Application of Artificial Intelligence Techniques in Educational Delivery; Ghana Perspective

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Abstract

The field of Artificial Intelligence in Education (AIED) has undergone significant development over the past decade in most developed countries. As we reflect on the educational system of Ghana, the future needs to implement the use of AI. To shape the future of the Ghana Educational System, we ask two main questions: What are the major strengths of AI? And what new opportunities lay on the horizon? We analyze 15 papers from the history of the Journal of AIED (2014 - 2016) to encourage the implementation of AI in the Ghana Education System.

Keywords


Introduction

Artificial Intelligence (AI) is the science and engineering that deals with the production of intelligent computer programs to solve complex problems in a more human-like fashion. Today, AI is applied in many fields including military, stock market, debit risk assessment, learning to read postcodes, medical diagnosis, automobiles, robot control systems, scientific discovery, and has become ubiquitous in numerous aspects of our daily lives (B). But many universities have not fully exploited AI techniques in educational
practice. The use of artificial intelligence (AI) in the education sector is a new trend in the worldwide competitive business environment. Although AI in education has not been given much attention throughout the year’s specific in Ghana, knowing the terms, tasks, methodologies, and applications of AI would provide the groundwork for the development of the education sector.

**Artificial Intelligence Conceptual Framework**

In 1956, during a meeting where numerous scientists decided to gather to investigate whether computers could be made intelligent, the phrase 'artificial intelligence (AI) was first used by John McCarthy. Since then, AI has been defined as a computer program's capacity to do activities or reasoning processes that we normally connect with human intellect. It often has to do with the capacity to make a smart judgment in the face of uncertainty, ambiguity, or excessive information.

As an example, it is believed that playing chess well or some complicated card games need some form of human intelligence and also selecting the best diagnosis in a difficult medical case or developing something new, such as a mathematical theorem, some sort of art or even driving a car in the heart of a congested city.

Many sector's productivity and growth are affected by artificial intelligence (for example; communication, transportation, finance, and commerce). However, there is a significant exception in education, where just a few learning systems based on AI are currently generally used in classrooms or at home. Despite this, they have a huge impact on the education system: today's educational software regularly adjusts learning to particular requirements of individuals, connects students, provides access to digital information, allows for the decentralized learning platform, and makes learning simpler. As a society, we have tremendous expectations from the education systems (train workers, scientific and creative growth, cultural transfer, etc.) and yet society continues to expect more from education regardless of how much it is accomplished. There are no opportunities to serve society or dynamically change the present educational environment (fixed classrooms, repetitive lectures, and static printed textbooks). Classrooms and printed textbooks are particularly unsuitable for those who utilize technology every day. For example, in parallel processing, digital native learns and work in real-time with visuals and connected to others (vs. stand-alone). For these digital natives, information is immediately available, changes are persistent, time and distance are not important and multimedia entertainment is ubiquitous. No wonder schools and classrooms are boring.
Artificial Intelligence Task/process

Application of Artificial Intelligence in Education

Computers have been used in education for over 40 years. The first attempts to educate with computers were computer-based training (CBT) and computer-aided instruction (CAI). The instruction in these systems was not tailored to the requirements of the student. Instead, judgments regarding how to progress a student through the subject were scripted, such as "if question 21 is answered properly, proceed to question 54; otherwise, proceed to question 32." The ability of the student was not taken into account. While CBT and CAI are both capable of assisting students, they do not give the same level of customized attention that a human tutor would provide (Bloom's, 1984). To offer such attentiveness, a computer-based educational system must reason about the domain and the student.

This has led to research on intelligent tutoring systems (ITSs). In presenting the materials, ITSs provide tremendous flexibility and an increased capacity to adapt to the individual requirements of students. These systems gain their 'intelligence' through pedagogical decision-making and learner information. This makes system interactions with the student more versatile.

In order to apply these emerging insights into human learning in the area of digital education needs a far deeper knowledge of human intelligence, along with significantly more effective, active as well as constructive teaching approaches. AI approaches are vital to create reasoning and representations on these new cognitive insights and to make the knowledge about how people learn and to measure collaborative activities better (Adamson et al., 2014).

Artificial intelligence will transform the education system (Bertels, 1994). Education and IA may be regarded as two sides of the same coin: education helps students acquire and broaden their collected social knowledge, and IA offers the methods needed to comprehend the fundamental mechanisms of thinking and intelligent behavior.

AIED Research

The domain of AIED's technical breakthroughs, educational benefits, and theoretical discoveries (IJAIED 25th anniversary special issue, Part 1) have gained success throughout the last 25 years (Koedinger & Corbett, 2006; Heffernan & Heffernan, 2014). Hence, through an examination of papers published in the IJAIED between 1994, 2004,
and 2014, we are highlighting important trends and successes in the field. These years have been chosen as the current AIED research. All 15 articles have been studied over these years (5 from 2014, 10 from 2016). These documents were regularly published in IJAIED issues or special issues (See Table 1). After a lot of discussions, we decided to add the special problems since they represent the community's interests and the availability of research.

The following dimensions including technology utilized, interaction and collaborative structure, learning, and learning goals are considered for the analysis of each study. This kind of interaction specifies the sort of activities offered to students (for example, phase-based, exploratory), whereas the collaborative structure describes whether learners working individually or with peers. The hardware (e.g., robot, computer, handheld) and education setup define technology and configuration (formal or informal environment). Last but not least, the emphasis on learning is the lesson. (field knowledge, abilities in metacognition, motivation).

A paper may get more than one code within each dimension. Grasser et al., (2014), for example, propose an interactive learning environment that supports complicated, step-based issues. Both step-based and complex problems were used to determine their aim. The figures (n) and percent (%) were shown for that year.

<table>
<thead>
<tr>
<th>Year</th>
<th>Regular Papers</th>
<th>Special Issue Papers</th>
<th>Special Issue Topics</th>
<th>Total Papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>2</td>
<td>3</td>
<td>Learning in groups (n=4)</td>
<td>5</td>
</tr>
<tr>
<td>2015</td>
<td>4</td>
<td>4</td>
<td>Language learning (n=2)</td>
<td>8</td>
</tr>
<tr>
<td>2016</td>
<td>3</td>
<td>0</td>
<td>Emerging Technologies (n=3)</td>
<td>3</td>
</tr>
</tbody>
</table>

**Interaction Style and Collaborative Structure**

To evaluate which learning activities are adopted and investigated by representatives of the AIED community, we use two criteria to analyze the type of activity, collaborative structure, and interactive style. We assess the activities as the experience of students, solely considering students. The major categories utilized to study the interaction of students were step-based issue resolution and complex problems (see Table 2). A step-based solution is the breakdown of particular activities which typically require single competencies with rapid feedback, whereas numerous competencies and stages of complex problems sometimes offer other viable solutions.
For instance, Britt and colleagues' (2004) design of ILE requires the synthesis of several documents. This category contains instructions to self-explain when students can articulate their explanations in natural language. In addition, exploratory environments and games are part of the third category. This includes simulations and other platforms in which students study subjects instead of finding solutions to specific issues.

<table>
<thead>
<tr>
<th>Year</th>
<th>Step-based problems solving</th>
<th>Complex problems</th>
<th>Exploratory environment and games</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>n=2 (40%)</td>
<td>n=2 (40%)</td>
<td>n=1 (20%)</td>
</tr>
<tr>
<td>2015</td>
<td>n=1 (30%)</td>
<td>n=0 (0%)</td>
<td>n=2 (70%)</td>
</tr>
<tr>
<td>2016</td>
<td>m=5 (80%)</td>
<td>n=1 (10%)</td>
<td>n=1 (10%)</td>
</tr>
</tbody>
</table>

As the following table shows, we have moved to focus more on the step-based method. Total of eight empirical studies classed as step-base problem-solving. Two empirical studies published in 2014 were classified as complex problems with easily assessed problems like programming and electronics (Dzikovska et al., 2014).

In addition, each article's collaborative organization is categorized into one of three categories: one learner: one computer, n learners: one computer, or n learners: n computers, all of which are synchronous.

As seen in Table 3, numerous opportunities for supported collaboration were not included in the 2015 publications. Many similar examples are shown in 2014 and 2016. While this special issue adds to these figures, we believe that special problems represent contemporary ideals and topics of community interest once again. This tendency is extremely welcome and is consistent with a similar trend in classrooms. Expanding to enable collaboration gives ILE the chance to communicate with students utilizing technology more adeptly.

<table>
<thead>
<tr>
<th>Year</th>
<th>one learner: one computer</th>
<th>n learner: one computer</th>
<th>n learners: n computers: synchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>n=3 (70%)</td>
<td>n=1 (30%)</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>n=5 (60%)</td>
<td>n=3 (40%)</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>n=2 (50%)</td>
<td>n=2 (50%)</td>
<td></td>
</tr>
</tbody>
</table>

Expanding to enable collaboration gives ILE the chance to communicate with students utilizing technology more adeptly. These processes may be tracked, modeled, and supported in collaborative contexts, potentially improving a significant aspect of modern learning experiences.
Technology and Setting

The technology under consideration includes the technologies utilized such as computer, robotics, wearables, or handhelds) and the location intended such as school, workplace, or informal. It was the simplest aspect to examine. Every user shows folks working with a computer or laptop.

We do not propose that all work in AIED is limited to computer-enabled schools. However, there is definitely a very obvious situation, if the papers evaluated represent the emphasis of the community. Artificial intelligence in learning should be extended to a range of technology, including smartphones, tablets, wearables, and robotics (Arroyo et al., 2014). These technologies become less expensive and more accessible. New technologies are also being implemented to create a new type of engagement. We emphasize the employment of contemporary technology for teaching and learning in the Ghana education service.

Future Prospects of Artificial Intelligence in Education

Basic Educational Activities, such as Grading, can be Automated Using Artificial Intelligence

Even though tutors split evaluation tasks among them, grading assignments and exams for big lecture courses in college may be a time-consuming process. Even at lower levels, teachers often find that studying, preparing for class, or working on professional development requires a significant amount of time. Although AI will never be able to completely replace human qualification, it is getting close. Teachers can grade nearly all forms of fill-in-the-blank and multiple-choice examinations mechanically, and automated evaluation for handwritten papers may not be too far away. Essay evaluation systems are still in their early phases of development and are far from ideal, but they can advance in the future years, encouraging teachers to focus on in-class activities and student participation instead of assessments and evaluations.

Programs for Education can be designed to Student Requirements

One of the major pathways of artificial intelligence– from elementary school to college – is to utilize more personalized levels of education. Most of this has already been made possible by the increase in adaptive learning, gaming, and software tools. These systems meet students' demands, focus on certain topics, repeat topics that students don't really understand, and typically assist them to study at their own pace.
This sort of personalized learning can be a machine-assisted option for supporting students in a single classroom at various levels, where teachers facilitating help and support as required. Adaptive education already having a huge impact on education throughout the whole nation (especially through initiatives like the Khan Academy), and AI advances will only enhance and expand adaptive systems like this over the coming few decades.

**It can Indicate Areas for Improving Courses**

Teachers might forget gaps in their lectures of specific topics and instructional materials. AI gives a solution to this issue. Coursera, a major online educational platform providing a large number of courses, has already incorporated this. The technology alerts the teacher when a large number of students provide the wrong answer to an assignment and gives the student with a personalized message which includes ideas for the proper answer.

This sort of approach helps to fill up the explanation gaps in classes and ensures all students have the same conceptual basis. Instantaneous feedback helps students comprehend and remember how to do something properly instead of waiting to listen to it from the lecturer.

**AI Tutors might Provide Further Assistance to Students**

While human instructors can certainly offer something that computers can't, in the future at least more students will not be educated by tutors that exist only in zeros and ones. There are already several systems in which kids may use fundamental math, writing, and other disciplines to learn based on artificial intelligence. However, such programs, which still require real-world tutors, and are not optimal for helping students achieve high levels of creativity and thinking. This should not however rule out the possibility of AI instructors doing this in the future. With rapidly evolved education systems in a previous couple of decades, they are not far away.

**Students and Instructors can benefit from AI-driven Systems that Provide Useful Feedback**

AI may offer feedback on the quality of a course as well as helping teachers and students discover disciplines of interest. Many institutions use AI systems to track the growth of students, especially those offering online services, and inform teachers if their student's performance is when difficult.
These kinds of IA systems can enable students and teachers to find areas where students who struggle with the subject might improve their knowledge. In these schools, however, AI algorithms give advice not just on specific courses. Many works on ways to assist students to choose higher education depending on their strengths and problems in various areas. While students do not need to be instructed, it can benefit future students in career options.

**It Changes how we Find Information and how we Deal with it**

We hardly even notice the AI algorithms affecting the information we view and find every day. Google adjusts results to users on a location-based basis, and Amazon provides suggestions based on prior buying, Siri adapts to your requests and requirements.

These smart technologies play a major part in our personal and professional way of interacting with information and might simply transform the way we access and utilize information in academies and schools. In recent decades, the way humans engage with information and most integrated technology has already dramatically altered in AI-based systems. Students might have a very different research experience and obtain information than students of the current generation.

**The Role of Teachers Might Alter**

Teachers will always have a part in education but the role and meaning they play in using new technology in terms of intelligent computer systems might be changed. As we have mentioned, AI may do work like grading, help students learn better, and even substitute real-life instruction. AI may be applied to a large number of other educational fields, though. AI systems can be set to provide knowledge and to offer a platform to students to ask questions and, of course, to find information or even content.

However, in most situations, AI changes the teacher's role to the facilitator's (Baker et al., 2006). Teachers will augment AI training, provide help to students with difficulties and provide them with real and human interaction experiences. In many respects, technology already pushes certain changes in teaching, particularly in online schools that follow the flip classroom approach.

**Conclusions**

We recognize that technology cannot have an independent impact on education; rather, it is one component in a sophisticated adaptive system that considers the environment created by students, teachers, domain knowledge, technology, and pedagogy.
Although education in the United States does not involve the use of artificial intelligence to better teaching and learning, this article has advocated the benefits of doing so. We hope to promote the use of artificial intelligence in Ghana's educational system. Policy concerns that entail social and political factors must be addressed, but are beyond the scope of this paper.

In AI and education research, the problems of teaching practices in the school setting must be taken into account. We're excited to see how AI empowers students throughout the world, expands learning opportunities, and provides engaging, interactive experiences for all learners of any age, anywhere, and at any time.

References


**Authors Profile**

Senior Lecturer, Certified Information Security Manager, and ITIL certified with over seven years of experience managing IT infrastructure, Trainer in I.T/Computer Science and Information Security Management specialist with over 7 years exposure to different fields of work including; Check Point Security Software Management, I.T Audit and Security
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IT Manager – Services and Academic Support at University of Environment and Sustainable Development, Somanya with research interest in Algorithms, Software Engineering, Cloud Computing. Eric holds a master’s in information and Communication Technologies – Management Option, Osei-Tutu Institute for Advanced ICT Studies, Ghana, and Bachelor of Science Degree in Computer Systems from the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. I am Software Engineer.

I have 12 years of experience in Software Development in both private and public sectors with experience in Database Management Systems. I have 10 years of cumulative experience in academia, until 2021, I was a lecturer at Presbyterian University College, Ghana. As an academic, I taught Computer Programming in Visual Basic, Internet technologies, Electronic commerce, Data structures and algorithms, Computer Graphics. The pronoun (he or she) is used instead of the author's last name in the second paragraph. It includes military and work experience, as well as internships and summer jobs. Job titles are written in all caps. The current task requires a location, and previous locations cannot be identified. It's possible to include material from previous publications. Make a list of no more than three new books or papers. Book publishers are listed in the biography in the following order: book title (city, state: publisher name, year), which is equivalent to a benchmark. The paragraph concludes with a discussion of current and previous research interests.

The author's title and last name begin the third paragraph (e.g., Dr. Smith, Prof. Jones, Mr. Kajor, Ms. Hunter). Other than the IAENG, list any professional society affiliations. Finally, make a note of any honors received as well as any committee or publishing work you've done. The biography will be indented around an image if one is provided. The photo appears in the biography's upper left corner. The biography's personal interests will be removed.