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Smart education : Roboprof

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Abstract—**This paper explores the concept of smart education and proposes substituting traditional human teachers with recent technological advancements, particularly those based on artificial intelligence (AI). It outlines the inherent limitations of human-led teaching, such as physiological needs, human interactions, and personal constraints, and discusses how emerging technologies like AI can overcome these constraints. Additionally, it examines the deficiencies of machine-led teaching and emphasizes the necessity of integrating educational robots (RoboProf) into the educational system, especially in light of challenges posed by events like the Covid-19 pandemic. The working environment of RoboProf and its architecture, which integrates databases for personalized and adaptive teaching, are also discussed.**

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Keywords*—*Smart Education; Artificial Intelligence; Human Teacher Limitations; Machine-Led Teaching; Educational Robots; RoboProf Architecture, Personalized Teaching; Adaptive Learning; Educational Technology

I. Introduction

When addressing the concept of smart education within academic circles, it is common to refer to a classroom equipped with cutting-edge educational technologies and overseen by a teacher. However, it is often overlooked that the teacher themselves is merely a facilitator of the learning process for students, whether they be pupils or students. With this perspective in mind, I propose substituting the traditional teacher with recent technological advancements, particularly those based on artificial intelligence.

Undoubtedly, it is challenging to conceive how advanced technology, such as artificial intelligence, could replace a human teacher, with their physical presence and ability to interact with students. To justify this initiative, it is imperative to begin by outlining the inherent limitations of human-led teaching, and then demonstrate how emerging technologies can transcend these constraints.

II. Limitations of the Human Teacher: Physiological Needs, Human Interactions, and Personal Constraints

The first inherent constraint of human-led teaching lies in the biological and social necessities to which the teacher is subject. For instance, a human teacher requires sufficient remuneration to meet their basic needs such as food, housing, transportation, and other vital necessities, as well as to support their dependents.

Furthermore, essential human needs such as sleep, rest, and a balanced social life limit the availability of the teacher. Consequently, it is impossible for them to work on holidays, weekends, or continuously for 24 hours a day.

Moreover, physical constraints impose additional limitations. A human teacher cannot move at the speed of light nor be simultaneously available for multiple students of different backgrounds and levels within the same learning session.

Additionally, inherent rights of the teacher's human identity, such as the right to experience emotions and to hold personal opinions that may diverge from institutional guidelines, introduce further complications. These opinions may even conflict with official directives, necessitating external supervision to ensure that the service provided aligns with institutional expectations. Consequently, the human teacher tends to influence students based on their own personality, which may result in the formation of citizens with complex, sometimes unexpected personalities, potentially lacking values coherent with societal needs.

III. The Teacher Machine

Similarly, it is important to recognize that machines, despite significant advancements in the field of new technologies, remain limited in their ability to create, innovate, or propose original solutions outside of pre-

established parameters. Indeed, a machine simply combines pre-programmed solutions and ideas from its design, as well as those acquired during its operation. Consequently, it is incapable of influencing learners in unpredictable ways and can only educate them according to specific information, preconceived ideas, and predetermined opinions.

Furthermore, a machine lacks human factors and personality, limiting its ability to influence learners. It does not have the ability to interact empathetically or adapt to individual learner needs. Additionally, a machine is solely powered by electrical energy, requiring neither rest nor social interaction, thus restricting its ability to integrate into broader educational contexts.

TABLE I. TEACHER'S NEEDS AND EXPECTAIONS

Teacher's Needs	Expectations from the Teacher
• **Food,** • **Housing,** • **Expertise in the Teaching Field,** • **Transportation,** • **Need for Sleep and Rest,** • **Balanced Social Life,** • **Time for Family and Loved Ones,** • **Right to Personal Opinion**	• Creation of a Favorable Learning Environment, Engagement and Support for Students, • Encouragement of Curiosity and Critical Thinking, • Adaptability to Individual Student Needs

In the context of contemporary social evolution, the introduction of a "robot teacher", a machine designed to fulfill the pedagogical functions of a teacher, can be considered an ideal solution to meet the demands of our educational system.

IV. Machine Deficiencies

Unfortunately, the ideal often remains out of reach, and this also applies to the use of machines in the field of education. Indeed, while a machine may address certain inherent shortcomings of human teaching, it replaces them with its own limitations. Fundamentally devoid of consciousness and empathy, a machine is unable to assume responsibility for the consequences of its actions on human beings. Moreover, it is incapable of meeting individuals' emotional needs, regulating their emotions, or assuming a moral guiding role to prevent potential deviations.

The absence of consciousness and empathy represents a significant gap in the educational context, where emotional support and moral guidance play a crucial role in learners' development. Without these human qualities, a machine can only offer limited assistance in navigating the complexities of human life and society.

In conclusion, although the introduction of machines in education may seem promising in addressing certain shortcomings of the current educational system, it is essential to recognize the intrinsic limitations of these technologies and to maintain a balance between their potential benefits and the associated risks of their use.

TABLE II. HUMAIN AND MACHINE COMMUNICATION PERFORMANCES

Student Indicators	Human Teacher	Machine : Artificial intelligence
Facial expressions	High	Variable
Gaze	High	Variable
Voice intonations	High	Variable
gestures	High	Variable
Emotions	High	Variable
Motivation	High	Variable
Attention	High	Variable

V. The Needs of RoboProf

Let's envision a scenario where a teacher is delivering a lesson to a student: they must be able, at a glance, to determine if the student is receptive to the teaching. Various facial expressions, gazes, and vocal intonations convey crucial cues enabling the teacher to adapt their teaching based on the opportune moment when the student is ready to absorb new information. While there are computer programs capable of detecting the emotions, motivation, and attention of the student using data from a microphone or digital camera, specialized artificial intelligence is necessary to interpret facial expressions, body gestures, and voice variations. These insights are then used to tailor the teaching according to the student's emotional state.

Feedback, in the form of emotional messages, can be transmitted to the student through a flat screen or 3D glasses, immersing them in a virtual environment where the teacher can interact with them. The choice of teacher is crucial for the student, as factors such as gender, physical appearance, age, gestures, and manner of speaking can positively or negatively influence learning. Additionally, external elements such as social events may also impact the effectiveness of teaching.

A human teacher instinctively integrates all these factors to create an optimal learning environment. In contrast, a machine must perform complex calculations to consider each variable and adjust its behavior accordingly. For example, a machine might present a virtual teacher with inconsistent characteristics, such as a masculine voice for a female teacher, or summer clothing in the middle of winter, simply because these parameters were recorded as optimal in its memory. To overcome this limitation, it is essential to develop artificial intelligence capable not only of recognizing relevant factors but also of combining them coherently to create an almost human-like learning experience for the student.

VI. The Necessity of RoboProf

The decade of the 2020s has been marked by an unprecedented event: the Covid-19 pandemic. This health crisis has led to disastrous consequences worldwide, shedding light on the fragility of our societies and systems, particularly in education.

The current educational model reflects our lifestyle choices, characterized by the concentration of the population in vast urban agglomerations, where densely populated neighborhoods and overloaded infrastructures

illustrate our desire to maximize the efficiency of exchanges of goods and services. However, this social proximity also facilitates the rapid spread of infectious diseases, as tragically evidenced by Covid-19.

The pandemic has highlighted the challenges facing our educational system. Restrictions on learning activities have made it difficult for students to assimilate lessons in the traditional manner. To ensure more optimal learning in this context, it is imperative to adapt distance learning models (Hartopo, 2023).

Indeed, the health crisis has underscored the importance of developing innovative solutions to ensure the continuity of education, notably through the use of technologies such as educational robots. These tools, which can be referred to as "Roboteachers," can offer an effective alternative by allowing students to continue their learning interactively and adaptively, while adhering to social distancing measures.

Thus, in the face of challenges posed by a catastrophe like the Covid-19 pandemic, the integration of technological solutions such as Roboteachers emerges as a promising response to ensure continued access to education, while ensuring the safety and well-being of learners.

While numerous scientific studies have examined the ability of machines to deliver education (Yu, 2011), there is still much progress to be made. And while robots offer multiple potential benefits for education and robotics is promising as a learning technology, their use in the educational domain remains largely unknown, both by researchers and educators (Ya-Wen Cheng, 2018).

VII. The Working Environment of RoboProf

The most appropriate and least risky educational model should rely on a restricted population, sufficiently distanced from other groups, while still promoting communication and exchanges among them.

In the past, emphasis was placed on the physical proximity between schools and students, with a tendency to bring students back to educational centers. Indeed, constructing a university in every village would be both complex and costly, leading to the establishment of large educational institutions in urban areas, complete with extensive dormitories and boarding facilities.

Unfortunately, this concentration towards urban centers has resulted in an exodus of populations from rural areas to cities, emptying remote villages and reinforcing urbanization, thus making citizen services more complex and costly.

However, thanks to current technological advancements, it is now possible to bring school to the students. Most educational services rely on information communication, and communication technologies have significantly evolved in recent years.

RoboProf is a system based on a vast centralized data storage center, but one that can move anywhere in the world, or even in space if necessary.

VIII. RoboProf Architecture

RoboProf presents itself to the user as much as possible like a human teacher; however, in reality, it relies on careful and judicious management of data provided by human beings:

- Expertise Database: Firstly, a database of the discipline to be taught, carefully organized:
  - From the first topic to address to the last.
  - From the simplest to the most complex.
  - The most suitable examples for the learner.
- Communication Database: It itself consists of several databases:
  - Audio database (Artificial Intelligence) for voice recognition, transcription of voice intonations into emotional indicators, text-to-voice conversion with emotional intonations, etc.
  - Image and motion database (Artificial Intelligence) for facial recognition, movements or activities of individuals (and animals) present in the classroom.
- Emotions Database: Translated from the previous audio and image motion databases.
- Actors Database:
  - Learners database,
  - Virtual teachers database,
  - Database of other actors in the learning area.

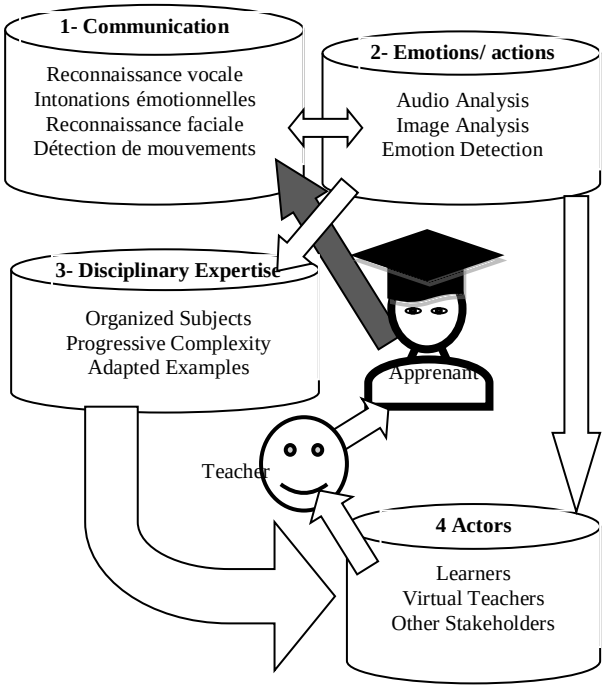

Figure 1 RobotProf processus

The process follows the flow depicted in Figure.

Communication (1) with the learner identifies the learner, their level, the programmed teaching session (3), the learner's emotions, their environmental circumstances, and the teaching approach (2). The system then selects (4) the suitable teacher, taking into account the learner's profile and their environment.

It is possible to associate, for a learner profile, teachers from the most to the least effective, as well as actors who promote or hinder teaching for this learner. The learner's profile could be built around a general profile considering their previous data (previous grades, family situation, age, etc.), and this profile would be refined as teaching progresses.

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################## Review 1 ##################
Saber Elotmani's paper, "Smart Education: RoboProf," explores the idea of substituting traditional human teachers with AI-driven educational robots, particularly in light of challenges like those presented by the Covid-19 pandemic. It effectively outlines the shortcomings of human-led teaching, including physiological needs and personal constraints, while discussing the potential advantages of integrating AI into education. However, the paper overlooks the crucial role of human empathy, consciousness, and moral guidance in the learning process, qualities that machines inherently lack. Despite proposing RoboProf as a solution, it neglects to address ethical concerns such as depersonalization and the ethical implications of relying solely on machine-led teaching. Additionally, the paper lacks empirical evidence or case studies to bolster its arguments, relying instead on theoretical assertions. Overall, while it raises thought-provoking questions about the future of education, its failure to provide a balanced assessment and empirical support weakens its credibility.

################## Review 2 ##################
1. Can you elaborate on the process of developing RoboProf and how it integrates with databases for personalized and adaptive teaching?
2. Are there specific challenges you encountered during the development phase?
3. In your paper, you discuss the limitations of both human-led teaching and machine-led teaching. How do you think about striking a balance between the two approaches to optimize the learning experience for students?
4. The author should provide more insights into the practical implementation of educational robots, especially in the context of events like the Covid-19 pandemic?
5. What challenges do you expect in deploying these technologies on a larger scale?
6. What specific research directions do you believe are most promising for advancing the field of smart education?