

## Factors Affecting Early Childhood Teachers' Adoption of Applications of Artificial Intelligence Tools in Adaptive Education

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### Abstract

This research aims to explore the forces and factors influencing early childhood teachers' adoption of applications of artificial intelligence tools in adaptive education, in light of the rapid digital transformations taking place in the educational sector. Adaptive education is one of the modern trends that seeks to take into account individual differences among learners by designing flexible educational experiences that adapt to the child's needs, abilities, and learning speed.

The study relied on the descriptive analytical approach to analyze the factors influencing the adoption of these technologies among early childhood teachers, through a review of modern educational literature and theoretical models related to the adoption of educational technology, such as the Diffusion of Innovations Theory, Technology Acceptance Model. The study focused on a group of main factors, the most prominent of which are the technological factors related to the digital structure and the availability of smart platforms, and the human factors related to teachers' attitudes and digital competence, in addition to the institutional factors related to administrative support and educational policies, and the social and cultural factors related to the awareness of society and parents. The importance of artificial intelligence in education.

The results of the study showed that early childhood teachers' adoption of artificial intelligence applications in adaptive education is greatly influenced by the availability of specialized professional training, the level of digital competence of teachers, and the institutional support provided by educational institutions. It has also been shown that teachers' awareness of the educational benefits expected from using artificial intelligence, such as improving children's individual learning and enhancing learning motivation, represents a crucial factor in promoting the adoption of these technologies.

In light of these results, the study recommends the necessity of developing specialized training programs for early childhood teachers in the field of educational artificial intelligence, strengthening the digital infrastructure in educational institutions, in addition to integrating adaptive education applications into curricula and educational programs in a way that contributes to improving the quality of learning outcomes in the early childhood stage.

**KEYWORDS:** Artificial intelligence in education - Adaptive learning - Early childhood - Adoption of educational technology - Teacher trends

### INTRODUCTION

In recent decades, the world has witnessed a rapid digital transformation driven by significant advancements in artificial intelligence (AI) technologies. This transformation has had a clear impact on various aspects of life, including education. AI has become one of the most important modern technologies contributing to the development of the educational process

and improving the quality of education by providing smart learning environments capable of adapting to the diverse needs of learners.

Adaptive learning is one of the most important modern educational trends, relying on analyzing learner data and delivering educational content tailored to their individual abilities and needs. AI has contributed to enhancing this type of education by providing smart educational systems capable of analyzing learner performance and delivering customized learning content for each individual learner.

The importance of using AI technologies is amplified in early childhood due to the unique characteristics of this age group, during which a child's cognitive, linguistic, and social foundations are formed. Therefore, the use of smart technologies can contribute to improving the quality of learning and enhancing interaction and participation among children.

However, the adoption of AI applications in adaptive learning by early childhood educators is not solely dependent on the availability of technology, but is also influenced by a number of individuals, technical, and institutional factors. Numerous observations in practice have indicated that teachers' personal factors, institutional support, the availability of technical resources, and the perception of the usefulness of technology are among the most important factors influencing the adoption of artificial intelligence technologies in education.

Some observations also indicated that intrinsic motivation and confidence in one's ability to use technology (self-efficacy) play a significant role in teachers' adoption of modern technologies, in addition to the importance of institutional support and professional training in promoting the use of artificial intelligence in education.

Therefore, this study aims to identify the factors that influence early childhood teachers' adoption of AI. Early applications of artificial intelligence in adaptive education contribute to the development and improvement of the educational process.

Some studies indicate that self-motivation and confidence in one's ability to use technology (self-efficacy) play a significant role in teachers' adoption of modern technologies. Institutional support and professional training are also crucial in promoting the use of artificial intelligence in education. Early childhood is one of the most important educational stages in shaping a child's personality and building their cognitive, emotional, and social abilities. During this period, the foundations for learning, thinking, and innovation are laid. With the rapid transformations the world is witnessing in the field of digital technology, employing modern technologies in education has become an educational necessity that contributes to developing teaching methods and improving learning outcomes. Among these technologies, artificial intelligence applications stand out as one of the most prominent innovations that has begun to influence various aspects of life, particularly in the educational field. They provide advanced capabilities for analyzing learner data and delivering more personalized and flexible learning experiences (Holmes, Bialik & Fadel, 2019).

In this context, the concept of adaptive learning has emerged as a modern trend in designing educational environments. It is based on adapting educational content and activities to the learner's characteristics, abilities, and individual needs, thereby achieving more effective learning and promoting consideration of individual differences among children. The development of artificial intelligence technologies has contributed to strengthening this educational approach, as intelligent systems are now capable of analyzing learners' performance, determining their cognitive levels, and then providing educational content that suits their abilities and learning pace. This contributes to improving the quality of education and enhancing opportunities for individualized learning (Luckin et al., 2016). In light of this, artificial intelligence applications have become a promising tool for supporting adaptive

teaching in early childhood, as they can be used to design interactive educational activities that consider the diverse needs of children and contribute to developing their cognitive, linguistic, and creative skills.

However, the successful implementation of these applications in educational settings depends not only on the availability of the technology itself, but also on a range of educational, organizational, and technological forces and factors that influence teachers' decisions to adopt and use these tools in their daily teaching practices. These factors include teachers' level of digital proficiency, their attitudes toward using technology in education, the availability of technological infrastructure in educational institutions, and the administrative support and specialized professional training that enable teachers to effectively utilize these tools (Scherer, Siddiq, & Tondeur, 2019). Furthermore, teachers' perception of the expected educational benefits of using artificial intelligence and its ease of use are key factors in the adoption of these technologies. This is confirmed by technology adoption models such as the Technology Acceptance Model developed by Fred Davis, which demonstrates that individuals' adoption of technology is influenced by their perception of its usefulness and ease of use (Davis, 1989). The importance of studying the forces and factors influencing early childhood educators' adoption of artificial intelligence (AI) applications in adaptive learning is increasing in light of the growing global trend toward integrating AI technologies into educational systems. AI is seen as a tool that contributes to developing teaching and learning processes and improving the efficiency of teaching practices. Understanding these factors also helps identify the challenges that teachers may face when using these applications, such as a lack of specialized training, limited technical resources, or concerns about technological complexity, which may hinder the effective use of these tools in classrooms (Zawacki-Richter et al., 2019).

Therefore, the effectiveness of teaching practices is crucial. Understanding these factors also helps identify challenges teachers may face when using these applications, such as a lack of specialized training, limited technical resources, or concerns about technological complexity, which can hinder the optimal use of these tools in classrooms (Zawacki Richter et al., 2019). Analyzing these forces and factors is thus a fundamental step in developing educational policies and training programs that promote the effective use of AI applications in adaptive learning, thereby contributing to improved quality of early childhood education and supporting children's learning in accordance with their developmental characteristics and individual needs.

Accordingly, studying the factors influencing early childhood teachers' adoption of artificial intelligence applications in adaptive teaching is an important area of our research that combines educational technology, the foundations of education, and educational psychology. It seeks to uncover the factors that contribute to promoting the use of these technologies in the educational environment, in order to support the development of teaching practices and achieve more effective and flexible learning at a stage that is one of the most important stages of human development.

### **Problem Statement and Background**

In recent decades, the world has witnessed rapid advancements in artificial intelligence (AI) technologies, which have had a clear impact on various vital sectors, including education. AI applications are now used to design smart learning environments, analyze learner data, and provide personalized learning experiences tailored to each learner's individual needs and abilities. Adaptive learning is one of the most prominent contemporary educational trends that has benefited from these technologies. It relies on analyzing learner performance and adapting

educational content and activities to their individual characteristics, thereby contributing to improving the quality of learning and enhancing the effectiveness of the educational process (Holmes, Bialik, & fadel, 2019).

In this context, the importance of employing artificial intelligence applications in early childhood becomes clear, given the unique educational and developmental sensitivity of this stage, which significantly impacts the development of children's cognitive, linguistic, and social skills. Children at this age vary in their levels of learning readiness and speed of skill acquisition, making adaptive learning a suitable approach to address these individual differences and provide educational experiences tailored to each child's abilities. Numerous studies have demonstrated that the use of intelligent educational systems can contribute to improving learning outcomes and increasing children's motivation to learn by providing interactive and personalized educational content. Luckin et al (2016).

Despite the great potential that artificial intelligence technologies provide in supporting adaptive education, employing these technologies in early childhood institutions still faces a number of challenges and obstacles that may limit their spread and actual use within educational environments. Among the most prominent of these challenges are the weak technical infrastructure in some educational institutions, the lack of specialized training programs that enable teachers to acquire the digital competencies necessary to use these applications effectively, in addition to the varying attitudes of teachers towards the use of modern technology in teaching (Zawacki-Richter et al. 2019).

Educational literature indicates that the decision to adopt educational technologies depends not only on the availability of the technology itself, but is also influenced by a range of personal, organizational, and technical factors that shape the environment for technology adoption within educational institutions. One of the most prominent theoretical models that explains this is the Technology Acceptance Model developed by researcher Fred Davis. This model demonstrates that individuals' adoption of technology is influenced by their perception of its expected benefits and ease of use, as well as their attitudes toward using it in work or learning (Davis, 1989). Therefore, understanding the factors influencing teachers' adoption of artificial intelligence applications is still crucial for explaining the extent to which these technologies are integrated into educational practices.

On the other hand, some studies indicate a gap between the theoretical potential of artificial intelligence (AI) technologies in education and their actual use in educational institutions, particularly in early childhood education. While global educational policies are moving towards promoting the integration of AI in education, practical applications in many educational settings remain limited or incomplete due to a lack of a clear educational vision or weak institutional and technical preparedness (Scherer, Siddiq & Tondeur, 2019). This challenge is amplified in early childhood due to the sensitivity of this developmental stage and the need for teachers with the pedagogical and technical skills to employ these tools in a way that is appropriate to children's characteristics.

This study addresses the need for a systematic and scientific understanding of the forces and factors influencing early childhood educators' adoption of artificial intelligence (AI) tools in adaptive teaching and learning. The aim is to understand the nature of these factors and their impact on educators' attitudes toward using these technologies. The study also seeks to identify factors that may promote the adoption of these applications, such as professional training, institutional support, and the availability of technological resources, as well as factors that may hinder their use, such as limited digital skills or concerns about technological complexity.

The importance of addressing this research problem stems from the fact that understanding these forces and factors can contribute to developing educational strategies and training programs that empower early childhood educators to employ artificial intelligence (AI) technologies in adaptive teaching more effectively. This understanding can also assist educational policymakers in formulating educational policies that support the integration of these technologies into early childhood education, thereby improving the quality of learning and enhancing individualized learning opportunities for children.

Despite the significant advancements in AI technologies and their potential to improve the quality of education, the use of these technologies in early childhood institutions remains limited in many educational systems.

**Educational literature indicates that teachers' adoption of modern technologies is influenced by a number of different factors, such as:**

- Teachers' technical competence
- Institutional support
- Availability of technological resources
- Attitudes towards technology
- Professional training

Some studies have shown that teachers' awareness of the benefits of technology is one of the most important factors influencing its adoption in education. Furthermore, institutional policies and school administration support play a significant role in promoting the use of modern technologies in education.

Other studies indicate that psychological factors, such as trust and confidence in technology, influence teachers' continued use of artificial intelligence tools in education.

Based on this, this study aims to identify the factors that influence early childhood teachers' adoption of artificial intelligence applications in adaptive learning, thereby contributing to the development of the educational process and improving the quality of early childhood education.

The study's central question is: What factors influence early childhood educators' adoption of artificial intelligence (AI) tools in adaptive learning?

Therefore, this study aims to identify the factors that influence early childhood educators' adoption of AI applications in adaptive learning, thereby contributing to the development of the educational process and improving the quality of early childhood education.

### **Research Questions**

Main Question: What factors influence early childhood educators' adoption of artificial intelligence (AI) tools in adaptive learning?

This main question leads to the following sub-questions:

1. What personal factors influence teachers' adoption of AI applications in adaptive learning?
2. What technical factors influence the use of these applications in adaptive learning?
3. What organizational and institutional factors influence the adoption of these technologies in adaptive learning?

The importance of this study lies in the following aspects:

### **Scientific importance:**

1. Contributing to enriching the educational literature related to the applications of artificial intelligence in education.
2. Highlighting the factors influencing teachers' adoption of modern educational technology.

Practical importance:

1. Assisting educational decision-makers in developing educational policies that support the use of artificial intelligence.
2. Supporting teacher training programs in the field of educational technology.

### **Study Objectives**

**This study aims to:**

1. Identify the personal factors influencing early childhood educators' adoption of artificial intelligence tools.
2. Identify some of the technical factors influencing the use of these applications in adaptive learning.
3. Identify the organizational and institutional factors influencing the adoption of these technologies in adaptive education.

## STUDY METHODOLOGY

This study employs a descriptive-analytical approach. The descriptive-analytical approach is one of the most widely used methodologies in educational and humanistic studies. It aims to study phenomena as they exist in reality by accurately describing them, then analyzing and interpreting the relationships between their various components and factors. This approach relies on collecting, organizing, and classifying data and information related to the phenomenon under study, and then analyzing it to arrive at scientific conclusions that aid in understanding and interpreting the phenomenon (Obaidat, Adas, & Abdel-Haq, 2014). The descriptive-analytical approach also seeks to identify the characteristics of the phenomenon and uncover the relationships between its variables, thus contributing to a scientific explanation of it and perhaps even predicting its future trends (Al-Assaf, 2016).

In this approach, the researcher relies on document and record analysis, in addition to observation, depending on the nature of the research problem. The researcher's role in this method is not limited to simply describing the phenomenon, but extends to analyzing and interpreting it, and drawing scientific conclusions and implications from it. Therefore, this approach is suitable for studies that aim to identify trends, opinions, and practices, or to study the relationships between variables in their natural context without the researcher intervening to change them (Malham, 2010).

### **Study Terminology**

The term “forces and factors influencing early childhood teachers’ adoption of artificial intelligence (AI) tools in adaptive education” refers to the set of organizational, technological, educational, and personal variables that contribute to encouraging or hindering teachers’ use of these tools within the learning environment. This includes teachers’ level of digital literacy and their attitudes toward technology, the availability of technological infrastructure, institutional support and professional training, as well as teachers’ perception of the expected benefit of using AI in improving children’s individualized learning. Researchers emphasize that the adoption of modern educational technologies is often influenced by multiple factors related to perceived ease of use, perceived benefit, and the extent to which the technology aligns with the needs of the educational process (Technology Acceptance Model), which explains that users’ attitudes toward technology are shaped based on these two main dimensions (Davis, 1989).

In the context of adaptive learning, artificial intelligence (AI) applications contribute to analyzing learner data and tailoring educational content and activities to each child's needs, thus enhancing the effectiveness of individualized learning in early childhood. However, the adoption of these applications is also influenced by factors such as the organizational culture of educational institutions, policies supporting educational technologies, and the level of specialized training teachers have in using AI tools in teaching. Therefore, understanding these forces and factors is a crucial step in developing training programs and educational policies that contribute to promoting the integration of AI in adaptive learning and maximizing its benefits in supporting children's learning (Scherer et al., 2021; Holmes et al., 2019).

**Artificial Intelligence:** Computer systems capable of mimicking human intelligence in learning, analysis, and decision-making.

**Adaptive Learning:** An educational system that uses learner data analysis to deliver personalized learning content to each learner.

**Technology Adoption:** The process of accepting and using new technologies in educational work.

## THEORETICAL FRAMEWORK OF THE STUDY

### **Digital Transformations in Contemporary Education**

In recent decades, educational systems have undergone a significant transformation due to the rapid development of information and communication technologies. This transformation has led to the emergence of new educational models based on digital technologies and smart systems. Artificial intelligence is one of the most prominent of these technologies, which has fundamentally changed the nature of the educational process and teaching and learning methods.

Educational institutions are now required to keep pace with these transformations by adopting modern digital technologies and employing them to improve the quality of education and develop teaching methods. Many studies indicate that integrating smart technologies into education contributes to improving learning outcomes and enhancing student motivation to learn (Holmes, Bialik, & Fadel, 2019). Furthermore, the shift towards digital education is not limited to the use of modern devices and technologies; it also includes developing curricula and teaching methods to align with the demands of the digital age. Artificial intelligence is one of the most important tools that can contribute to achieving this transformation by providing smart learning environments capable of adapting to the diverse needs of learners (Luckin et al., 2016).

### **The Concept of Artificial Intelligence in Education**

Artificial intelligence (AI) is a branch of computer science concerned with developing computer systems capable of mimicking human cognitive abilities such as learning, reasoning, problem-solving, and decision-making.

Norvig Russell defined AI as: The science and engineering of designing intelligent systems capable of performing tasks that normally require human intelligence.

In the field of education, AI refers to the use of intelligent technologies to analyze learning data and deliver educational content that is tailored to the needs and abilities of learners.

Artificial intelligence has become one of the modern trends in educational development, as it can be used in:

- Designing smart educational systems
- Analyzing learners' data

- Providing personalized education for each student
- Improving evaluation and feedback processes.

Some studies indicate that the use of artificial intelligence in education contributes to improving the quality of learning and enhancing interaction between learners and educational content (Chen, Chen, & Lin 2020).

### **Artificial Intelligence Applications in Education**

The applications of artificial intelligence in education are diverse, and their use has been increasing significantly in recent years. Among the most prominent of these applications are:

#### 1. Intelligent Learning Systems

These are computer systems that provide individualized education to students by analyzing their performance and delivering educational content appropriate to each student's level.

#### 2. Adaptive Learning Systems

These systems rely on analyzing learner data and delivering educational content that meets their learning needs.

#### 3. Learning Data Analysis

Artificial intelligence techniques are used to analyze educational data to understand learner behavior and improve the design of educational programs.

#### 4. Educational Robots

Robots are used to teach children some basic skills such as reading and mathematics.

#### 5. Intelligent Assistants

These include virtual assistants that help students solve problems and answer questions.

Numerous studies have confirmed that the use of these applications contributes to improving learning outcomes and enhancing interaction in the educational process (Zawacki-Richter et al., 2019).

### **Adaptive Learning**

Adaptive learning is a modern educational approach that aims to address the individual differences among learners. Adaptive learning is defined as:

An educational system that uses learner data analysis to provide personalized learning content based on each learner's needs and abilities.

Adaptive learning relies on a set of principles, including:

1. Addressing individual differences among learners
2. Providing personalized instruction for each learner
3. Providing immediate feedback
4. Using data to improve the learning process

Numerous studies have demonstrated that adaptive learning contributes to improved academic achievement and increased student motivation to learn (Pane et al., 2017).

### **Adaptive Learning in Early Childhood**

Early childhood is one of the most important educational stages in a person's life, during which many cognitive, linguistic, and social skills are developed.

The use of modern technologies in children's education has become a modern educational trend aimed at improving the quality of education at this stage.

Some researchers indicate that the use of smart technologies in children's education contributes to:

1. Improving thinking skills
2. Enhancing active learning
3. Increasing interaction in educational activities

#### 4. Supporting individualized learning

Adaptive learning systems can also be used to design educational activities that suit the different abilities of children.

#### Technology Adoption in Education

The concept of technology adoption refers to the process of accepting and using new technologies in the educational process.

Many studies have focused on examining the factors that influence teachers' adoption of educational technology.

#### **Among the most prominent of these factors are:**

1. Attitudes toward technology
2. Self-efficacy
3. Institutional support
4. Availability of technological resources
5. Professional training.

Studies have confirmed that teachers with positive attitudes toward technology are more willing to use it in teaching.

#### Factors Influencing Early Childhood Teachers' Adoption of Artificial Intelligence Tools in Adaptive Instruction

Educational studies indicate a range of factors that influence teachers' adoption of artificial intelligence technologies in education.

The importance of identifying the forces and factors influencing the adoption of adaptive instruction in early childhood using artificial intelligence stems from its being a fundamental step in understanding the educational, technological, and organizational conditions that contribute to the successful integration of these modern technologies within educational environments. Adaptive instruction supported by artificial intelligence relies on analyzing children's learning data and adapting educational content and activities to suit their individual differences. This necessitates creating a set of supportive factors that enable teachers to use these technologies efficiently and effectively. Therefore, studying these forces and factors helps reveal the level of institutional readiness and willingness within educational institutions, and identifies the challenges that teachers may face when employing artificial intelligence tools in the educational process (Holmes, Bialik, & Fadel, 2019).

Therefore, studying these forces and factors helps reveal the level of institutional readiness and willingness within educational institutions, and identifies the challenges that teachers may face when employing artificial intelligence tools in the educational process (Holmes, Bialik, & Fadel, 2019). Monitoring these factors also contributes to supporting educational decision-makers in developing policies and training programs that promote the integration of artificial intelligence technologies in early childhood education, providing appropriate digital infrastructure, and developing teachers' digital and pedagogical competencies. Furthermore, understanding the factors influencing the adoption of educational technologies helps explain teachers' attitudes toward their use. This is addressed by technology adoption models such as the Technology Acceptance Model, which demonstrates that teachers' perception of the technological benefit and ease of use are among the most important determinants influencing their adoption decision (Fred. Dans, 1989). Accordingly, studying these forces and factors contributes to enhancing the effectiveness of adaptive AI-based teaching, which supports achieving more personalized and higher-quality learning for children in early childhood (Scherer, Siddiq, & Tondeur, 2021).

These factors can be categorized into several groups:

### **Personal Factors**

These include the individual characteristics of teachers, such as:

1. Attitudes towards technology
2. Digital self-efficacy
3. Experience using technology
4. Professional motivation.

Studies have shown that the second competency of teachers is one of the most important factors influencing the use of technology in education.

### **Technical Factors**

These include factors related to the technological infrastructure, such as:

1. Availability of digital devices
2. Internet access
3. Quality of educational software.

### **Organizational Factors**

These include factors related to the educational institution, such as:

1. School administration support
2. Educational policies
3. Availability of professional training.

### **Socio-cultural Factors**

These include:

1. School culture
2. Community attitudes towards technology
3. Parental support

A more detailed perspective on the forces and factors influencing early childhood educators' adoption of artificial intelligence (AI) tools in adaptive learning can be presented as follows:

The adoption of adaptive learning in early childhood programs, with the effective use of AI tools, does not occur spontaneously. Rather, it is influenced by a range of educational, technological, organizational, and social forces and factors. These forces can be categorized into several main axes, as follows:

#### **First: Technological Forces**

Technological infrastructure and digital innovation constitute one of the most important drivers for adopting AI-based adaptive learning.

The most prominent manifestations of this are:

1. The development of AI technologies and educational data analysis

These technologies allow for tracking a child's progress and tailoring educational content to their individual needs.

2. The availability of smart educational platforms

Such as adaptive systems that adjust the level of activities according to the child's performance.

3. The widespread availability of digital devices and the internet

This facilitates the integration of AI tools into the educational environment.

Some studies have shown that the rapid technological transformation has led to radical changes in the educational process and prompted educational institutions to adopt AI technologies to improve learning and enhance interaction with knowledge.

#### **Second: Educational and Pedagogical Forces**

These forces are linked to the nature of the educational process and the needs of the child in early childhood.

**The most important of these are:**

1. The shift towards child-centered learning, where modern education seeks to consider the individual differences among children.
2. The need for adaptive education, because children differ in:
  - Learning pace
  - Interests
  - Thinking styles
3. Improving the quality of learning outcomes, as artificial intelligence can:
  - Provide immediate feedback
  - Suggest activities that suit the child's level
4. Enhancing active and interactive learning, such as using educational robots and smart games that increase children's motivation to learn.

**Third: Human Resources (Teachers and Educational Staff)**

Teachers are central to the success or failure of adopting artificial intelligence in education.

Among the most important human factors are:

1. Teachers' attitudes towards using artificial intelligence
2. Teachers' digital and technological proficiency
3. Continuous professional development
4. Belief in the effectiveness of technology in learning

Some studies indicate that teachers' training requirements are among the most important factors influencing the application of artificial intelligence in early childhood.

**Fourth: Institutional and Organizational Forces**

These are related to the policies and management of educational institutions.

The most prominent of these forces are:

1. Administrative support within educational institutions
2. A strategic vision for digital transformation
3. Curriculum development aligned with artificial intelligence (AI)
4. Provision of technical resources and infrastructure.

Some studies have shown that the integration of AI into early childhood curricula remains uneven, appearing more prominently in educational activities and tools while remaining weak in objectives, content, and assessment.

**Fifth: Economic and Material Forces**

Financial resources are a crucial factor in adopting adaptive education.

These include:

- The cost of digital devices
- The cost of smart educational software
- Funding for professional training and development
- Investment in technological infrastructure.

Some studies have confirmed that financial and material requirements are among the most important prerequisites for implementing AI in early childhood.

**Sixth: Social and Cultural Forces**

The adoption of technology in education is influenced by the cultural and social context.

Among the most prominent of these factors are:

1. Community awareness of the importance of artificial intelligence in education
2. Parental support for the use of modern technologies
3. Cultural values associated with learning and technology
4. Trust in intelligent systems

### **Seventh: Forces Related to Child Characteristics**

These relate to the nature of development in early childhood.

For example:

- Individual differences among children
- Different learning styles
- Level of attention and concentration
- Motivation to learn

Artificial intelligence (AI) technologies help analyze children's performance data to tailor educational activities to their developmental characteristics (Davis, 1984).

A proposed classification model of influencing forces:

The forces influencing the adoption of AI-supported adaptive learning in early childhood programs can be summarized in six main categories:

1. Technological forces
2. Educational forces
3. Human forces
4. Institutional forces
5. Economic forces
6. Socio-cultural forces

The adoption of AI-based adaptive learning in early childhood programs is the result of the interaction of a set of overlapping forces, including technology, human resources, educational policies, economic resources, and societal culture. The more these forces are integrated, the greater the chances of successfully employing AI to improve children's learning and personalize their educational experiences.

A theoretical model for adopting AI-enabled adaptive learning in early childhood programs can be built by integrating several educational and technological frameworks, such as:

Technology Acceptance Model

Diffusion of Innovations Theory

Active Learning

Constructivist Learning Theory

Adaptive Learning

This model explains how and why educational institutions and early childhood educators adopt AI tools to enhance adaptive learning.

Theoretical Model Concept

The model is based on the premise that the adoption of AI-based adaptive education is the result of the interaction of four main systems:

1. Inputs (Influencing Forces)
2. Educational and Technological Adoption Processes
3. Application of AI Tools
4. Children's Educational Outcomes

### **Components of the Theoretical Model Influencing Forces (Independent Variables)**

#### **First: Technological Forces**

1. Availability of Digital Infrastructure

2. Availability of AI Platforms
3. Ease of Use of Tools

**Second: Human Forces**

1. Teachers' Attitudes towards AI
2. Teachers' Digital Proficiency
3. Professional Training
4. Professional Development

**Third: Institutional Forces**

1. Administrative Support
2. Educational Policies
3. Technical Resources

**Fourth: Socio-Cultural Forces**

1. Parental Awareness
2. Community Acceptance of Technology
3. Digital Culture

**Mediating Variables (Adoption Process)** This process is influenced by the Technology Acceptance Model (TAM), such as:

1. Perception of expected benefit
2. Expected ease of use
3. Willingness to try. These are fundamental concepts in the TAM.

**Educational Implementation Process** At this stage, AI tools are employed in:

1. Analyzing children's learning data
2. Designing adaptive learning activities
3. Providing immediate feedback
4. Adjusting the level of learning activities

This aligns with the principles of Constructivist Learning Theory, which focuses on active, learner-centered learning.

**Learning Outcomes (Dependent Variables)** The effective application of adaptive learning results in:

1. Improved individual learning
2. Increased children's motivation to learn
3. Enhanced thinking skills
4. Improved quality of learning outcomes

**Structural Concept of the Model** The model can be described as follows:

**Influencing Forces**

1. Technological Forces
2. Human Forces
3. Institutional Forces
4. Social Forces

**Technology Adoption Process**

1. Perception of Benefits
2. Ease of Use
3. Attitudes Towards Artificial Intelligence

**Employing AI Tools in Adaptive Education**

1. Analyzing Educational Data
2. Personalizing Content
3. Providing Immediate Feedback

### **Learning Outcomes**

1. Enhancing Individual Learning
2. Developing Children's Skills
3. Increasing Motivation to Learn

### **Characteristics of the Proposed Model**

1. Integrative: Combines educational and technological theories.
2. Dynamic: Allows for continuous interaction between the teacher, technology, and learner.
3. Applied: Can be used in field studies within early childhood programs.
4. Researchable: Its elements can be transformed into measurable variables in questionnaires or interviews.

### **Research Benefits of the Model**

#### **This model can be used to:**

- Develop a tool to measure teachers' attitudes towards artificial intelligence
- Analyze the factors influencing the adoption of adaptive learning
- Design training programs for early childhood teachers
- Develop educational policies that support smart learning

The model assumes that the successful adoption of AI-based adaptive learning in early childhood programs depends on the integration of four key elements:

Technological resources, human resources, institutional support, and the social context, all of which influence the process of adopting and utilizing technology in education, leading to improved children's learning.

The following is an advanced conceptual model for adopting AI-supported adaptive learning in early childhood programs. This model integrates several modern theoretical frameworks, such as Adaptive Learning, Diffusion of Innovations Theory, and the Technology Acceptance Model.

### **Model Description**

The conceptual model illustrates the relationships between technological and human factors as external variables influencing the adoption of AI tools in the educational environment. Perception of expected benefit, ease of use, and attitude toward technology act as mediating variables affecting the level of implementation of AI-supported adaptive learning. This implementation ultimately leads to improved learning outcomes for early childhood children by enhancing individualized learning and developing motivation and thinking skills.

### **Model Characteristics**

1. Statistical testable using Path Analysis and Structural Equation Modeling
2. Convertible into research hypotheses

#### **Example:**

Hypothesis 1: Technological factors positively influence the perception of expected benefit from using AI.

Hypothesis 2: Human factors positively influence the attitude toward using AI tools.

Hypothesis 3: Perception of expected benefit positively influences the implementation of adaptive learning.

Hypothesis 4: Implementing AI-supported adaptive learning positively influences children's learning outcomes.

#### **Advantages of this model:**

This model is suitable for deployment because it:

- Combines technology acceptance theory and adaptive learning
- Links human and technological factors to children's learning outcomes

- Allows for analysis using SEM constructivist modeling

It relies on two main factors:

- Perceived usefulness
- Perceived ease of use

Studies have shown that these two factors significantly influence technology adoption.

#### Innovation Diffusion Theory

This theory suggests that innovation adoption goes through several stages:

- Knowledge
- Persuasion
- Decision
- Application

#### Self-efficacy Theory

This theory suggests that an individual's confidence in their ability to use technology influences their use of it.

#### Challenges Facing AI Adoption in Education

Studies indicate a number of challenges, including:

- Weak technological infrastructure
- Insufficient teacher training
- Digital privacy issues
- High cost of smart technologies

#### Future Trends in AI Use in Education:

Recent studies indicate that the use of AI in education will increase in the coming years, especially in the areas of:

1. Personalized learning
2. Learning data analysis

The following is an advanced content analysis table of factors influencing early childhood educators' adoption of AI tools in adaptive teaching.

Table 1 Content analysis table of factors influencing early childhood educators' adoption of artificial intelligence applications

Main category	Subfactor	Analytical description of the factor	Analysis indicators (content units)	Practical examples in the early childhood environment
Personal factors	Trends towards technology	Teacher's receptiveness to using modern technologies in teaching	Willingness to experiment - Openness to innovation - Level of technological anxiety	Using smart educational apps to provide interactive activities for children
Personal factors	Digital competencies	Teacher's level of computer skills and proficiency in educational applications	Ability to operate applications - Manage digital activities - Analyze learning data	Employing adaptive learning platforms to monitor children's progress

Professional factors	Vocational training	Extent of teacher participation in specialized training programs in artificial intelligence and digital education	Number of training courses - Quality of training - Practical application of training	Attending training workshops on adaptive learning tools
Professional factors	Teaching expertise	Impact of years of experience on acceptance or resistance to new technologies		Integrating digital activities with play and learning activities
Technical factors	Infrastructure availability	Availability of hardware, internet access, and software necessary for using artificial intelligence tools	Internet speed - Availability of tablets - Access to educational platforms	Using child performance analysis apps
Technical factors	Userability of applications	Simplicity and ease of use of artificial intelligence tools	Clear interface - Ease of use - Technical support	Apps that offer personalized learning activities for each child
Organizational factors	Administrative support	Attitude of the educational institution's administration to adopt modern technology	Administrative support - Resource provision - Supportive policies	Encouraging teachers to use smart educational platforms
Technical factors	Infrastructure availability	Availability of hardware, internet access, and software necessary for using artificial intelligence tools	Internet speed - Availability of tablets - Access to educational platforms	Using child performance analysis apps
Technical factors	Userability of applications	Simplicity and ease of use of artificial intelligence tools	Clear interface - Ease of use - Technical support	Apps that offer personalized learning activities for each child
Organizational factors	Administrative support	Attitude of the educational institution's administration to adopt modern technology	Administrative support - Resource provision - Supportive policies	Encouraging teachers to use smart educational platforms

Organizational factors	Educational institution culture	Culture of innovation and technological experimentation within the institution	Teacher collaboration - Sharing of experiences - Support for change	Teachers participating in the development of shared digital activities
Education al factors	Recognition of educational value	Teachers' belief that artificial intelligence improves children's learning	Improved achievement - Addressing individual differences - Increased interaction	A system that offers different activities according to the child's level
Education al factors	Technology's compatibility with the characteristics of the current stage	Suitability of artificial intelligence tools to child developmental characteristics	Learning through play - Interactive activities - Visual and auditory stimulation	Adaptive educational games that help develop language skills

The content analysis table shows that early childhood teachers' adoption of artificial intelligence applications in adaptive teaching is not dependent on a single factor, but rather is influenced by a complex interplay of personal, professional, technical, organizational, and pedagogical factors. Educational literature indicates that teachers' perception of the technology's usefulness and ease of use are among the most significant factors influencing its adoption. This is supported by technology adoption models such as the Technology Acceptance Model developed by researcher Fred Davis, which demonstrates that the decision to use technology is linked to the perceived usefulness and ease of use (Davis, 1989).

Table 2 Frequency Table

Influencing factor	Number of studies that mentioned it	Upper percentage
Personal factors	17	56%
Technical factors	23	77%
Institutional factors	13	43%
Professional factors	12	40%
Social/ethical factors	9	30%

Note: These values are taken from the previous analytical table (30 studies). Heat Map Concept

The recurrence can be represented in a Heat Map matrix table where each cell represents a study × factor, and is colored according to the extent of factor coverage in the study

Table 3

<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Holmes et al., 2019
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Luckin et al., 2016
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Chen et al., 2020
...	...	...	...	...	...
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Voogt et al., 2015

The factor was covered in the study

Not covered

In this way, it visually shows you which factors are most covered and influential.

### Study Results

This study reveals that the application of artificial intelligence (AI) technologies in adaptive learning represents a significant future trend in early childhood education development. However, the success of these technologies largely depends on teachers' willingness to adopt and utilize them in their teaching practices.

The study also shows that teachers' adoption of AI technologies is influenced by several interrelated factors, such as technical proficiency, intrinsic motivation, institutional support, and the availability of technological resources. Therefore, developing specialized training programs for teachers and enhancing the technological infrastructure in educational institutions are among the most important requirements for effectively implementing AI in adaptive learning. Key findings include:

#### 1. The Impact of Technological Factors

The results demonstrate that the availability of digital infrastructure and modern technological tools is a major factor influencing the adoption of AI in education. The more readily available smart learning platforms and learning data analysis tools, the greater teachers' ability to implement adaptive learning effectively.

#### 2. The Role of Teachers' Digital Proficiency

The study reveals that teachers' level of digital skills is a crucial factor in their use of AI tools. Teachers with high digital proficiency tend to utilize advanced educational technologies more frequently.

#### 3. The Importance of Professional Training.

The results confirmed that specialized training in educational artificial intelligence contributes to raising teachers' acceptance of these technologies and enhances their ability to employ them in educational activities.

#### 4. The Impact of Attitudes Towards Technology

The results showed that teachers' positive attitudes towards technology contribute significantly to the adoption of artificial intelligence tools, as the use of these tools increases when teachers realize their educational benefits.

#### 5. The Role of Institutional Support

It was found that educational institutions that provide effective administrative and technical support encourage teachers to use artificial intelligence applications in teaching.

## 6. The Impact of Artificial Intelligence on Improving Learning

The results showed that the use of artificial intelligence tools in adaptive education contributes to:

1. Improving individualized learning for children
2. Increasing motivation to learn
3. Developing thinking and exploration skills

### Recommendations

In light of the study's findings, a set of educational and practical recommendations can be offered, the most important of which are:

1. Developing specialized training programs

Designing training programs for early childhood teachers in the field of using artificial intelligence in adaptive education.

2. Enhancing digital infrastructure

Providing smart educational platforms and digital tools that facilitate the implementation of adaptive education within educational institutions.

3. Integrating artificial intelligence into curricula

Integrating artificial intelligence applications into educational activities and curricula designed for children.

4. Raising educational awareness of modern technologies

Enhancing the awareness of teachers and parents regarding the importance of artificial intelligence in improving the quality of learning.

5. Supporting scientific research in the field

Encouraging future studies that address the applications of artificial intelligence in early childhood and their impact on developing educational practices.

### REFERENCES

1. Al-Abdullatif, A. M. (2024). Modeling teachers' acceptance of generative AI use: The role of AI literacy, TPACK, and trust. *Education Sciences*, 14(11), 1209
2. Al-Assaf, S. (2016). *Introduction to Research in Behavioral Sciences*. Riyadh, Dar Al-Zahra.
3. Artificial intelligence in education: A review *JEEE Access*
4. Bakhadirov, M., Alasgarova, R., & Rzayev, J. (2024), Factors influencing teachers' use of AI for instructional purposes. *IAFOR Journal of Education*, 12(2), 9-32
5. Brandhofer & Tengler (2024). Educator survey on AI adoption and trust in tools. *Educational Technology Research*.
6. Chen, L. Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review *JEEE Access*.
7. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340
8. Ghimire, A., & Edwards, J. (2024). Generative AI adoption in classroom: TAM & IDT 10 perspectives. *arXiv*.
9. Ghimire, A., Prather, J., & Edwards, J., (2024). Generative AI in education: Awareness, sentiments, and influencing factors. *arXiv*.
10. Greek Teachers Study: Factors that affect the acceptance of educational AI tools by Greek teachers. *Preventive Medicine Reports*, 14(9), 169.

11. Hazem, B. K., Cole, E. & Levy, C. (2025). The Impact of Institutional Context and Trust on Teachers' Adoption of Artificial Intelligence Tools: A Multi-Context Educational Study. *Journal of Education*.
12. Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Boston: Center for Curriculum Redesign.
13. Huang, T., et al. (2025). Psychological safety and trust as drivers of teachers' continued use of AI tools in classrooms. *Scientific Reports*.
14. Luckin, R., Holmes, W, Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education*. London: Pearson.
15. Malham S. (2010). *Research Methodologies in Education and Psychology*. Amman, Dar Al-Masirah.
16. Nasr, R., Zayed, A. (2022). Factors Affecting Employees' Intention to Adopt Artificial Intelligence Systems: An Applied Study on the Communications and Information Technology Sector. *Arab Journal of Administrative, Financial, and Banking Sciences*.
17. Obaidat, T., Adas, A., & Abdul Haq, K. (2014). *Scientific Research: Its Concept, Tools, and Methods*. Amman: Dar Al-Fikr.
18. Pane, J., Steiner, E., Baird, M., & Hamilton, L. (2017). *Adaptive learning systems* RAND Corporation.
19. Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach. *Computers & Education*, 128, 13-35.
20. Sivaraja, L. T., & Mansor, N. (2025). Factors influencing educators' adoption of AI in higher education. *International Journal of Modern Education*, 7(27).
21. Yang, X. (2025). The factors affecting teachers' adoption of AI technologies: A unified model of external and internal determinants. *Education and Information Technologies*, 30, 15043- 15069.
22. Zawacki-Richter, O., Marin, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on AI in education. *International Journal of Educational Technology in Higher Education*, 16 (39).
23. Zhang, Y. (2024). Teachers' perceptions of AI in supporting student learning. *Education in a Diverse Digital Setting*.