10.24193/ed21.2023.25.38

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Educatia 21 Journal 25 (2023) – Special issue
Special Issue: Proceedings of 11th International Conference Education, Reflection, Development (ERD 2023)
Educatia 21 Journal, (25) 2023, Art. 38
doi: 10.24193/ed21.2023.25.38
Research article

A Study Regarding Early Teacher'S Perception Toward the Introduction of Artificial Intelligence Applications and the Use of Educational Robots in the Teaching Process

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Abstract

Over the years Artificial Intelligence (AI) has revolutionised not only industries but also education worldwide. With the 2020 pandemic, teachers around the world have had to reconfigure their teaching process, so AI products are becoming more and more prevalent in early childhood settings to enhance the learning and development of pre-schoolers. Although robotic toys (Bee-Bot, Robot Mouse, Robotbloq Qobo, Ozobot) have been used for several years as modern teaching tools, teachers in Romania face some difficulties in integrating them into the teaching process, either because of lack of adequate training in handling these tools or because of the infrastructure needed for this purpose. The use of robotic toys in kindergarten activities is a matter of teachers' perceptions, so they decide on the use of robotic toys in the teaching process and the types of activities that would allow their use for teaching purposes. In our study, we aimed to measure teachers' perceptions of children's use of robotic toys and their incidence of using them appropriately, in the teaching process, integrated into Experiential Domain Activities. In this way, we will be able to make correlations between the use of these tools and teachers' perceptions, highlighting the benefits they bring to the teaching process and consequently to the development of children in early education.

Keywords:
artificial intelligence; educational robots; robotic toys; computational thinking; early education.

Zusammenfasung

Im Laufe der Zeit hat die Künstliche Intelligenz (KI) nicht nur die Industrie, sondern auch das Bildungswesen international revolutioniert. Mit der Pandemie 2020 mussten Lehrkräfte auf der ganzen Welt ihren Unterricht umgestalten, so dass KI-Produkte zunehmend in Klassenzimmern für Kleinkinder zu finden sind, um das Lernen und die Entwicklung im Vorschulalter zu verbessern. Obwohl Roboterspielzeug (Bee-Bot, Robot Mouse, Robotbloq Qobo, Ozobot) schon seit einigen Jahren als modernes Lehrmittel eingesetzt wird, haben die Lehrkräfte in Rumänien einige Schwierigkeiten, sie in den Unterrichtsprozess zu integrieren, entweder weil sie nicht ausreichend im Umgang mit diesen Werkzeugen geschult sind oder weil es an der dafür erforderlichen Infrastruktur fehlt. Der Einsatz von Roboterspielzeug in Kindergärten ist eine Frage der Wahrnehmung der LehrerInnen, die daher entscheiden, ob sie im Unterrichtsprozess eingesetzt werden können und welche Arten von Aktivitäten ihren Einsatz zu Unterrichtszwecken erlauben. In unserer Studie wollten wir die Wahrnehmung der Lehrkräfte in Bezug auf die Verwendung von Roboterspielzeug durch die Kinder und die Häufigkeit ihrer angemessenen Verwendung im didaktischen Prozess, integriert in Aktivitäten im Erfahrungsbereich, messen. Auf diese Weise werden wir in der Lage sein, Korrelationen zwischen der Verwendung dieser Werkzeuge und den Wahrnehmungen der Lehrkräfte herzustellen und die Vorteile hervorzuheben, die sie für den Unterrichtsprozess und implizit für die Entwicklung von Kindern in der Früherziehung bringen.

Schlüsselworte:
Künstliche Intelligenz; Bildungsroboter; rechnergestütztes Denken; Früherziehung.

1. Introduction

Artificial intelligence is now widely regarded as the next electricity and plays a significant role in society (Tuomi, 2018, p. 3) that people cannot live without (Lee, 2021, p. 9). Under these circumstances, we wonder *What are the attitudes and perceptions of teachers in early education regarding the integration of Artificial Intelligence in the teaching process?* With the 2020 pandemic, teachers around the world have been forced to reconfigure their teaching process, so AI products are becoming more and more prevalent in early childhood settings to enhance preschool learning and development.

Artificial intelligence has been developed as a result of recent advancements in digital technologies. Coppin defines artificial intelligence as the capacity of computers to adapt to new settings, deal with unforeseen circumstances, solve issues, provide answers, make plans, and carry out a variety of other tasks that call for some amount of intelligence (Coppin, 2004). The culmination of technological advancements and advances is artificial intelligence,

which enables computers to carry out tasks that are comparable to or identical to those performed by humans. Artificial intelligence has also been widely used in the education sector, in accordance with the adoption and usage of new technology in education. (Chen, 2020). If we are to be able to talk about the effective integration of AI in early education, teachers and decision-makers need to understand this sophisticated concept. There currently exists not a single definitive definition of AI since, for a variety of reasons, scientists cannot agree on what the term means. One reason is that the definition of AI is continually evolving, and another is that the discipline is interdisciplinary (Lukin et al., 2016).

According to the European Union, Artificial intelligence (AI) systems are software (and possibly hardware) systems that humans have created that, given a complex goal, act in the physical or digital dimension by perceiving the environment through data collection, interpretation of the gathered structured or unstructured data, reasoning about the knowledge or processing of the information that is drawn from this data, and selecting the best action or actions to achieve the given goal. Artificial intelligence systems can learn a numerical model or apply symbolic rules, and they can adjust their behaviour by examining how their prior actions have affected the environment. Machine learning, of which deep learning and reinforcement learning are specific examples, machine reasoning, which includes planning, programming, knowledge representation and reasoning, search, and optimisation, and robotics, which includes control, perception, sensors and actuators, and the integration of all other techniques into cyber-physical systems, are some of the approaches and techniques that make up artificial intelligence (AI) as a scientific discipline (Independent High-Level Expert Group, 2019).

Other experts describe AI as a synthesis of ideas from various traditional fields, including linguistics, philosophy, mathematics, economics, neuroscience, psychology, and computer science (Nuno, 2022). According to Naqvi (2020), artificial intelligence (AI) is a subfield of computer science that studies how well computers can mimic and enhance human behaviours.

The European Commission created DigCompEdu, the European Framework for Digital Competence for Educators, in 2017 and encouraged Member States to incorporate it into their national policy. Thus, Romania has assumed responsibility for this framework of digital competencies of the education professional by Ministerial Order no. 4150/29.06.2022. One of the 22 competencies included in DigCompEdu is the Use of emerging technologies in ethical ways to explore innovative learning experiences and content. Based on this competence, which is also addressed to teachers in early education, we aimed to identify teachers' attitudes and perceptions towards educational robots, or smart toys as some researchers call them, by asking the following question: What is the attitude of teachers in early education towards the integration of these smart toys in the teaching process? Teachers and academics are very interested in the integration of AI in education because it is thought that this idea significantly improves the instructional-educational process by personalising learning settings. Artificial intelligence (AI) is becoming more and more crucial in enabling teaching, learning, and evaluation (from robotic instruction to the development of automatic scoring systems) (Jiahong, 2022).

With its capacity to develop teaching and learning methods, artificial intelligence (AI) has the potential to address many of the difficulties that the modern educational system is currently facing. However, rapid technology advancements undoubtedly pose a number of risks and difficulties, therefore teachers must be given training on how to incorporate AI into the teaching process.

UNESCO is committed to supporting its Member States in harnessing the potential of artificial intelligence technologies to achieve the 2030 Agenda for Education (UNESCO, 2030 Agenda). According to UNESCO, it proposes ten attitudes to be considered while employing artificial intelligence in order to embrace it from the standpoint of human rights. One of these attitudes concerns media and information literacy, civic involvement, training in digital skills and AI ethics, awareness and literacy, and understanding of artificial intelligence that should be encouraged through open and accessible education.

We can infer from these artificial intelligence applications that there is a strong emphasis on facilitating anytime, anywhere, life-long, and all-encompassing learning (Roll, 2016). Although robotic toys have been used for several years as modern teaching tools, in Romania teachers experience some difficulties in integrating them into the teaching process, either due to the lack of adequate training in handling these tools or due to the lack of infrastructure needed for this purpose.

Additionally, the application of artificial intelligence in education has opened up new avenues

for innovation, such as the creation of a sophisticated educational framework that takes into consideration the current environment in which children live, which is permeated with information and intelligent systems at every turn. A close combination of AI technologies and the teaching process is needed to support teaching and learning, as practitioners have to adapt their teaching strategies to children's particular interests and needs (Ouyang, 2021).

In our study, we aimed to measure teachers' perceptions of the use of robotic toys by children and its incidence in the proper utilisation, in the teaching process, integrated in Experiential Domain Activities. Since teachers frequently act and respond in accordance with their paradigms regarding the employment of artificial intelligence in the teaching process, we believe that the integration of these toys into kindergarten activities is directly related to their perspectives. This highlights the advantages of artificial intelligence applications in the teaching process and, as a result, in the development of children in early education. A correlation between the employment of these tools and the perception of teachers can thus be drawn.

2. Theoretical background

2.1. Implications of Artificial Intelligence in Education

As artificial intelligence permeates all spheres of social life, including educational institutions, the integration of digital technology, and in particular artificial intelligence applications, into education is becoming a higher priority for society. Children may learn, gain information, and hone their digital abilities with the help of artificial intelligence. Teachers and academics are getting more and more interested in the use of AI in education since it appears to have a substantial impact by tailoring learning opportunities to students' needs and interests. AI plays a significant role in supporting teaching, learning, and evaluation, from developing robotic instruction to creating an automated system for grading homework or responses to quizzes. (Jiasong Su, 2022). The introduction of artificial intelligence into the educational environment has provided opportunities for teachers and students to develop both personally and professionally (Xu, 2021). Teachers need knowledge and tools to discover if activities supported by artificial intelligence facilitate the achievement of goals, but they also need support in using those tools appropriately in the teaching process (Flogie, 2023).

The literature identifies a variety of applications for artificial intelligence in education, ranging from administrative functions (scheduling, resource mapping, reporting) to individualised instruction (Reiss, 2021; Skinner, 2019). Simultaneously, artificial intelligence can be considered as a potent instrument for developing novel teaching strategies, promoting group learning, synchronous and asynchronous learning, and individualised instruction depending on the requirements and interests of the students (Nguyen, 2023). Applications of artificial intelligence may enhance children's educational experiences by piqueing their curiosity and encouraging active participation. However, as children have diverse learning needs that can be satisfied in group activities planned by the teacher and because AI cannot replace human connection (Dishon, 2017; Regan, 2019). Thus, we can say that AI applications are recommended to be used in group activities to bring children together for a common goal, solving tasks.

It is important to emphasise that educating future generations of children will require the integration of artificial intelligence in the teaching process, and more teacher professional development is needed in early childhood education (Akgun, 2022). For example, by participating in continuous professional development courses, teachers could have access to resources and teaching strategies, and have the opportunity to be part of a community for sharing and critically reflecting on their experiences with AI applications.

According to studies, artificial intelligence in education has attracted interest in schools and kindergartens since 1980 when Seymour Papert introduced his logo frogs into school units. Since then, various digital platforms and tools such as educational robots (Bee-Bot, Robot Mouse, Robotbloq Qobo, Ozobot) have emerged. Robotics has become more attractive, and according to recent studies, it is proven that the use of educational robots in the teaching process can improve the motivation for learning of the children (Lee et al., 2008; Alimisis, 2013). Although the number of extracurricular activities related to robotics has increased in recent years, these educational robots are insufficiently used in formal education. Some researchers argue that this is due to a lack of material resources, but also to insufficient training for their use in teaching (Chevalier, 2016). In the age of digital natives, it is part of the teacher's responsibility to bring technology into the teaching process and promote a positive attitude towards it. Teachers should be able to effectively and efficiently

use artificial intelligence applications in the teaching process to support and manage teaching and learning activities (Chuanmei, 2016).

Future education and learning of new competencies will heavily rely on artificial intelligence. Artificial intelligence can help teachers find the most creative teaching methods depending on the needs and interests of the students. Artificial intelligence will have a significant impact on how kids learn since it can automate marking and feedback, construct evaluations, and revitalise boring chores (Chaudhry, 2022).

In terms of the usefulness of AI applications in education, we can say that AI aims to reduce teachers' burdens without affecting the teaching and learning process while providing personalized learning experiences based on children's experiences. There is an increasing need for teachers to adapt to the changes that have emerged in the digital age, finding opportunities to improve in order to effectively use these tools. This is due to the emphasis that has been placed on online education during the pandemic and the emergence of new tools to facilitate digital learning.

2.2. The impact of using educational robots on children's development in early education

Artificial intelligence in early education can be considered a challenge for teachers because of the early age of children, who are often considered too young for such complex tasks. However, in the digital age, children have access to these applications of artificial intelligence outside of kindergarten from a young age.

Both the present and the future of society need for the development of computational thinking in the classroom. However, in primary education, this topic is generally ignored, and this is particularly apparent in preschool education. It is crucial to stress that educational robots provide kids with the opportunity to learn about robotics and programming while developing other cognitive abilities that are age-appropriate. When it comes to early childhood education, educational robotics allows kids the chance to quickly build and programme a robot that can carry out a variety of tasks. The STEM paradigm, a teaching strategy created to bring science, technology, engineering, and mathematics closer together, including educational robotics.

In early education, opportunities are created to develop the child in terms of skills such as self-regulation, working memory, self-control, communication and collaboration. Recent studies show that introducing activities that develop computational thinking from preschool age will increase children's analytical skills and encourage problem-solving in collaboration with others. According to Bers, the development of computational thinking in early school will result in a good degree of technology growth, with children developing in the digital age later employing digital tools to support their social conduct (Bers, 2019).

Children can learn computational thinking, one of the fundamental cognitive abilities for mathematical thought, through play with educational robots. The relationship between computational thinking and mathematical thinking has been extensively researched on a global scale, although preschoolers have received less attention. Wan-Rou et al.'s analysis of the literature indicates that mathematical thinking enhances problem-solving abilities while computational thinking aids in the development of mathematical concepts through the use of software or programming (Wan-Rou, 2022).

Programmable educational robots have been shown to be exceptional instructional tools for the development of computational thinking in preschoolers, according to a study by Bakala et al. These robots offer a tailored interface that makes it easier for kids to participate in activities meant to foster computational thinking (Bakala, 2021). A set of problem-solving abilities known as computational thinking is what future generations of kids will need to master in order to properly comprehend this digital world. Studies show that children with computational abilities can only be discovered in middle school, when there is a chance to advance educational standards in computer science (Román-González, 2018). These findings raise a warning about the importance of developing these digital skills from an early age, involving children in various activities gradually.

It is crucial to stress that the usage of these artificial intelligence apps is designed to foster knowledge and skill development, not the early acquisition of programming skills in young children. The focus is on developing critical thinking, creativity and spatial perception. Computational thinking is closely linked to the ability to identify and solve problems, discover the importance of humans in programming, and then learn about the role of technology in today's society. Creativity is developed

through activities in which children are encouraged to build, experiment, observe and repair, as errors can often occur in programming, causing children to start the process again in a completely new way. Spatial perception is another important aspect that is developed through robotics as pre-schoolers are made aware of logical sequencing in programming, but also of reaction time, discovering the link between cause and effect, and the importance of carefully following the steps established at the beginning.

At the same time, the use of educational robots in the teaching process allows children to learn the steps involved in engineering and to identify problems and find solutions. Also, in activities based on these artificial intelligence applications, children have the chance to plan, build and share the results with their peers. In such activities, children are encouraged to try, observe the results, fix and correct, and they also discover some of the limitations of artificial intelligence and the importance of the human factor in designing and programming these robots. During coding and programming, some errors may occur and there is a possibility that the robot may not work as planned, but children are encouraged to try different methods and approaches to achieve the result they want. Robotics, therefore, develops children's resilience and perseverance, skills they will need throughout their lives. Children can learn about the ethics of using robots in daily life and the effects they have on society while simultaneously observing the activity of the robots they programme and understanding how coding affects the physical environment when robots carry out specific tasks as directed. Children may readily learn about morals, right and wrong, and good and bad in this way.

Coding and programming involve logical and computational thinking which means solving problems in simple steps. Through educational robots, children develop logical and computational thinking skills, which will help them in the future in reading and mathematics, gradually increasing their school performance. As a result, teachers should be encouraged to modify the current curriculum to incorporate coding and computational thinking by first giving kids step-by-step tasks to get them acquainted with various programming concepts and skills. Children can be encouraged to become familiar with educational robots (Bee-Bot, Robot Mouse, Robotbloq Qobo, Ozobot) through a variety of obstacles before handling them in a variety of teacher-prepared activities.

It is crucial to emphasise the role of the teacher in the usage of these robots in early education on this topic. Perception, boldness, and ownership are key factors in how well educators integrate these resources into their lessons. In this way, a context for learning is created to encourage the responsible use of technology. Technological development is a phenomenon in a perpetual state of change and development, and sometimes being tough for teachers to adapt their teaching strategies and methods to these changes, but children require the right tools, adapted to their level and needs, to develop with this new coding trend. With the help of robotics, they will develop skills and abilities for a more competent world, and the use of innovative techniques and applications of artificial intelligence in early education is essential.

3. Research methodology

3.1. Research design

The research employed both quantitative (questionnaire survey method) and qualitative (focus group method) approaches. 120 instructors who work in organisations that offer early education services made up the target group for our approach. We proposed this study to measure the perceptions of early education teachers regarding the integration of educational robots (Bee-Bot, Robot Mouse, Robotbloq Qobo, Ozobot) in the teaching process. Therefore, to evaluate the perceptions of early childhood education teachers, we conducted a 44-item survey structured along the three dimensions:

- the utility of educational robots as experienced by teachers in early education;
- their capacity to work with robots in the teaching of kindergarten;
- the level of acceptability of educational robots in activities used in kindergarten instruction.

By applying the survey based on these three directions, we aimed to measure the perceptions of early childhood teachers, as self-reported, about the introduction and use of educational robots in activities with children. The measurement found that the perceptions of early education teachers influence their attitudes about the acceptability of artificial intelligence in the teaching process, which has some implications for the introduction of educational robots in practice.

3.1.1. Research questions

The following major research issue served as the basis for our research:

What do early childhood educators think about the usefulness, usability, and acceptability of integrating artificial intelligence technologies into the educational process?

3.1.2. The purpose of the research

Through a qualitative and quantitative investigative method, we sought to understand how early education instructors perceived themselves and the factors influencing their views towards the integration of artificial intelligence applications into the teaching process.

3.1.3. Research objectives

O1. To determine how the study's participating instructors felt about the value of educational robots in the early childhood classroom.

O2. To determine the type of motivation for the use of educational robots by the teachers involved in the study.

O3. To monitor the ability of early education teachers to use Artificial Intelligence applications in the instructional-educational process.

O4. To assess the level of early education instructors' acceptance of the use of educational robots during the teaching process.

3.1.4. Research hypothesis

Early education teachers' perceptions of Artificial Intelligence applications (Bee-Bot, Robot Mouse, Robotbloq Qobo, Ozobot) influence the decision to use them in the teaching process from the perspective of utility, ability to use and acceptability.

3.1.5. Research variables

Independent variable: teachers' perception of early childhood education

Dependent variable: introduction of robotic toys (Bee-Bot, Robot Mouse, Robotbloq Qobo, Ozobot) in the teaching process from the perspective of utility, ability to use and acceptability.

3.2. Participants

On the basis of volunteers, convenience sampling was utilised to identify the target audience. 120 early childhood educators from Romania's rural and urban areas made up the target group for our study. There were 120 female teachers who took part in the study, all of varied ages and educational backgrounds. Having early childhood education credentials was a crucial requirement for study participation. Of the 120 early education teachers, 96 worked in urban kindergartens and 24 in rural settings. The 96 urban kindergartens are organised differently: 76 work in extended-day kindergartens and 20 in regular-day kindergartens. In rural areas, 24 early education teachers work in regular kindergartens.

Before beginning the study, General Data Protection Regulation (GDPR)-related data protection concerns were taken into consideration. The study's goal and duration were explained to the teachers, and they consented to its terms and circumstances. Law 679/2016, which implements European Union regulations, ensures a high level of protection for people and alleviates issues with the flow of personal data, ensuring that the level of protection of people's rights and freedoms regarding the processing of such data is the same in all Member States (Regulation EU 2016/679 of the European Parliament and of the Council of 27 April 2016).

3.3. Research methods and instruments

Both quantitative (questionnaire survey) and qualitative (focus group method) methods were used in the research. For hypothesis testing, we used the Chi-square test (X^2) which included the frequency test to estimate the probability of correlation between the three directions (utility, ability to use and acceptability) and the adoption of artificial intelligence tools in the classroom, upon which the survey's development was founded. The chi-square test is suited for our investigation since it assesses whether the observed and predicted proportions differ significantly from each other. If the calculated X^2 value is higher than the value in the predetermined table, then we describe this value as significant, otherwise, we consider the calculated value compared to the value in the table as insignificant (Onchiri, 2013).

3.3.1 Quantitative methodological approach: Questionnaire Survey

The primary method for gathering quantitative data is through questionnaire surveys. A questionnaire enables the standard collection of quantitative data, ensuring that the data are consistent both inside and across analyses (Roopa, 2012). Following the literature and the purpose of the research, a pilot questionnaire was developed before the study began to identify and modify problematic questions. The questionnaire was developed using Google Forms and

consisted of 44 items with a 40-50 minute completion time. The questionnaire was designed to avoid inaccurate answers, which are not related to the content of the question, in mind, these helped to make administration more efficient.

The main structure of the questionnaire is made up of four parts including both closed and open questions. The first part covers the demographic data of the participants, including their experience of using technology. The second section of the questionnaire was used to gather information about how early childhood education teachers felt about the use of educational robots in the classroom. The questions were built using Likert scales with five response options, where 1 indicates a strong disagreement and 5 indicates a strong agreement.

The third section of the survey measured the effectiveness of using educational robots in the teaching-learning process and identified the type of motivation (intrinsic or extrinsic) surrounding the introduction of AI applications in the teaching-learning process in early education.

The last section of the survey examined the early education teachers' level of acceptance of the use of educational robots in the teaching process. In order to gather qualitative information about attitudes towards and against the employment of educational robots in the teaching process, a descriptive question about perceived utility, the capacity to employ educational robots in teaching activities, and acceptability was added.

3.3.2 Qualitative methodological approach: focus group

To gain a clearer view of teachers' perceptions of Artificial Intelligence applications, in addition to the questionnaire-based survey, we used the focus group method, a qualitative method that is extremely useful for accessing the opinions of the study participants, since it is also a flexible research method (Wilkinson, 1998). At the same time, this method helped to explore differences in the experiences of the participants, providing new insights (Nyumba, 2018). The focus group talks were sparked by the instructors who took part in the study's personal opinions on the usage of instructional robots in the early education classroom and their curiosity about the uses of artificial intelligence. With the purpose to identify the perceptions of the participating teachers, the discussion evolved from the question: *What is the primary function of educational robots in the teaching process, and what qualifications are required for using and accepting educational robots?*

To make the method more efficient, the target group of 120 participants was divided into groups of no more than 15-20 people to encourage dialogue and opinion sharing in small groups. Each group was given 45-50 minutes to share their views, with 10 minutes allocated to a question-and-answer session to clarify any concerns. The nominal group technique was used, with participants being asked to express their views individually, and then the discussions were collected according to some common points of view.

We were able to draw connections between the three strands—utility, ability to use and acceptability of educational robots in the teaching process—by gathering and analysing the focus group responses, which provided us with useful information about the beliefs and experiences of the participating teachers. All of these connections are explained in the findings.

3.4. Demographic data

The 120 participants in the study were 20-50 years old: 30.8% were between 20-30 years old; 33.3% between 30-40 years old; 24.1% between 40-50 years old and 11.6% over 50 years old. Of the total number of participants, 80% work in urban kindergartens (79.1% in extended day kindergartens and 23.9% in regular day kindergartens) and 20% in rural kindergartens, all of them working regular hours. Extended-day kindergartens operate on a 10-hour timetable with two teachers working in shifts, while regular-day kindergartens have a fragmented timetable of 5 hours/day with only one teacher per group.

The level of education of the participants focused on the last completed degree programme, so 53.4% had completed a Bachelor's degree in Early Education Pedagogy and 46.6% had completed a Master's degree in Educational Sciences. The average professional experience of the participants is 19 years (sd=8.5)

4. Results

Following the survey of 120 participants, we measured the perception of the teachers involved in the study, themselves, about the three areas: the utility of educational robots, the ability to use them and their acceptability of them in the teaching process.

After responding to the questionnaire's four demographic questions, participants were asked to rate a list of 10 statements regarding the usefulness of AI applications in the teaching process using a five-step Likert scale, where 1 indicates a strong disagreement

and 5 indicates a strong agreement. An example of a statement extracted from the survey is: In your opinion, do educational robots help children acquire knowledge and skills? After analysing the answers, we found that 55% of the respondents believe that educational robots are useful in the teaching process, especially in consolidation and knowledge transfer activities, 20% did not see any utility, claiming the young age of the children, and 25% had no opinion due to not having heard about the types of robots listed in the questionnaire. It is important to note that 40% agreed that educational robots increase children's engagement in teaching activities, which leads to the achievement of the proposed operational objectives.

In the third part of the questionnaire, we determined the capacities of early education teachers to use Artificial Intelligence applications in the instructional-educational process. The analysis helped us to understand the willingness of acceptance or rejection behind the decision to use educational robots, highlighting the professional competencies required for this purpose. An example of an item was: *What professional skills are needed to use educational robots in the teaching process?* In terms of participants' responses, half (50%) consider that ICT skills are needed, while the other half (50%) consider that ICT skills are not necessarily needed. The results of this question were cross-checked with the results obtained from the question *Have you used educational robots in your group activities?* and we found that these results are correlated with each other.

It is found that all respondents who have had contact or worked with types of robots in kindergarten feel that computer skills are not necessarily required, and those who are not familiar with types of robots feel that they need these skills. The chi-square test value, p=0.005 confirms the described correlation. The usage of educational robots in the teaching process is also met with a lack of confidence. After the implementation of refresher courses with the purpose of training and improving professional skills based on the three directions of comprehension, usefulness, usage, and acceptance of educational robots in the teaching process, this perception—which inhibits—could change. When asked *How we could improve our skills in using educational robots?* the majority of respondents referred to technical improvements from a coding language perspective.

In the last part of the survey, we wanted to answer the question: What is the acceptability of integrating types of educational robots into teachers' practices, correlating acceptability with the type of motivation? We used this correlation because we believe that intrinsically motivated teachers want to accumulate new skills to become more effective and have the ability to use educational robots in an innovative pedagogical way. This statement is also supported by the findings of another study which revealed that teachers are eager to learn something new in the field of ICT which proves that they are intrinsically motivated (Román-Graván et. al., 2020). To understand the degree of acceptability of educational robots, teachers answered a set of questions aimed to identify the type of teacher motivation. According to the findings, 85% of teachers had a strong intrinsic motivation to learn new programming abilities for instructional robots.

The question *I use/like to use educational robots to make the teaching process more efficient* showed a value of p=0.002 in the chi-square test, which shows us that those who want to use educational robots in the teaching process were more intrinsically motivated than those who have had contact with them since they are familiar with the algorithm of operation. External factors affecting the acceptability of artificial intelligence applications in early education were monitored to gauge extrinsic motivation. Because there is no emphasis on using technology in the teaching process in their kindergartens, the remaining 15% of respondents are extrinsically motivated.

At the same time, it was found that there are significant differences between the intrinsic motivation of participants working in urban kindergartens and those working in rural kindergartens because in urban kindergartens there is a higher emphasis on digitalization and in rural kindergartens there is no suitable infrastructure. We are confident that the PNNR projects will equip schools, which will provide additional motivation. We can conclude that all early education teachers who easily accept the integration of Artificial Intelligence applications are intrinsically motivated, having a strong motivation to acquire new skills. The usability, acceptance, and feasibility of educational robots in the teaching process were examined statistically using the chi-square test, which also included the frequency test to estimate the probability of correlation. The results showed that the three variables are not independent but rather interdependent.

Therefore, we may draw the conclusion that the perspective of teachers has a major role in the integration of educational robots into the teaching

process, a statement also supported by Dong, C. (2016) All teachers who find robots useful embrace and use them in the teaching process to make teaching and learning more attractive (Chevalier et. al., 2016).

5. Discussions

We determined certain challenges that instructors may encounter while attempting to introduce instructional robots in early education based on the comments of demotivated teachers. The following issues were raised: Lack of the required material resources, a lack of senior management support, a lack of explicit computational thinking-based dimensions and behaviours in the early education curriculum, a lack of teacher preparation in integrating technology in early education and tailoring teaching methods to the particular group. The low percentage of extrinsic incentive indicates that the usage of educational robots in the teaching process has little impact on early education instructors' practices.

Because programming languages are not covered in kindergarten curricula and teachers are not sufficiently prepared for this novel approach, the results of our study are also consistent with other studies that have noted that the limits of acceptability are closely related to the limits of use (Chevalier et al., 2016).

6. Conclusions

We were able to pinpoint the factors driving the usefulness, practicability, acceptability, and motivation of instructors to incorporate AI applications into the instruction of young children thanks to our study. According to an acceptability analysis, teachers wish to learn new skills to improve their professional effectiveness, which illustrates their high intrinsic motivation.

Because instructors believe that children are already fully digitalized, the analysis of children's capacity to use educational robots revealed that teachers are more confident in children's ability to use educational robot technologies than in their own abilities. This emphasises how crucial it is for teachers to receive special training in using educational robots as well as training on integrating AI applications into early education.

Finally, from the standpoint of their usefulness, efficiency, and acceptability, early childhood educators' perceptions play a significant role in the introduction of educational robots into the teaching process. We hope that the results of our study will facilitate the introduction of educational robots in early education, positively influencing teachers' perceptions. At the same time, we would like to highlight the need to introduce continuous training courses Regarding the usage of AI apps in kindergarten so that they can be incorporated into instructional designs that address the developmental domains outlined in the 2019 early education curriculum, the framework for how lessons should be taught.

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References

Akgun, S., & Greenhow, C. (2022). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. *AI Ethics 2*, 431–440. https://doi.org/10.1007/s43681-021-00096-7

Albulescu, I., & Catalano, H. (2021). *E-Didactica. Procesul de instruire în mediul online*. Editura Didactica Publishing House.

Alimisis, D. (2013). Educational robotics: Open questions and new challenges, *Themes in Science & Technology Education*, vol. 6, no. 1, pp. 63–71.

Bakala, E., Gerosa, A., Hourcade, J. P., & Tejera, G. (2021). Preschool children, robots, and computational thinking: A systematic review. *Internațional Journal of Child-Computer Interaction* 29, 100337. https://doi.org/10.1016/j.ijcci.2021.100337

Bers, U. M., González, C., & Armas–Torres, B. (2019). Coding as a playground: Promoting positive learning experiences in childhood classrooms, Computers & Education, vol. 138.

Chaudhry, M. A., & Kazim, E. (2022). Artificial Intelligence in Education (AIEd): a high-level academic and industry note. AI Ethics 2, 157–165. https://doi.org/10.1007/s43681-021-00074-z

Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review, in *IEEE Access*, vol. 8, pp. 75264-75278, 2020, doi:10.1109/ACCESS.2020.2988510.

Chevalier, M., Riedo, F., & Mondada, F. (2016). How do teachers perceive educational robots in formal education? A study based on the Thymio robot. IEEE *Robotics and Automation Magazine*, 1070(9932/16), 1-8.

Dong, C. (2018). Preschool teachers' perceptions and pedagogical practices: young children's use of ICT, *Early Child Development and Care*. DOI:10.1080/03004430.2016.1226293

Coppin, B. (2004). *Artificial Intelligence Illuminated*, Boston, MA, USA: Jones & Bartlett Learning.

Dishon, G. (2017). New data, old tensions: big data, personalized learning, and the challenges of progressive education. Theory Res. Educ. 15(3), 272–289.

Flogie, A., & Krabonja, M. V. (2023). Artificial intelligence in education: developing competencies and supporting teachers in implementing AI in school learning environments. In *2023 12th Mediterranean Conference on Embedded Computing (MECO)* (pp. 1-6). IEEE.

Independent High-Level Expert Group on Artificial intelligence. Set up by the European Commission. (2019). Disponibil online: *https://digital-strategy.ec.europa.eu/en/library/definition-artificial-intelligence-main-capabilities-and-scientific-disciplines* (accessed la 3rd of June 2023)

Su, J., & Zhong, Y. (2022). Artificial Intelligence (AI) in early childhood education: Curriculum design and future directions. *Computers and Education: Artificial Intelligence*, *3*, 100072.

Su, J., & Yang, W. (2022). Artificial intelligence in early childhood education: A scoping review. *Computers and Education: Artificial Intelligence*, *3*, 100049. https://doi.org/10.1016/j.caeai.2022.100049.

Joshi, A., Kale, S., Chandel, S., & Pal, D. (2015). Likert Scale: Explored And Explained. (AU Meng Ma, Ed.) British Journal Of Applied Science & Technology 7 (4): 396-403, 2015, Article No. *Bjast*, 2231-0843.

Lee, E., Lee, Y., Kye, B., & Ko, B. (2008). Elementary and middle school teachers', students' and parents' perception of robot-aided education in Korea. In *EdMedia+ Innovate Learning* (pp. 175-183). Association for the Advancement of Computing in Education (AACE).

Lee, K. F. (2021). *Superputerile Inteligenței artificiale. China, Silicon Valley și noua ordine mondială*. Editura Corint.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence Unleashed: An argument for AI in education. http://oro.open.ac.uk/50104/1/Luckin%20et%20al.%20-%202016%20-%20Intelligence%20Unleashed.%20An%20argument%20for%20AI%20in%20Educ.pdf (accessed la 26th of June 2023).

Onchiri, S. (2013). Conceptual model on application of chi-square test in education and social sciences. *Educational Research and Reviews*, *8*(15), 1231.

Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, *2*, 100020. https://doi.org/10.1016/j.caeai.2021.100020

Naqvi, A. (2020). *Artificial intelligence for audit, forensic accounting, and valuation: a strategic perspective*. John Wiley & Sons.

Nguyen, A., Ngo, H. N., Hong, Y., Dang, B., & Nguyen, B. P. T. (2023). Ethical principles for artificial intelligence in education. *Education and Information Technologies*, *28*(4), 4221-4241. https://doi.org/10.1007/s10639-022-11316-w

Nuno, J. C. (2021). *Inteligența artificială. Un pas înainte în evoluție.* Editura Litera.

Nyumba, T. O., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, 9(1), 20-32. https://doi.org/10.1111/2041-210X.12860

Regan, P. M., & Jesse, J. (2019). Ethical challenges of edtech, big data and personalized learning: Twenty-first century student sorting and tracking. *Ethics and Information Technology*, *21*, 167-179.

Regulamentul U.E. 2016/679 al Parlamentului European și al Consiliului din 27 aprilie 2016 https://eur-lex.europa.eu/legal-content/RO/TXT/?uri=celex%3A32016R0679, accesat la data de 14 iunie 2023.

Reiss, M. J. (2021). The use of AI in education: Practicalities and ethical considerations. *London Review of Education*, 19(1), 5, 1–14. https://doi.org/10.14324/LRE.19.1.05

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education*, *26*, 582-599. https://doi.org/10.1007/s40593-016-0110-3

Román-González, M., Pérez-González, J. C., Moreno-León, J., & Robles, G. (2018). Can computational talent be detected? Predictive validity of the Computational Thinking Test. *International Journal of Child-Computer*

Interaction, *18*, 47-58. https://doi.org/10.1016/j.ijcci.2018.06.004

Roopa, S., & Rani, M. S. (2012). Questionnaire designing for a survey. *Journal of Indian Orthodontic Society*, *46*(4_suppl1), 273-277. https://journals.sagepub.com/doi/pdf/10.5005/jp-journals-10021-1104

Skinner, G., & Walmsley, T. (2019). Artificial intelligence and deep learning in video games a brief review. In *2019 ieee 4th international conference on computer and communication systems (icccs)* (pp. 404-408). IEEE. https://doi.org/10.1109/CCOMS.2019.8821783

Ilkka, T. (2018). *The impact of artificial intelligence on learning, teaching, and education*. European Union. URI: https://hdl.handle.net/20.500.12799/6021

UNESCO 2030 Agenda https://stairwaytosdg.eu/images/UNESCO_Education_for_Sustainable_Development_Goals_ENG.pdf

Xu, W., & Ouyang, F. (2021). A systematic review of AI's role in the educational system based on a proposed conceptual framework. *Education and Information Technologies*, 1–29. https://doi.org/10.1007/s10639-021-10774-y

Wilkinson, S. (1998). Focus group methodology: a review. *International journal of social research methodology*, *1*(3), 181-203. DOI: 10.1080/13645579.1998.10846874.

Wu, W. R., & Yang, K. L. (2022). The relationships between computational and mathematical thinking: A review study on tasks. *Cogent Education*, *9*(1), 2098929. https://doi.org/10.1080/2331186X.2022.2098929