therefore, I formulated the following two main research question:

1. How do teachers perceive the idea of having AI as an efficient tool in education?
2. How do teachers perceive the usage of pedagogical agents to empower their practice?

Theoretical overview

Artificial intelligence in education

Artificial intelligence (AI) has the potential to significantly increase the efficiency of the education system, personalize the learning process according to the individual needs of

students, and significantly reduce the administrative burden on teachers. AI could enable individualized learning that a teacher in a class of 20+ students is unable to do, and bring formative assessment to a whole new level (Fadel et al., 2019).

Research in the field of AI and machine learning can also make a positive contribution to the disciplines of education, determining how people learn specifically, how the thought processes of learning occur. For example, AI algorithms can pinpoint which parts of learning materials are less clear to students or where they make more mistakes. Ultimately, they can tailor learning to each student (Guan et al., 2020).

Online educational systems and entire digital platforms using AI are already helping teachers in many countries to evaluate student work. Some studies have shown that algorithms evaluate more objectively than the best teachers. For example, they are freed from the personal bias that a teacher may sometimes have. Thus, AI could avoid unfairness in some phases of students' work assessment or design. It is through the collaboration of man and AI, rather than the replacing teachers, that many authors see the future of learning (Chen et al., 2020).

From a pedagogical point of view, AI can help learners to develop competencies that will enable them to overcome learning difficulties, as AI has the potential to reduce the burden of mechanical activities that might be hindering the opportunity to engage in more important cognitive abilities. AI can be thought of as the ability of computer programs to operate similarly to the human brain. Although AI has not yet reached the level of the human brain, it is rapidly evolving. Therefore, AI has the potential to be trained to perform and behave like teachers which in consequence could serve as a personalisation solution (Luan et al., 2020).

Summing up the views of different authors on the future of the AI in education, it is possible to distinguish five main roles of the AI in the education:

- **Personalized learning.** According to van der Vorst & Jelcic (2019), AI should support the uniqueness of each student. Systems will be able to recognize the strengths and weaknesses of students and adapt the way and process of learning accordingly. AI will recommend to a particular student what he needs to pay more attention to, suggest a learning pace, where learning gaps have been detected and what needs more training.
- **Tutors.** There are already AI-powered tutoring programs that help students learn the basics of math, writing, and other subjects. Humanoid robots are unlikely to replace teachers in the coming years. AI can help teachers ease their administrative burden.

Teachers will then have more time to prepare for teaching and face-to-face interaction with students (Kengam, 2020).

- **Identification of gaps.** AI can track the impact of lessons on individual students. Based on test scores or homework, it analyzes what they don't understand and where they have gaps. By doing so, it will provide teachers with feedback on how to correct teaching or understand what are the gaps of study materials (Chen et al., 2022).
- **Choice of school or job.** AI developers are working to create systems that will help students choose a college or future job based on the subjects and areas they score best in and that suit them. The intelligent systems then compare the strengths with the requirements and programs of the schools or the requirements of employers and make recommendations, which can help them make a decision (Westman et al., 2021).
- **Smart schools.** Data analytics and AI can control security, lighting, classroom use, and the movement of people around buildings. AI detects fraud and plagiarism attempts (Dimitriadou & Lanitis, 2023).

Although all the possibilities of using AI in education have not been disclosed, based on the research made by different authors, it is possible to make some conclusions about the five main changes that could occur in education with AI help:

- **Creating a self-regulated learning environment.** AI makes education adaptable and flexible. Based on the premise that all learners are different and for some it is easier to read texts and understand visual information, for others it is easier to perceive and remember information by ear. AI can help tailor the learning environment to be the most productive for a particular student (Araka et al., 2020).
- **Improving Efficiency.** AI is able to speed up learning processes and reduce the manual work associated with education. Some routine tasks can actually take up most of a teacher's or student's time. AI can automate these processes, increasing the efficiency and quality of education. In the future, teachers and students may get rid of many time-consuming, unproductive processes (Udvaros & Forman, 2023).
- **Educational platforms based on artificial intelligence.** Through AI, students can access an educational platform that is not only tailored to their needs, but can also teach them in areas where human teachers cannot (Liu & Ren, 2022).
- **Game-based learning.** Learning through games has already become popular in

primary education. Children learn how the world functions from some educational games. However, this creative approach to learning can also be implemented at higher levels of education, helping students develop skills they have to acquire (Alam, 2022).

- **Teaching students with special educational needs.** When it comes to students with special educational needs, some problems can be tackled with AI, such as personalization. Its algorithms are designed to help people with special needs in the most efficient way (Anderson, 2019).

However, despite AI potential for improving education, some authors are also raising attention to the fact that people need to understand how machines “think”. According to Shin (2021), researchers should consider a higher form of AI that will be able to explain its actions.

Pedagogical agents in empowering teacher’s practice and student’s learning

PA evolved from intelligent tutoring systems (ITS), which take advantage of knowledge modeling and are capable of supporting students with learning aids like feedback. The combination of PA and ITS gives teachers an opportunity to use PA as a tool of personalized help to students. Overall use of ITS together with PA had more positive reviews from both teachers and students (VanLehn, 2011). However, there is still no common solution, how to use the ITS in the educational process. There are different reasons, including the attitude of teachers towards new technologies, different subjects and level of students (Nye, 2014).

Literature suggests PA can also serve as an assistant teaching process and save teachers from unnecessary workload. Mahmoud & Ferneley (2006) mentioned two challenges why teachers would benefit from a PA: student-teacher ratio challenges and personalized scaffolding for each learner (or group of learners). Roa et al. (2022) work suggests PA may help teachers to effectively balance between the needs of the whole classroom and individuals.

It seems that PA versatility to play different pedagogical roles is a promising path for AI to go beyond rigid design scripts. For instance, if the agent can learn from the user, it may be called a teachable agent (Blair et al., 2007). Another example is when PA appears as a peer student, then it is called – Pedagogic Agent as a Learner Companion (Kim et al., 2007).

Despite the fact that PA can complete different tasks and act as a teacher’s assistant, some of the teachers are rather skeptical about using agents in their classrooms. According to Zumstein & Hundertmark (2017), it is important to remember that the teacher is the basis of

the learning process, and learning technology cannot substitute them. PA can't fully substitute the human interaction between a teacher and a student, however can achieve motivational benefits such as reduced anxiety and increasing engagement, in some situations PA can be used to improve student learning.

One of the reasons why teachers resist such new technologies as PA and AI in education is the fact that teachers have a very limited knowledge about technology and opportunities to use it in their practice. At the same time teachers suggest that technologies may help them to develop creativity in their work by having groups of students with different levels. However, they still consider AI and PA a threat, which may worsen the communication skills, encourage passiveness and replace a human teacher (Chounta et al., 2022).

In the teachers' interaction with PA and their attitude towards implementing agents into the learning process, Roa et al. (2022) distinguish four different agent's roles:

- **The Annotator.** PA should be able to help the students who need it and manage some small issues that occurred during the group work.
- **The Scaffolder.** PA should be able to explain the same thing to different students, who work and understand at a different pace, which may be overwhelming and PA may solve this issue.
- **The Substitute.** Sometimes teachers have plenty of other different tasks at school, apart from teaching. In order, not to lose lesson time, the teacher may focus on solving problems and PA may substitute him in the introductory phase of the lesson.
- **The Peacekeeper.** PA should be able to keep peace in the classroom. If a teacher works with one group and suddenly a conflict appears in another, the PA may steer the students in the right direction.

So, despite some of the research showing that the teachers are positive PA will help them with a workload, at the same time they don't want to lose control over a pedagogical process and the situation in the classroom. First, teachers expect that PA will help them with a balance between individual and classroom needs, offer either their or PA assistance for those students, who are behind or ahead of the other students, provide the support in the explanation part of the lesson and help them by reducing the routine work.

From a theoretical view, PA can elicit principles from the following effects:

- **Persona Effect.** Only the existence of the PA in the educational environment of the classroom already has a positive effect on the students' academic results and motivation (Lester et al., 1997).

- **Proteus Effect.** In this case, students try to take an example from the pedagogical agent and repeat after PA. It can easily lead to the improvement of the academic performance among students (Yee et al., 2007)
- **Protégé Effect.** Which shows that students are ready to spend more time and effort to teach the PA then learn from his tasks and explanations (Chase et al., 2009).

Domagk (2010), for example, considers PA as a serious means of increasing students' motivation to study. The author found that PA can improve learning productivity, but only if they are physically attractive. The positive effect is enhanced if a physically attractive teaching agent talks to the student and gives encouraging feedback.

However, Moreno (2005) said that if the students don't ignore PA's image immediately, they can start doing it over time. But Louwrese et al. (2008) didn't agree with that statement, as their eye-tracking research showed that 56% of the students still look at the PA, even if it is located on less than a quarter of the screen. Moreno (2005) only agreed that students don't ignore and are not distracted by the pedagogical agents, if they have high motivation to study.

Perez-Marin (2021) admitted the positive effects of the different design elements on the motivation of the students. They feel more confident and comfortable during the lessons. PA stimulates them to study more. Students increase their communication and problem-solving skills and improve memory. However, she also mentions the importance of the personal teacher-student relations. It's also important as pedagogical agents rarely show empathy and emotional support, so much needed by students.

Zumstein & Hundertmark (2017) also agreed with such a statement. They mentioned that although PA can't completely replace human interaction, they can provide students with motivational benefits such as reduced anxiety and increased engagement, in some situations pedagogical agents can be used to enhance student learning.

Based on the importance of the teacher's role, Castro-Alonso et al. (2021) conducted several experiments with students and both of them proved that PA helps students to improve their academic performance, however this improvement was minimal. They also concluded that a female 2D agent with a real human voice improves the students' results more. Sikström et al. (2022) came to the same conclusion, that there is a certain improvement in the academic results of the students, but it's not significant at all. At the same time Guo & Goh (2015) stated that despite the minor effect on the student's knowledge acquisition and retention, the effect on the motivation of the student is significant.

Grivokostopoulou et al. (2020) focused on the higher effect of usage of PA in the specific game-based activities and virtual environments. In such a virtual world, PA may perform the role of companion and teach the student through the game. In their case the virtual 3D world AVARES was introduced, where students learnt about environmental engineering and energy generation. Johnson (2015) also discovered the effect of the PA as a part of virtual role-play simulation. According to him such virtual role-play simulations could be used in the different phases of learning: guidance, practice and assessment.

Woolf et al. (2010) in their research focused on the possible effect of the PA on the low achieving students and students with disabilities. They decided to do their research with a hundred students from two rural public schools in the USA. The PA had to prepare students for standardized tests in mathematics. The main result showed that low achieving students spent more time studying with PA than high achieving. This may be explained that low achieving students had to spend more time on average on one task. Such learning companions made low achieving students feel more confident and improved their academic results. With the help of such online peers, low achieving students improved both their results and confidence, compared to students without the access to the PA.

However, there were also drawbacks of using the PA of low achieving students. In some of the cases, when they didn't know the response, they started guessing more than high achieving students. Also, low achieving students had less interest in the new technology in their classroom than high achieving students. And, finally, low achieving students rely more on the hints from the PA than on their own knowledge.

Johnson & Lester (2016) also came to the conclusion that PA helps younger than older students to receive better results and more K-12 than post-secondary students. Same for the subjects, the results in math and science are easier to improve with the help of the PA than the results in humanities. Wang et al. (2008) also mentioned that the PA are more suitable for novice learners than for more experienced ones.

Another usage of PA in the educational process was offered by Edwards et al. (2018). With the help of PA, they provided feedback for students and gave them an opportunity to communicate with agents to receive personalized feedback. Usually, when the personalized feedback is provided in the classroom, it may be ignored due to the lack of interest and overall noise. In this case the PA returned the importance of the feedback and encouraged the communication between the agent and a student. Such an important element as feedback may improve the motivation and academic results of students, which happened in that case also.

Ethical considerations and concerns of using pedagogical agents

Using PA with students should not only help increase their motivation and academic performance, but also it should comply with ethical principles and regulations (Dignum et al., 2018). Cordova et al. (2021) also raised questions about the opportunity to transfer the ethical concepts and behavioral norms to the PA and make them accountable for their decision-making process.

Kim et al. (2019) offered a broader term to cover these issues – Value Alignment (VA). With VA, it's possible to make sure that everyone has the same moral and ethical values, and only after that it's possible to succeed in successful implementation of PA in the studying process. However, in education, VA might be a controversial issue due to the different cultural backgrounds of the students. In this case, Cordova et al. (2021) offered to implement not simply PA, but Artificial Moral Pedagogical Agents.

Bickmore (2003) mentioned that overall, the relations between PA and students raise a certain amount of moral and ethical issues. In this case, the important question is whether students and agents can maintain long-term relations. It raises another amount of the questions, which were not fully discovered in the academic literature: is it ethical to create PA that can communicate with students on a deeper emotional level?

Culley & Madhavan (2013) also focused on student-agent relations, but they discovered more factors that may influence such relations – students' and agents' gender and ethnicity. In their opinion the deeper the relationships are, the less focus on education may be from the students' side. However, without the trust and emotional connection between agent and student, the effectiveness of the educational process will also be low.

Roa et al. (2022) findings on ethical considerations from a teacher's perspective are the following:

- **Substitute teachers.** The main concern that teachers have, that over a short period of after showing their effectiveness, the PA may substitute the real teachers. Or it simply may lead to a certain number of teachers losing their jobs.
- **Role of the teacher.** Some teachers worried that with the implementation of PA they won't be the main characters in the classroom and their authority may fall.
- **Data protection.** Some of the teachers have concerns about the data protection issues.

In their opinion students, as digital natives, may have less concerns about the opportunity that their personal data may be stolen, however parents may worry about the leakage of the students' faces or grades into the open access.

- **Less offline education.** Another concern was that the implementation of the PA will lead to an increasing trend in online education and to the uselessness of the teachers, especially in the online learning environment.
- **Grading.** Some teachers have concerns that if PA will take on the grading function from the teachers, it may use the different logic in work assessments and will give points only for correct answers and not for the correct logic of the response.
- **Who controls the agent?** And finally, the concern that teachers have is, how smart is PA? Whether it is just a teacher's puppet, or it is smart enough to be the real assistant.

Most of the concerns are shared by teachers and educators and not by the students.

Students are more open and ready to try something new and innovative. However, teachers can't be blamed for being not modern in their teaching techniques. Mostly, they are responsible for what and how they teach, and before they are not sure that certain new technology doesn't harm, but help the students, they won't implement it in their classrooms.

Method

Study design

For this Master thesis, a qualitative approach was used, as it allowed to individually gain new insights and better understanding about the participants through online individual interviews. During the interviews, the interviewer paid attention to asking the planned protocol's questions without expressing own opinion to avoid bias induction. Furthermore, the interviewer was trained to prompt additional questions aiming to find out the greatest number of participants' utterances (Maxwell, 2021).

Qualitative methods in research, presuppose a structured, but still free narrative in the form of a monologue or dialogue, argument or discussion on a given topic. Despite the existence of a preliminary discussion or conversation plan, in which the topics and questions are premarked, the basis of this study is the story itself as a product of the independent activity of the respondent in a given semantic space. The same happened during the interviews with teachers (Nathan et al., 2019). Therefore, despite having a research protocol

with established questions, the sequence of the questions was changed regularly based on the direction of participants' answers.

Another reason to choose the qualitative method was the fact that, through qualitative methods, subjective opinion can be studied deeper and the experience of teachers regarding the issue of using technologies and AI may be discovered in more details (Watkins, 2012).

Some logistical considerations affected my research design and data collection instrument. The first reason is that half of the respondents were located in Kaunas and the other half in Vilnius. The second reason was the fact that with an interview format, each teacher would have more opportunities to talk personally about the topic and not to be influenced by the more experienced colleagues (Archibald et al., 2019).

Finally, the interview gave the opportunity to talk more deeply with each participant, so during the interview process each teacher had the opportunity to fully express themselves. Participants' openness was important and needed mainly to answer some controversial questions towards the end of the interview (Gray et al., 2020).

Sample

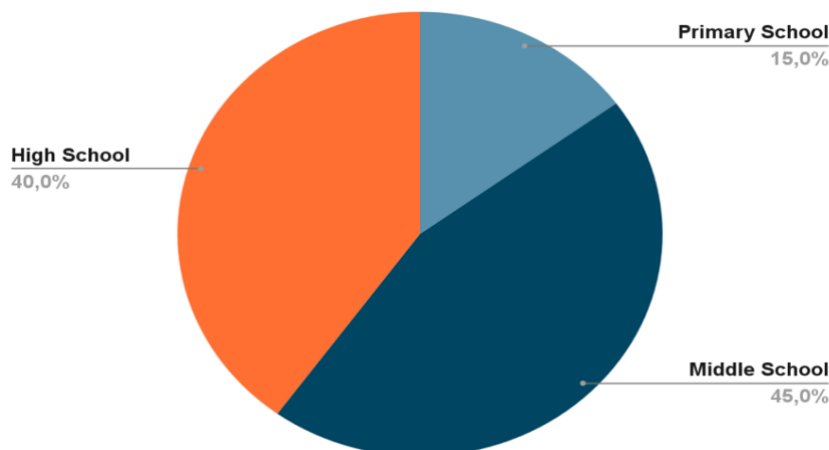
The participants of this study were International school teachers of Erudito Lyceum. This institution offers primary, secondary and high school curriculums (Lithuanian, Cambridge and International Baccalaureate, IB) in two campuses – Vilnius and Kaunas, Lithuania. All teachers participating in this study, have different cultural backgrounds, taught and teach different curriculums, work with different age groups and have different experience and attitude to the technologies.

This study's sample consisted of ten teachers in total, five teachers were from Kaunas school and five teachers from Vilnius. The gender balance was also almost maintained – six teachers were males and four teachers were females. Regarding teachers' cultural background, two teachers were from Lithuania, two from the USA, one teacher from Australia, one from Azerbaijan, one from Belgium, one from Georgia, one from the UK and one from Ukraine. All teachers had international experience, working in Canada, Colombia, China, Greece, Israel, Kuwait, Malaysia, Poland, Romania, South Africa, South Korea, Spain, Turkey and the UAE.

Regarding the practice experience of participants, all the teachers had at least five years of experience; three of them were the most experienced with 15, 22 and 32 years of

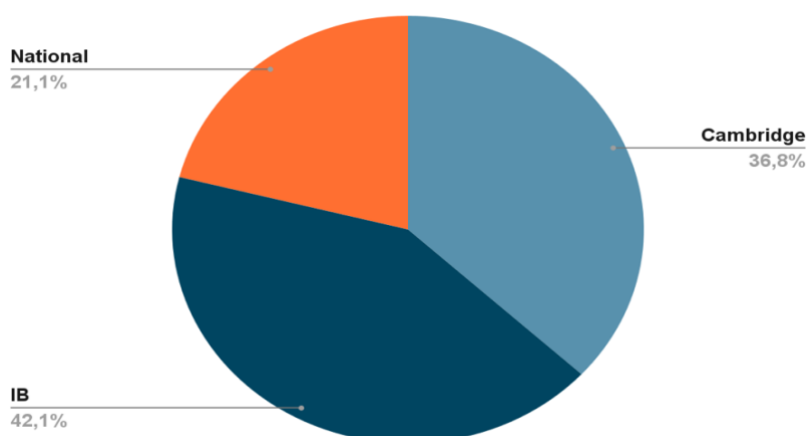
experience. The average duration of the teaching experience of the respondents was almost 11 years. Furthermore, one teacher works only in Primary school, one teacher works in Primary and Middle School, one in Primary, Middle and High School. Rest of the teachers (seven) teach both in Middle and in High School (Figure 1).

Figure 1. Where are the teachers working



As for the curriculum, two teachers work solely with Cambridge curriculum, four teachers work with both Cambridge and IB, three teachers work with both IB and Lithuanian Curriculum and one teacher with all three curriculums available in Erudito Lyceum – Cambridge, IB and Lithuanian. Previously teachers also had experience with American, Australian, South African, Spanish, Catalan and Ukrainian curriculums. Apart from that one teacher was also involved in the Lego curriculum for the Robotics course (Figure 2).

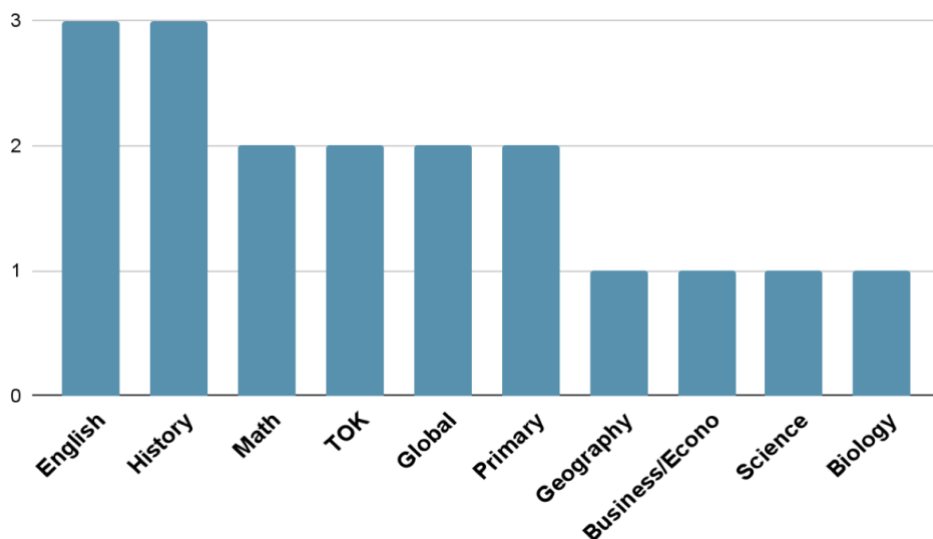
Figure 2. Which curriculum do teachers teach



Three of the respondents teach English language, three teach History, two teach Math, two TOK (Theory of Knowledge), two Global Perspectives, two General Primary subjects, one Geography, one Business, one Economics, one Entrepreneurship, one Biology and one Science. Some teachers are teaching more than one subject. Only 4 teachers have only one

subject, 3 teachers have two subjects, 2 teachers – three subjects and 1 teacher – four subjects. Overall, 12 different subjects are covered by the teachers, who were interviewed (Figure 3).

Figure 3. Which subject do teachers teach



Data collection

Before the interview, teachers were asked to share one lesson plan with the author of this thesis. The latter helped to understand the level of the usage of modern technologies and possibility to implement the pedagogical agents into the lessons.

The interview protocol consisted in four main parts: getting to know the teacher, introduction to the pedagogical agents' concept, implementing pedagogical agents into the teacher's lesson, concerns and support for implementing pedagogical agents. Ethically Wise the consent form was created and provided to all the teachers to sign it before the interview started. Interviews took place between March 28th and April 5th 2023. For introducing the study's topics to participants, the interviewer prepared slides about artificial intelligence in education, the definition and overall state of the art of pedagogical agents.

Participants could choose between a face-to-face or online meeting format interview. Nine out of ten teachers decided to have it online, in Zoom (<https://zoom.us>). Only one teacher preferred to have it face-to-face. The average time of one interview was 19 minutes 5 seconds, with the longest interview of 22 minutes 56 seconds and the shortest of 14 minutes 36 seconds.

All the interviews, both online and offline, were recorded and then transcribed using the Descript app (<https://www.descript.com/>). Before the interviews started, the interviewer asked for participants' permission to record the interview.

Data analysis

All interviews' recordings were gathered in one Google Drive folder for organization purposes. Next, the transcription process started using the Descript app. After transcription, all interviews required some cleaning of parasitic words and some spelling mistakes. Next, participants, questions and linked utterances were organized and coded in a Google Sheet. The latter strategy made the data more structured and gave the opportunity for engagement in the analysis process.

The author of this thesis used thematic analysis. 28 main topics were identified from the teachers' responses. The latter strategy gave an opportunity to see the topics, which were raised by one teacher several times and the most popular topics, which were raised by different teachers at the same time.

The thematic analysis objective is twofold:

1. To analyse the current trends and issues in the teacher's work with technologies, AI and PA.
2. To contribute to the body of research that builds on teachers' insights and recommendations on how AI technology in education should empower their practice.

Results

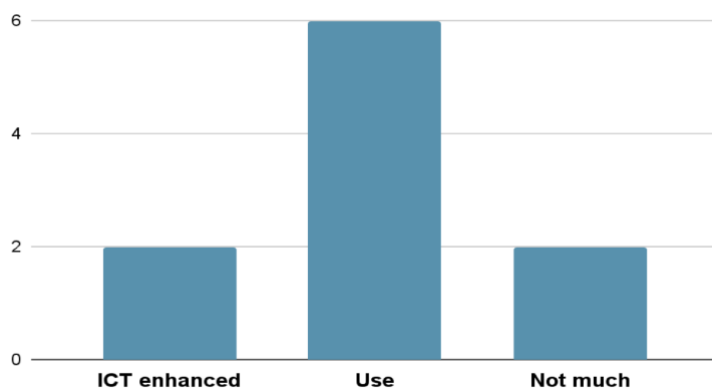
Choosing the interview as a source of qualitative data collection instrument, I conducted 10 interviews with teachers, working in the Erudito Lyceum in Vilnius and Kaunas campuses, in Lithuania. The goal of the interviews was to understand how the integration of the elements of AI, in particular PA, can improve the lesson flows and empower their practice.

Each teacher answered 13 questions about the usage, or potential usage, of technologies and AI in their lessons, opportunities to implement pedagogical agents in different parts of the lessons, the future of education with AI and concerns about the AI in schools.

Question 1: Do you use any technologies in your lessons? Which?

From the first question, I wanted to understand teachers' attitude towards the technologies and to explore if some teachers' profiles could emerge. Overall, there were three types of responses: "Yes, I'm very progressive", "Yes, I'm ICT enhanced" as the first type of the response. These teachers wanted to highlight their attitude to the technologies. Then six teachers just said: "Yes" and two teachers said: "Not much" (Figure 4).

Figure 4. Teachers, who use technologies in their lessons



Next I organized teachers' examples of technology usage into five groups. The first group of technologies used is hardware – smartboards, laptops, tablets. Although, four of the teachers haven't mentioned any of the hardware technologies they use, probably it happened, as I haven't specified in the question, which kind of technologies I expect to hear, as it wasn't the scope of my research and more to serve as an introductory question.

The second group is teaching platforms, which include IB (InThinking) and Cambridge platforms, question banks, Kahoot, Quizlet, Padlet, Twinkl. Also, some of the teachers named math, reading, grammar and vocabulary platforms. Only three teachers didn't mention any of the teaching platforms, which they use in class.

Next group of educational technologies, used in class by the respondents, is different Google resources. This included Google docs, Jamboard, Google Classroom, Google maps and YouTube. Six teachers out of ten used one or another Google tool, however for the presentations two teachers named PowerPoint and one named Canva.

Despite only one teacher named ManageBac, however it is obviously used by every teacher in Erudito Lyceum as it's mandatory learning management software in this school. In this case. Also, two teachers mentioned Moodle and Google Classroom among the technologies they use, despite these platforms performing the same role as ManageBac.

Finally, only two teachers mentioned videos among technologies that they use in class, however, later in the dialogue, most of them mentioned videos. One teacher also mentioned that he uses podcasts in his lessons.

Question 2: Do you use any elements of AI in your teaching (chatbots, ChatGPT)?

With this question, I wanted to find teachers' insights about the potential implementation of PA or similar technologies in their lessons. I found that the widespread use of Chat GPT at the beginning of 2023 made for almost every teacher the clear association that the one and only element of AI in education is Chat GPT. Despite some of the teachers just discovered for themselves Chat GPT, five out of ten teachers already use it for educational purposes.

Two teachers mentioned that they used Chat GPT only for themselves, not using it together with students: “I use Chat GPT for myself, but not directly with the students” – mentioned one teacher and “I use Chat GPT, if I have any questions myself, but I still don't implement it directly in my teaching”.

There was one more teacher, who also used Chat GPT in a very limited way, as he just discovered it: “It's very useful, I sometimes generate questions with it. I just type in chat the command – to generate tasks for a certain topic and it gives me some ideas”. It led to another teacher, who also was inspired by Chat GPT in generating new ideas for lessons: “I use Chat GPT to search for some ideas, for example for creative projects. Then I adapt them to my teaching”. It is worth mentioning that she was not only using it by herself, but also encouraged students to use it and explained in which way they could and could not use it.

There was also one teacher, who really, despite the fact that Chat GPT appeared recently, used it actively in his educational process both for himself and introduced it to the students. However, only in high school, as he considered middle school students rather immature for it: “It can be used as a tool to remember or classify things. Chat GPT can be very useful, when it comes to revision of rather broad material before the exam, it can help to build bibliography in internal assessments”.

There were also teachers, who haven't used AI in their lessons. Two of them just heard recently about Chat GPT, so they didn't have enough time to get familiar with it and start using it. “I've heard a few people talk about Chat GPT, but I've never used it” – mentioned one of these teachers and “I have only very recently become aware of Chat GPT, but I'm not against it, and I think, no one should” – was the opinion of the second teacher.

Before coming to the last two teachers, who were not very supportive of the usage of AI in the classroom, I would like to mention one not very common opinion, which was expressed by just one teacher. She mentioned that the first school should introduce AI to the teachers and students and only after that teachers may start using it. “Since I'm the primary teacher

and, if it comes to the IT lessons, we have a specialist teacher. So, I'm not sure whether it has been presented to the kids by school, but I'm sure that they haven't been working with it yet".

Finally, two teachers haven't used any elements of AI before and were not ready enough to start using it immediately. Paradoxically, these two teachers were the most experienced from all the respondents with more than 20 years of teaching experience. One of them said: "Not yet, that's probably, I'm still a digital immigrant, and not a digital nomad". The second one was more categorical, especially about students' usage of AI in education: "I've told the students not to use Chat GPT because I want them to do their own work".

Question 3: Have you heard anything about pedagogical agents?

All teachers answered that they haven't heard anything about PA before and only after I started introducing this technology, one teacher remembered that he has limited experience before: "Now after you're starting explaining, I remember that I actually did a leadership course in 2015. And we had to do a computer program and there was like a person who was filmed or created, who guided us, so I might have actually used one of these agents".

Question 4: Do you think that it's possible to incorporate a PA in your lesson?

Overall, participants' openness to incorporate a PA in their lesson was positive. Teachers expressed four utterances on how they would incorporate pedagogical agents in their classroom. Six teachers directly answered: "Yes", one added that it's possible, another that it would be hard, one teacher wanted first to learn more and try herself and only after that implement and the last one mentioned that he was afraid of a need to program PA himself.

I found three different excerpts from the teachers that expressed positive about incorporating a PA in primary school:

- "When you started presenting PA, I automatically thought about primary classroom";
- "With smaller kids it's definitely possible to implement that";
- "I think this would be a great bridging tool to connect primary and secondary".

Another important thought that was expressed by several teachers considered the usage of PA for the classes with different levels of students, either use PA with the stronger students or adapt it for the needs of weaker ones. This thought was also continued later in the interview, providing the example of a student with dyslexia: "I have a student with dyslexia and he has difficulties in understanding sometimes tasks. So, that would be really useful because I cannot always be there for him. Also, I thought of my students who are not native in English speakers, so it could support them also keeping up with the tasks because they're intelligent students and they're on the same level as the ones who speak in English".

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Another example is of non-native speakers, whom PA helps to adapt to the new conditions: “Sometimes, in math and some other classes, the students’ states are different. And I each time prepare different questions for them, like for some advance, some for basic, and so on. Now I can do it with a PA”.

And one more teacher agreed that PA perfectly fit the classrooms with the students, who have different levels of knowledge: “When you have students with different abilities, I think it might be very helpful to either students who are ahead of the rest of their classroom or students who are slightly behind”.

From the suitability to use PA for different age groups and academic levels of students, teachers expressed their expectations that PA could help them when dealing with multiple groups of students during the lesson. This was reflected in some utterances like:

- “I can see how it might be used in even something simple like, explaining directions for a project, so I don’t have to go around and repeat it 50 times to every student’.
- “I think it can help with terminology. Kids might forget what terminology means, so they could ask PA”.
- “I think it may be used when we give feedback on assessments”
- “I could have used it during my English lessons, or when we teach kids vocabulary, reading because basically PA can read for the kids, or if you’re talking about the new vocabulary kids can practice there and develop the vocabulary”.
- “PA could facilitate learning in the sense that it would facilitate memorization”.

Finally, there were several teachers, who were doubting that incorporating a PA to their lessons could go smoothly. For instance, lack of programming skills: “I’m not sure if I would need to program it myself”. The second constraint was the stability of internet connection: “I can use it if I can work online whenever I want with my computer and phone, and connection is really good”. Another teacher couldn’t tell anything exactly before she tried everything by herself: “I believe that I would need to learn about it quite a lot. And try it out myself”.

Question 5: Which part of your lesson do you think best suits the pedagogical agent?

In this particular question, teachers tried to specify, which exact part of their lesson was more suitable for the implementation of the pedagogical agents and why. From all the responses, seven teachers were not ready to share one or another part of the lesson with PA. Only three teachers could imagine the PA assisting them through the whole lesson. Their responses could be best characterized by the quote of one teacher: “Well, to be honest, I think, it would be good for all parts of the lesson”.

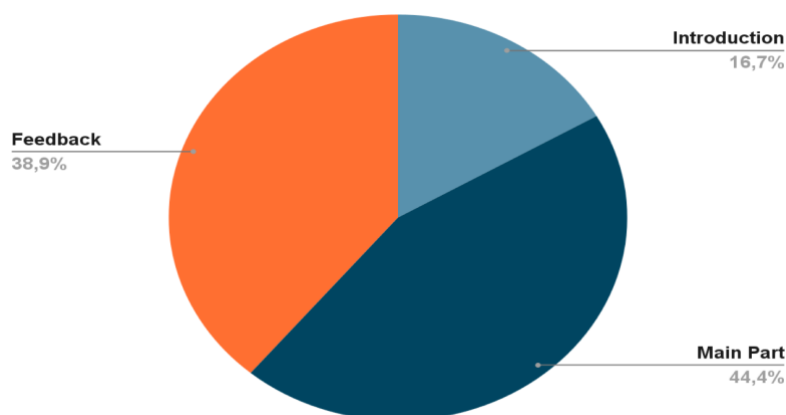
Five teachers didn't want to share the introduction part of the lesson with PA. They had different arguments; however, they felt the importance of human contact at the beginning of the lesson. One of the teachers specified that she: "As a teacher can do a great introduction". Another one totally agreed with such an idea: "I still think, the beginning part is important for the teacher to introduce the topics". From these five teachers four teachers easily could find a place for PA in any part of the lesson through the middle till the end and only one teacher wanted to share just the middle part of the lesson with PA. Here is what these teachers mentioned:

- "I think it will be good to incorporate PA from the middle to the end of the lesson".
- "When in the middle of the lesson students' attention declines, and this is exactly when I would use multimedia or video previously or I can use a PA in the future".
- "The first part of the lesson is teacher-centered and not student-centered; I would say that it is important that we diversify the way we deliver the information later towards the lesson. So, the more diverse it is including video or agent, the better it is"

There was just one teacher, who didn't want to share the final part of the lesson, as she felt it's important to sum up and provide the feedback at the end. She said: "We can finalize lessons together with children".

The same is with the main part of the lesson. Just one teacher wanted to keep it fully by himself and not share it with PA, others were more flexible in this question: "For me it would for some reason, I want to make sure I'm doing the main part of the lesson. I could see PA being something that you could open and close lessons with" (Figure 5).

Figure 5. Which part of the lesson is most suitable for PA?



Question 6: Will you use PA as assistants for explanation or will you explain by yourself?

With this question, I tried to understand what teaching activities could, or not, be shared with PA. Three teachers wouldn't share explanations at all, while three teachers were open to

do it partially. On the negative side one teacher said: “I still think that teachers should explain like it's the teacher's role”. Several teachers said that they were afraid about non-flexible colleagues, who were not strong in technologies, others simply afraid about the future of the whole teaching profession.

Another problem raised by one teacher expressing lack of trust was: “I wouldn't trust PA from the beginning. I wouldn't give this program, the beginning of my lesson or the explanation part”.

For some of the teachers, they on the one hand showed the importance of teacher in explanation, on the other agreed that PA will really help: “I think it's always better to be presented by human, but if you're explaining to different abilities in one class, you're always will have kids who'll say, I don't understand. So maybe you can get the PA to talk to a certain group while you talk to another group in mixed classes”. This idea develops one of the thoughts, which were brought previously by the teachers, that PA can suit pretty well for different groups of the students, for the classes with different levels, and can be equally effective for both stronger and weaker students.

Another interesting and important factor for the usage of PA in lessons and particularly in the explanation section, is that it can either substitute or empower the videos as an explanation tool. As I discovered in these interviews, several teachers regularly use video as part of explanation. They can either provide different to teacher's opinion or simply provide it in more entertained way:

- “When I explain and I think that it doesn't work, I make them watch videos”;
- “In my lessons I use videos from Crash Course History. John Green, the host of the channel, uses a lot of multimedia to illustrate things”.
- “So the more diverse the explanation is the more like, if there is a video, if there is the pedagogical agent, if there are different sources of information, then you could accommodate all sorts of learners, including visual learners”.

To sum up, I want to add the opinion of the teacher, which differs from everyone's. He mentioned that the decline of the teacher's role happened earlier: “Education has focused more on student-centered programs that allow for students to do research themselves. And especially in IB, this sense of inquiry is being fostered all the time. So, I think the importance is taken away a little bit from the teacher”. However, he doesn't see the danger in such an approach and hopes that PA may help both teachers and students.

Question 7: Which feedback in your opinion will be better? Your, PA or both?

The goal of the next question that was asked is to understand the readiness of teachers to share another important part of teacher's responsibilities – providing feedback to students. In this case the situation was also not definite. However, the number of teachers, who were ready to share the feedback part with the PA, was not as huge as those who can share explanations.

One of the teachers wants to share providing feedback with a PA, as he thinks it will be more accurate and objective. However, he doubts whether it will be technologically possible: "I don't really know technically enough about what AI can do in terms of this in particular".

Another important reason to share the feedback with the PA is the fact that it's rather time consuming. However, one teacher admits that and is ready to share feedback: "I think just because that is so time consuming, that that will be great to share it", another understands how much time will be consumed, but still will provide it by himself: "Sometimes it could be complicated for us to write the whole feedback to everyone, but still it's a human also task and we need to do that. I think you need to know the student to give feedback"

One more teacher mentioned the importance of the human aspect in feedback, still doesn't exclude the role of PA in it: "I think there is a human aspect to providing feedback. But I think in the long run when you know this becomes pretty normal, I think this could be, there is a place for the PA to also give us feedback".

There was also a teacher, who was more categorical about the usage of PA in providing feedback: "We're still in one classroom, so it would lead out into discussion and what each student took from the lesson. Otherwise there would be no reason for them to be at school". It raised the already familiar topic of the role of teacher in the classroom.

There were also teachers, who were ready to share some parts of the feedback with PA, but some parts would still keep by themselves or simply would double check them or have opportunity to add extra feedback:

- "I think maybe for giving directions. Only directions. I would maybe explain the directions if there's a further question";
- "I give the feedback to the students, and if kids don't understand, PA can step in".
- "Depends on the form in which you would be providing feedback it could be provided by human or PA"
- "You put all of the feedback together and maybe the agent can help you identify things that you would overlook. The human brain would be more subjective to it and maybe the agent can be a bit more objective".

Question 8: How will AI change the lesson workflow?

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By asking this question it was important to understand not just whether, how and where teachers will use PA or any other elements of AI, but whether they think it would improve their or overall lesson workflow.

Overall, more teachers had an optimistic approach to the future of lessons and education with the active implementation of the AI elements. Four teachers were sure that the lessons would improve:

- “For better, I think mostly. I don't think AI can completely replace the role of a teacher definitely. But I think it can make the lesson much efficient because the human brain can think of maybe a thousand scenarios, but AI can think of a million scenarios and give the best possible refined question”
- “It definitely will help me to improve. I really support the idea of having it and even using it and implementing to the education fully”
- “With the help of AI, definitely my lesson would improve”
- “It has already improved my lessons and especially my preparation for them”.

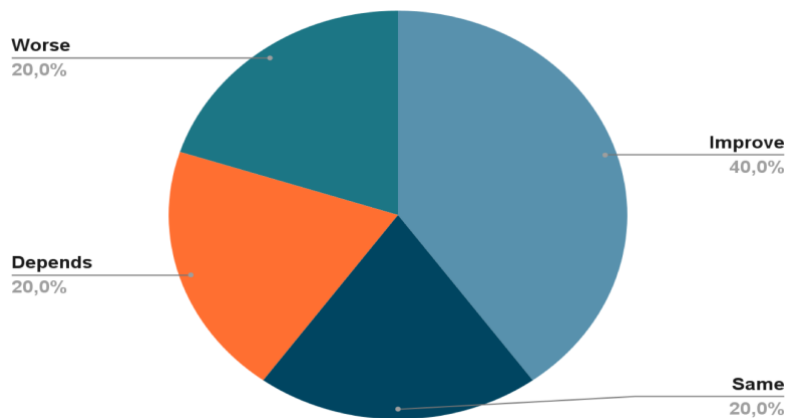
There was also an opinion expressed by two teachers, that it is not possible to change anything and teachers have to adapt. One teacher mentioned it in that way: “I would say I'm thinking globally and the thing is, we can't now stop this snowball that is rolling us down here. So, I think the best thing that we can do is learn how to live with it and teach our kids how to live with it”.

Also, two teachers had concerns that whether artificial intelligence or pedagogical agents would improve or not the lesson flow depends on the level of maturity of both children and teachers. One teacher was sure of the maturity of teachers, but doubted the maturity of students: “We as teachers are mature enough and knowledgeable enough to understand whether to trust the AI's information. But when it comes to processes of learning, then there might be some shortcomings, there might be this misinformation, which students may accept”, another doubt was influencing the both sides of the educational process: “It's a difficult to answer, whether the lesson will improve, as just I think because it depends a lot on the mindset of students and teachers”.

However, there were also two teachers, who were extremely skeptical about the future of education and the lesson workflow with the rapid development of artificial intelligence. One teacher mentioned:” I think it's going to be worse because I don't know if the student's really doing the work and not just programming the computer. I fear that we'll all get so lazy because of AI”. And another was even more pessimistic in his predictions: “It's a disaster for

the whole studying process because students may use it for the assignments and teachers also don't want to prepare a lot. They can share their lesson preparation with artificial intelligence” (Figure 6).

Figure 6. How will AI change the lesson workflow?



Question 9: If you will have to create your lesson plan for this unit again, how will you use PA in it?

Before conducting interviews with teachers, I asked them to send their lesson plans. They were free to choose any lesson plan, from the lessons they taught previously. It helped to have a more structured dialogue and understand in advance, how the teachers design their lessons, which technologies implement and in which part of the lesson. However, it was just one example of hundreds that they had, so there were also exceptions to the rules.

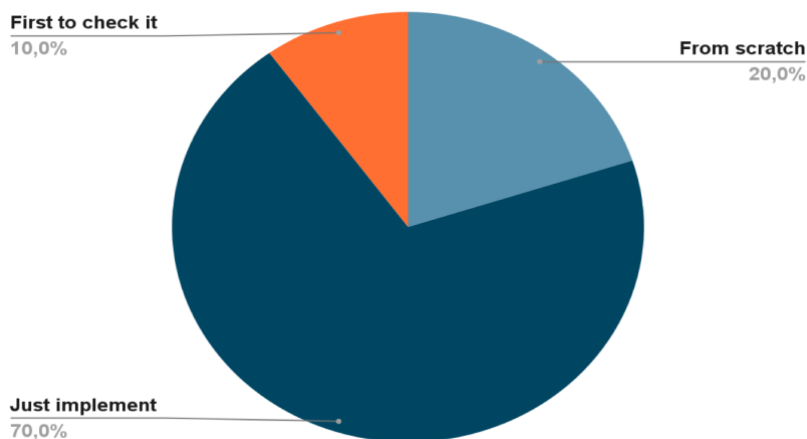
Overall, despite most of the teachers were ready to implement the PA in their lessons, when I asked them about their already created lesson plans, seven teachers answered that they would just partially implement PA into their lessons, leaving the main part of it unchangeable:

- “I think I would just implement a pedagogical agent. I would change the lesson only if the curriculum changes”;
- “Maybe I can use it in just several parts of the lesson”;
- “I will just incorporate it in some parts of the lesson. I won't create a whole new”;
- “I would say I would just implement and I would say that I wouldn't really trust pedagogical agent from the very beginning”;
- “The explanation could be facilitated by PA. All other elements will remain the same”
- “I would try it out definitely a little bit and see how students react”;
- “It would probably be in certain parts because I like lessons to be interactive. And I think a teacher is better at getting kids to be interactive”.

One more teacher expressed the opinion that only humans could make a lesson more interactive, that was why it was not possible to give the main role in his lesson to PA. Close to the thought of that teacher, who wanted to see students' reaction, was another opinion by the teacher, who also first wanted to try and then only change his lesson plan: "I would like to see how it works, to see whether or not it makes my lessons more efficient".

But there were also two teachers, who were ready to change their lesson plans totally. One of them was ready only to leave the general structure: "I think I would stick to the overall structure of my lessons, but it would have to change necessarily. Even if you insert AI or pedagogical agents here and there you will have a completely different lesson". However, another would simply create a new lesson plan from scratch: "So, it'll be totally different. I probably would redesign it because I built that lesson plan based on just my way of teaching. So, I think it'll be a bit difficult to push the pedagogical agent into a rigid structure. So, I'll kind of redefine it and then make more room for both the teacher and the agent" (Figure 7).

Figure 7. Teachers, who want to change the lesson plan after the introduction of PA



Question 10: Which other lessons could be great for using PA and which not?

Answers to this question should be divided into two big categories. First one, examples for using PA during the lessons. The second category was the lessons, which are not appropriate, in teachers' opinion, for implementing the pedagogical agents.

First, focus will be on the different lessons, which were good for the implementation of pedagogical agents, in teachers' opinion. One of the teachers thinks of the science and literature lessons as most suitable for PA: "Science lessons would be like experiment parts and also literature lessons for reading would be really great".

Another teacher, who was a middle school Math and Global Perspectives primary teacher, thinks that both subjects suit PA, but primary one even more: "Besides mathematics,

I think, it's primary. So, I would use 80% pedagogical agents in my lesson because it could be so fun for them and they will be much more involved”.

There was one more teacher, who thought that math would be a suitable lesson to implement PA, but she also admitted that art lesson was another possible place for the effective assistance of pedagogical agents: “Well, I can really see, this as the assistance with the math lesson, and you'll be surprised with the art lessons. Well, math is obvious because you always have students who would wish to do more. And when it comes to art, I would think that you always have kids in your class that are more artsy and who would wish to draw or learn more”.

Next, teachers mentioned some most suitable activities or topics for pedagogical agents. For example, a Business teacher was ready to implement PA in marketing, but was uncertain about the finance: “I mean anything to do with balance sheets and profit loss accounts, you still do yourself. But anything from marketing is a good opportunity to use a PA, because it will be just more interactive, and not as much fact based”.

The history teacher mentioned that pedagogical agents may help those students, who hate his subject because of previous perceptions, change their opinion, however, he was pretty sure that pedagogical agents wouldn't help in exam preparation: “They hate history as a subject. And each time that I ask them to do something more interesting, something more different. They become much more engaged. However, I don't see it right in preparation for the exams”.

One of the English teachers thinks that it could be hard to implement pedagogical agents into the debates or discussion, however she thought that for the preparation or inspiration it could be used effectively by both teachers and students: “I guess in lessons when it comes to discussions where we share either personal experiences or we are just debating something. I wouldn't really use it. But I can use it for preparation and maybe they can use it as inspiration just”.

One of the teachers couldn't share interactive lessons with pedagogical agents, in his opinion, this interaction should happen without computers: “Like interactive lessons, I think, we can't use them. When the children are out of the computer, when I do a lot of. In my old school, I've always done things like carousels where children are moving around and reading, reading things on the wall. I think such lessons are better without PA”.

For another English teacher, there are also elements, which are not possible to share with PA, for example writing and preparing essays: “So I think like the heart of the task, especially

a writing task where students have to show that they're doing the work and show their logic and reasoning. I think that would be something, I would not want to use any sort of pedagogical agents”.

But for example, one more English teacher couldn't tell in particular that he may offer any possible part of the lesson that is not suitable for the PA and he didn't worry much about it in terms of the risk of his job in the future: “But I can't necessarily think of anything in particular that you can confidently say that only a human teacher can do really. And I don't if I'm talking myself out of a job, but I guess that's the fact of the matter and again, I don't know how well this particular character would work with my students”.

Finally, one teacher did not talk about certain subjects, topics or parts of the lessons, he mostly focused on the particular class and students, which he had. Also, he mentioned possible unfavorable conditions to use pedagogical agent in class:

- “I think, for example, if certain kids have, issues with technology, because if they're always addicted to phones and if they can't ever do anything in the real world, I think in these scenarios it's better to have the teacher”;
- “What if the internet fails? Or what if the pedagogical agent doesn't work then. The lesson should still continue”;
- “If the kid has certain behavioral issues...”;
- “If student is from a background where he's not familiar with technology as much, he doesn't know what to do, then I think the teacher could be the beginning steps”

Question 11: If you will have such an opportunity, will you use PA in your lessons, always, frequently, rarely or never?

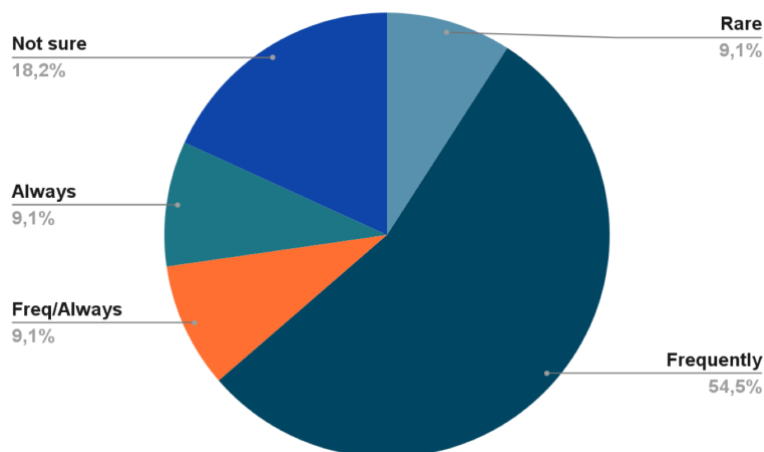
In this question, I decided to provide an opportunity for the teachers to choose the option. After the long discussion, which already happened and before one of the last important questions about concerns of using pedagogical agents in their lessons, it is important to make such questions more relaxed, and give them an opportunity to sum up what they've said previously.

Five teachers answered that they are ready to use pedagogical agents in their lessons frequently. One more teacher said that she was ready to use several times a week, which could also be considered as frequent, one teacher said that she would use between frequent and always and another that always for primary and rare for middle school.

Only two teachers were not sure about the frequency of using these pedagogical agents in their lessons. One teacher said: “I think it would depend on how much training I get”, so he

was ready to implement it frequently if he considers himself an advanced user. And another teacher couldn't say anything in particular before starting working with PA: "I've never heard of it before this interview, so I'd like to see how it works first" (Figure 8).

Figure 8. How often teachers are ready to use PA?



Question 12: If you will use the pedagogical agents in your lessons, what will be your concerns and hassles?

One of the last questions of the interview was about concerns and the hassles. All of the teachers had several concerns, some of them were similar one to another, some only mentioned by one teacher. However, it gave a great research material and understanding, why not everyone was ready to start using artificial intelligence or pedagogical agents immediately in their teaching practice.

Despite the teachers having lots of concerns, all of them can be easily grouped: role and the future of the teacher, reliability of data, problems with students' level and behavior and ethical considerations about discrimination.

The biggest concern, which was mentioned by half of the teachers, was that the teacher's job is now endangered, that the role of the teacher is declining and one day students won't understand why they need a classical human teacher: "Do you end up getting rid of teachers? Maybe you do. Or you just have us being the programmers, so we program PA ourselves".

However, another teacher thought that with the introduction of AI and PA in education teachers would have to be even more creative in order to remain in demand: "The education is risking become a service cause then the problem is that you, each time you show up in your class, people may start expecting that you will be entertaining them each time".

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So, all these concerns may lead to the loss of jobs by some teachers, however, one of the respondents thought that it applied only to the inflexible teachers: “There is a possibility that a few percent of the teachers might lose their jobs if they're not adapting to the changes”.

Some issues were to deal with reliability of AI and which databases it uses:

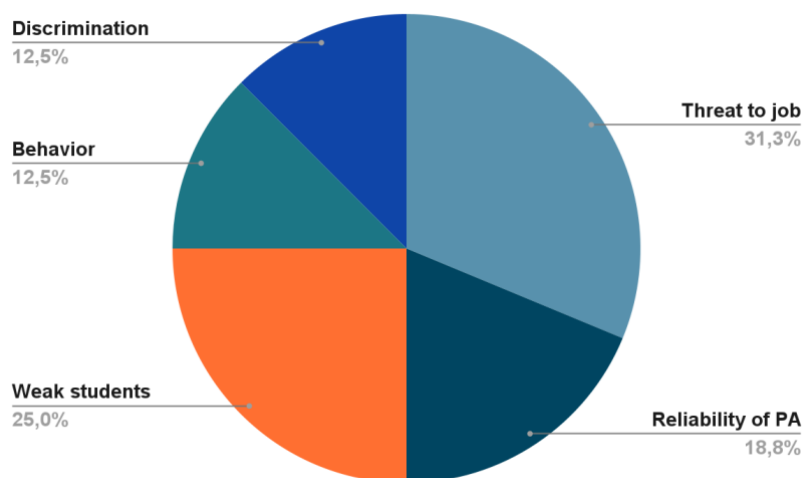
- “Another ethical concern would be the reliability of AI. Because AI is just what we feed into the system, so if the AI gets in wrong information, it will be teaching wrong information. So how sure are we, or is there a method to test it? Is there a standard?”
- “So I think the biggest concern is disinformation...”;
- “You cannot trust this stuff, these kinds of agents, but I don't really think that this is something is wrong. And I think it, the part of human being mentality, thinking that all the new things will lead us to something bad”

There are also several concerns that AI and PA may make students weaker, lazier, with worse memory and imagination:

- “It's leading to the end of creativity and imagination. They can just complete their tasks, but I think there are no tools to check it so”;
- “Students are human beings. And they can get lazy”;
- “Another immediate concern is, whether somehow it may hinder a student's capacity for critical thinking”;
- “My biggest concern would be memory loss. Because then, during their actual exams, they would not have that knowledge from the PA and they will be sourceless”.

Also, two teachers had concerns about students’ attitude and behavior. One teacher mentioned: “For 8th grade, I think they would say it not seriously, not consider seriously because of their age period”. And another teacher was worrying that PA won’t deal with inappropriate students’ behavior: “I believe when it comes to behavioral moments and when it comes to emotional moments, you really need to know the kids, and PA can’t do that”.

The final group of concerns was about different sorts of possible discrimination, which may happen because of PA. One teacher cared about some religious aspects: “Just see in case it doesn't know who it is talking to, so talking to a Muslim, who's got different beliefs than a Christian. So maybe that could be an issue”. And another teacher was thinking about other possible discriminations, like gender: “We might have basic inequalities when it comes to the treatment or the depiction or the portrayal of women, for instance, or certain other minorities. If that is the sort of content that these AI programs feed them, then we might realistically expect the outputs to mirror those inequalities” (Figure 9).

Figure 9. Concerns, which teachers have about using PA

Question 13: Which kind of extra support or what exactly do you think you will need if you will use PA?

The final question of the interview was about the extra support, which teachers expect to receive if they would start using the PA in their educational process.

Three teachers mentioned that they want to receive a workshop, one specified that it should be a small one and another added that it has to be face-to-face: “I would prefer to have a very small workshop that is a hands-on experience instead of just a presentation or Youtube video, because if it's just a video, then I could watch it on my own”.

Two more teachers said that it should be training, so workshops together with the training could be part of one category, as one of these two teachers also mentioned that training should be peer to peer:

- “Well, if the school decide to, you know, include it as our curriculum change, let's say, I would expect to have proper training”.
- “The best way is, if you have a teacher that is quite trained in it to get peer-to-peer training and to see a practical example of how it's utilized the correct way”.

Two teachers preferred to learn from an experienced colleague or a teacher from a different school. In their opinion this communication and dealing with the person, who has a personal case of usage would be more effective: “I think the best thing that we can do is learn from the experiences. Reading manual is important, but I would prefer real people”

Finally, three teachers wanted to discover PA by themselves. One would like to read some specific materials and research about PA, another read tutorials and case studies and third one would like to learn through practicing and use PA by himself: “I usually feel more like safer than I have tried it myself a few times before the class, I really hate to improvise”.

Discussion

While conducting qualitative research, ten teachers were asked 13 questions during the interview. The main goal was to understand how open are secondary school teachers to using elements of AI and PA in their teaching practice. It was important to understand which parts of their lessons are most suitable for PA and which concerns they have about using them.

The results showed overall openness of the teachers to use new technologies, as all of them already implement them in their lessons. For most participants, AI and PA are also part of the educational technologies. Moreover, one of the results of the research was not even the desire of teachers to work with PA, but different tasks, they are ready to delegate to the PA.

So, by answering about the possibility of using the PA in their lessons, teachers already started thinking about the tasks and elements of the lesson plan, which they could improve. It included explanation, feedback, grading, vocabulary, reading and memory exercises.

But also, teachers specified different age groups, which may be most suitable for using PA with. Some of the teachers considered that primary school may be the perfect place, which actually was confirmed by Johnson & Lester (2016), who mentioned that pedagogical agents help younger students more than older to achieve better results.

However, there were also teachers, who planned to use PA more with high school than with middle school students. The main explanation is that older students are more mature to understand all the possible risks and drawbacks of AI in education, however younger students may not adequately react to some changes in the classroom.

Apart from age groups teachers also considered which lessons may be suitable or not for the PA. Johnson & Lester (2016) concluded that in Math and Science students may improve their results better, however the respondents also added History, Language, Business and Arts. They were concerned about several topics, which may not be suitable for the usage of PA, for example, finance in Business and essay writing and debating in Language.

As for the such unexpected subject as Art, the main role in which PA may be used is assistance for students with different levels, as sometimes it is very complicated for the teacher to diversify and spend time equally with everyone. This challenge may be solved by a PA, most of the teachers from different subjects admit it.

Both Nye (2014) and Chounta et al. (2022) mentioned that one of the ways PA may assist teachers in the classroom – is working with children with different levels. Most focus of the researchers was on the students of lower level, however several respondents also mentioned

that PA may work also with students, who have higher level than other classmates, while the teacher will explain something again to the rest. It may be explained by the fact that these teachers don't want to share the explanation part of the lesson with pedagogical agents.

And the group of teachers, who didn't want to share explanations, wasn't small. The biggest surprise was that this question mostly polarized the teachers and divided them into two groups. Those who were against mostly were not trusting pedagogical agents and those who were for sharing the explanation part compared PA to other current technologies they use as an assistant in explanation, for example videos. Roa et al. (2022) also discovered such a group of teachers, who didn't want to share explanations with PA and called them scaffolders.

Almost the same situation happened, when discussing the feedback part of the lesson. Some teachers didn't want to lose it either because of the importance of teacher-student relations or because of fear that the role of teacher may decline. However, those who were for admitted that PA would be more objective, so it could be effectively used in both grading and providing feedback to students, and also PA may save teacher's time. The positive effect of the feedback provided by the agent was proved by Domagk (2010), as he mentioned that such feedback may motivate students and by Edwards et al. (2018), who mentioned that to such feedback students may listen more carefully.

Apart from just generally talking about the implementation of PA to the teachers' lessons, it was important to understand to what extent teachers were ready to change their own already existing lesson plans. Most of the teachers wanted just to implement the PA and not create the plan from scratch. One of the reasons was a change of curriculum. All of the teachers who worked in Erudito were involved in different curriculums, so they preferred to change their lesson plans, if the curriculum changes.

But there was also one important idea mentioned by the teacher, that teachers have to redesign the lesson plan, because if there would be a PA in it, and as pedagogical agent is teacher's virtual assistant, there could not be enough space for two of them in the new lesson plan. However, it really depends on how much space the teacher would be ready to leave to the pedagogical agent. And this issue wasn't covered enough in the research.

The final important part of the interview with teachers was about the concerns and hassles they had about PA. One of the main reasons was lack of trust to the PA. For example, a teacher, who worked in primary school really felt her extra responsibility for the future development of small children and she had to double check all the materials that she presented to the class. It also was a possible reason not to fully implement PA into the lesson.

Roa et al. (2022) also raised such concern, as sometimes teachers are doubting how smart are PA and which databases they are using.

Next reason to partially implement PA into the lesson was uncertainty about the student's reaction. Erudito teachers had different age groups, from primary to high school, and they couldn't fully predict the reaction to PA in every class, especially younger students. However, Johnson & Lester (2016) proved that younger students react positively to PA.

Finally, some teachers expressed their fears about whether they have or not to program, what PA can or can't do, where it will take the information and so on. All of these fears lead to the caution in the use of PA by teachers, however one teacher mentioned that people usually try to find something bad and dangerous in the new and unknown things. And that is exactly what is happening in this particular case.

To sum up, I want to classify the teachers, based on their openness to the use of pedagogical agents in their lessons:

- **Innovator.** Such teachers are rather flexible, as they are ready to improve their lesson workflow by implementing new technologies and don't stick to some traditions in any part of the lesson;
- **Improver.** These teachers are also open to innovations and new technologies; however, they implement them partially. They try to experiment either with classes, which they are confident in or with several topics, which may be more suitable for experiments;
- **Doubter.** This type of teachers may be ready to implement the pedagogical agents but first they have lots of questions they want to receive the responses and also they want to try everything first by themselves;
- **Executor.** Such teachers will only start implementing the new technologies after the school's decision. They have to finish training first, receive all the instructions and start implementing something new, because they have to do it;
- **Conservator.** These teachers try to resist something new as long as possible. They usually see some kind of threat from every new technology and innovation, and only start using, if they don't have any other chance.

Limitations and future research opportunities

The main limitation of the study was that half of the respondents were located in one city and half in another. It didn't give me the opportunity to conduct the focus group. Also, due to

the high workload at the end of the school year, almost all (nine out of ten) of the teachers preferred to have an online interview rather than offline. It also led to the interviews to be rather short (on average not more than 20 minutes) and some of the questions were not discussed in more detail.

The next limitation was that due to the fact that almost all the teachers were not familiar with the PA concept, their responses were on the one hand spontaneous, which is good for research, on the other hand they were just learnt about new concept, so it was hard for them to provide some meaningful information from the beginning of the interview.

During the process of research, I found several possible ways for the future research. First opportunity is to go deeper into the several parts of the lesson – introductory, explanation or feedback and discover why teachers are ready or not to share this part of the lesson with pedagogical agents and how students react to it.

The next possible research opportunity came up from one of the teacher's responses. He mentioned that he was doubting whether it would be enough space for a teacher and a teacher agent assistant during one lesson or it may harm the quality of the teaching.

Finally, the ethical concerns and considerations, which were only partially discovered during this research, is another huge and extremely important topic, which may cover not only the presence of pedagogical agents in education, but also generally all the aspects of AI.

Conclusion

Based on the findings of this study on how AI and PA could empower teachers' practice, I discovered some dimensions important for the stakeholders and the technological implementation. The study showed the openness of the teachers to use new technologies and their readiness to implement new technology – artificial intelligence, in their lessons. Also, it showed that teachers felt that pedagogical agents could empower their lessons and teachers agreed to change their lesson plans to implement PA in them.

Different teachers were ready to implement pedagogical agents into the different parts of the lessons – introduction, explanation or feedback. Some of the teachers saw PA as part of lessons in primary, some in middle and some in high school. There were also different lessons offered for the implementation of PA – Math, Science, History, Business, Language and Arts.

However, some of the teachers had different concerns about the implementation of the pedagogical agents. Some worried about the reliability of the agents, some didn't know what

to expect from students, some were not sure about discrimination or even were afraid that pedagogical agents may make students lazier and less motivated.

Based on the discovery during the research information and conducted a theoretical overview, the new classification of the teachers, based on their openness to the implementation of the PA into their lessons was offered. There are five types of teachers: Innovators, Improvers, Doubters, Executors and Conservators.

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Finally, I want to thank my family, who despite the desire to be with me in my free time, fully understood my passion to learn more and write this thesis day and night.

Author's declaration

I hereby declare that I have written this thesis independently and that all contributions of other authors and supporters have been referenced. The thesis has been written in accordance with the requirements for graduation theses of the Institute of Education of the University of Tartu and is in compliance with good academic practices.

Oleksandr Pavlenko

/Digitally signed/

02.06.2023

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Appendix 1. Interview protocol

1. Interviewer asks teachers for lesson plans
2. Interviewer explains the consent form
3. Interviewer explains the research and ask permission to record an interview
4. Ask first block of questions
 - a) Do you use any technologies in your lessons? Which?
 - b) Do you use any elements of AI in your teaching (chatbots, ChatGPT)?
 - c) Have you heard anything about pedagogical agents?
5. Interviewer briefly explain the PA concept
6. Ask second block of questions
 - a) Do you think that it's possible to implement a PA in your lesson?
 - b) Which part of your lesson do you think best suits the pedagogical agent?
 - c) Will you use PA as assistants for explanation or will you explain by yourself?
 - d) Which feedback in your opinion will be better? Your, PA or both?
 - e) How will AI change the lesson workflow?
 - f) If you will have to create your lesson plan for this unit again, how will you use PA in it?
 - g) Which other lessons could be great for using PA and which not?
7. Ask third block of questions
 - a) If you will have such an opportunity, will you use PA in your lessons, always, frequently, rarely or never?
 - b) If you will use the pedagogical agents in your lessons, what will be your concerns and hassles?
 - c) Which kind of extra support or what exactly do you think you will need if you will use PA?

Appendix 2. Consent to Act as a Participant in a Research Study

Study title: How to empower teacher practice with Artificial Intelligence by integrating Pedagogical Agents as effective assistants

Principal Investigator: Oleksandr Pavlenko

Introduction: As a participant of the research, you are invited to complete an interview, regarding your expectations, concerns, wants, needs, suggestions, opinions, and ideas about collaborating or using elements of artificial intelligence and pedagogical agents in your classroom. This could allow developers and researchers to better design these systems in a teacher-driven as well as student-driven direction.

Content of the study: This study is conducted as an MA Thesis at the Institute of Education of the University of Tartu (Estonia). The following questions cover basic demographic information, your experience, needs, wants, expectations, concerns and suggestions for dealing with a PA in the classroom.

Participation requirements: Teachers from K-12 Education can participate and must be at least with 18 years old or older. Participants which are able to take part in the interview and that are decent English speaker(s) are eligible to participate.

The expected duration of the study: The interview will take about 20 to 30 minutes of your time.

Risks and Benefits: The risks that are associated with this research are no greater than those ordinarily encountered in daily life. There is actually no material benefit for participating in this case study, but participants may feel positive by being part of an academic research process.

Privacy and Confidentiality: The researchers will follow the following procedure to protect participants' identities during this study: The original audio/video files will remain on the original recording device or a hard drive for safety storage, which is only accessible to the Principal. The audio/video files will be transcribed; potential identifiers will be removed or aggregated and the original audio/video files will be used for the purposes of this study.

Your data and consent form will be kept separate. Your consent form will be stored securely and will not be disclosed to third parties.

By participating, you understand and agree that the data and information gathered during this study may be used by the University of Tartu for publication purposes. However, any identifiable information will not be mentioned in any such publication or dissemination of the research data and/or results. The University of Tartu requires all research records to be maintained for at least 5 years following final reporting or publication of a project. Aggregated data will thus be archived by the Principal Investigator for that timespan.

Questions about the Study: If you have any questions, comments, or concerns about the study either before, during, or after participation, please contact Oleksandr Pavlenko (oleksanp@ut.ee)

Voluntary Participation: Your participation in this research is voluntary. You may discontinue participation at any time during the research activity. Your decision regarding whether to participate in this study will not result in any loss of benefits to which you are otherwise entitled.

Participant: The above information has been explained to me and all of my current questions have been answered. I understand that I am encouraged to ask questions, voice concerns or complaints about any aspect of this research study during the course of this study, and that such future questions, concerns or complaints will be answered by a qualified individual or by the investigator(s) listed on the first page of this consent document.

Study outcome:

I _____ teacher of/at _____. I confirm that I am (age) _____ old. I have read and understand the information above. I want to participate in this research and continue with enrollment in the study

Yes No

Participant _____

Contact information:

Oleksandr Pavlenko

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