Artificial Intelligence Enabled Double Reduction Policy Path Analysis

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Abstract. The "Double Reduction" policy starts from both inside and outside the school, with a view to combating the excessive academic burden of students and building a favourable educational ecology. However, the implementation of the policy has faced resistance and problems within and outside the school and in the general environment. The application of AI can provide new ideas in improving classroom quality, innovating educational tools, and evaluating and regulating education. At the same time, AI promotes the transformation of the education model and the innovation of education concepts. Artificial intelligence presents both opportunities and challenges for applications in education. This artical examines the obstacles in implementing the double reduction policy and explains the machine learning algorithms. By analysing pertinent education data, it explores AI's role in aiding double reduction policy execution and potential risks.Whilst encouraging their integration, it is important to clarify the instrumental role of AI whilst addressing issues such as educational equity and Digital Gap problems.

1 The reason for integration of artificial intelligence and education

The proliferation of big data and increased computing power in recent years, particularly with the debut of GPT-4 in 2023, has facilitated another booming phase in AI research and application. Through a continuum of advancements, AI's implementation is significantly altering people's livelihoods and productivity at an unparalleled pace and scope. Among them, the education industry is a promising area for AI application scenarios. [1] The double-reduction policy, which is a significant step in the overall reform of China's education development, is also the most far-reaching policy in recent years in the field of education. Some argue that artificial intelligence (AI) technology can enhance policy efficiency, lower resistance to policies, and facilitate education reforms and innovation. However, others contend that AI will impact the education ecosystem. [2] By collecting and summarising the literature, it is found that there are more research results on AI education, but there are relatively few studies on AI-assisted double reduction policies. Therefore, it is worth studying how AI can aid the implementation of the double reduction policy whilst simultaneously minimising associated risks.

2 Dilemmas in the implementation of the double reduction policy

2.1 On-campus dimensional analysis

Traditional homework design is typically uniform in nature, lacking the ability to provide personalised assignments tailored to individual students' knowledge and ability. Moreover, it has increasingly strayed from its nurturing function. When creating homework tasks, excessive emphasis is placed on subject teaching effectiveness, with insufficient attention given to the "learning" that occurs through student-assignment interaction.

The classroom quality may be impacted by the Double-reduction policy, as it results in a longer study time for students at school and decrease the importance of extracurricular tutoring. This could cause a stronger reliance on tutoring within the school, which may lead to a wider gap between schools. The level of teaching is hindered by the personal ability and experience of teachers. Introducing new teaching methods may result in an added workload for teachers, reducing their motivation to reform the current mode of teaching.

The issue of narrowing the role of after-school services is prevalent in practice. Schools can only offer supervised care to complete homework during extended hours without facing increased risks. Additionally, the assessment system for such services is flawed. Insufficient incentive for schools to develop after-school

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programs can be attributed to the absence of evaluation standards for assessing their level and quality. Insufficient incentive for schools to develop after-school programs can be attributed to the absence of evaluation standards for assessing their level and quality.

2.2 Off-campus Dimensional analysis

Although the outlawing of the subject-based tuition sector by large educational institutions has largely removed it from sight, shadow education persists in both overt and covert forms. New forms of shadow education such as in-residence tutoring and high-end childcare services are increasingly prevalent. Educational institutions operating covertly pose more management challenges, leading families to invest more in education. Unapproved advertisements intermittently intensify anxiety. Short-video platforms have witnessed a spike in "anxiety-trafficking" ads, catering to all levels of education.

Teachers usually take charge, while parents tend to cooperate passively to complete light duties such as correcting homework, preparing school supplies, and ensuring attendance. They play a less active role in participating in their children's educational journey. Sending group messages often becomes repetitive and tedious for parents. The Report on the National Family Education Survey indicates that many parents and even some teachers lack adequate parenting abilities. The study highlights problems, including less frequent communication with their children and high expectations of their offspring, which may leave parents feeling bewildered.

Educational equity is a cornerstone of social equity and a key objective of the double-reduction policy. However, there continues to be a significant gap in the distribution of educational resources across different geographical areas within China. In relation to equity in education, Gardner categorises human intelligence into 6 forms with individuals exhibiting either strong or weak capabilities in each respective area.[3]Typically, traditional education entails a focus on nurturing and valuing mathematical-logical and linguistic intelligences whilst neglecting other areas of intelligence.

3 Basic Theories and Principles of Machine Learning

3.1 Basic Theories and Principles of Machine Learning

Generally, machine learning involves allowing the computer to learn from data in order to acquire certain knowledge or patterns.[4]As a field, machine learning typically refers to a particular problem and the methods used to address it, namely, how to identify patterns from observed data and use the resulting model to predict unknown or unobservable data. In the early years of the engineering industry, machine learning was often referred to as pattern recognition. However, pattern recognition is more commonly applied to specific tasks such as optical character recognition, speech recognition, and face recognition. These tasks are easy for humans to perform, but we do not understand how we do them. Therefore, it is challenging to create a computer programme manually to complete these tasks. A viable approach involves developing an algorithm that enables the computer to acquire understanding from tagged samples and utilise it in accomplishing diverse identification tasks. [5]As machine learning technology is increasingly embraced, pattern recognition is being substituted by the idea of machine learning. It has come to be a comprehensive designation for this sort of difficulties and the techniques employed to solve them.

A tagged feature or label may be conceived as a sample or an illustration. The collection of samples is referred to as a data set or corpus in many fields. Typically, a data set is divided into two categories: training set and test set. The training set comprises training samples that are employed for model training. The test set is composed of test samples that are used to evaluate the model performance. We typically use a dimension vector D= [$x1$, $x2$,...,xD] t to represent the vector containing all the characteristics of a mango, also known as a feature vector, where each dimension corresponds to a feature. Assuming the training set $\mathcal{D}$ comprises D samples, where each sample is independent and identically distributed, that is, extracted independently from the same data distribution, they are recorded as:

$$D=\{(x(1),y(1)),(x(2),y(2)),\square,(x(N),y(N))\}. \quad (1)$$

Given the training set $\mathcal{D}$, we aim to use a function set $\mathcal{F}$ = {$f1$ ($\boldsymbol{x}$), $f2$ ($\boldsymbol{x}$),...} to enable the computer to automatically determine an "optimal" function f * ($\boldsymbol{x}$) that approximates the relationship between the eigenvector $\boldsymbol{x}$ and the label y of each sample. By utilising the function f * ($\boldsymbol{x}$), we can predict the label value of a sample $\boldsymbol{x}$. The process of discovering this "optimal" function f * ($\boldsymbol{x}$) typically requires completion through a learning algorithm $\mathcal{A}$ which determines the key to machine learning. In some literature, the learning algorithm is alternatively referred to as the "learner." The process of searching for patterns within the data is typically called "learning." [6] As a result, the learned function can be utilized to predict the sample's quality based on its characteristics during testing as:

$$Acc(f^*(\mathbf{x}))=1\left|\hat{\partial}'\right|\Sigma(\mathbf{x},y)\in\hat{\partial}'I(f^*(\mathbf{x})=y) \quad (2)$$

3.2 Artificial Intelligence in Education

There are numerous technological applications in the education sector, as demonstrated in Table 1. We compare education and learning outcomes, comparing AI and non-AI learning application data using three mechanisms of mechanical learning. The results are depicted in Figure 1. The evidence demonstrates a

significant presence of AI application, warranting further categorisation and meticulous examination.

Table. 1 Main technology used in education

Funtion	Main technology	Technology maturity
Emotion recognition	Natural Language Processing, image recognition	Medium
Intelligent Homework Correction	Optical Character Recognition	High
Student Grade Prediction	Machine Learning	Medium
Courseware Generation	Artificial Intelligence Generated Content	High
Pronunciation Evaluation	Speech Recognition	High
Voice User Interface	Speech Recognition, Natural Language Processing	Low
Adaptive Learning	All of the above	Low

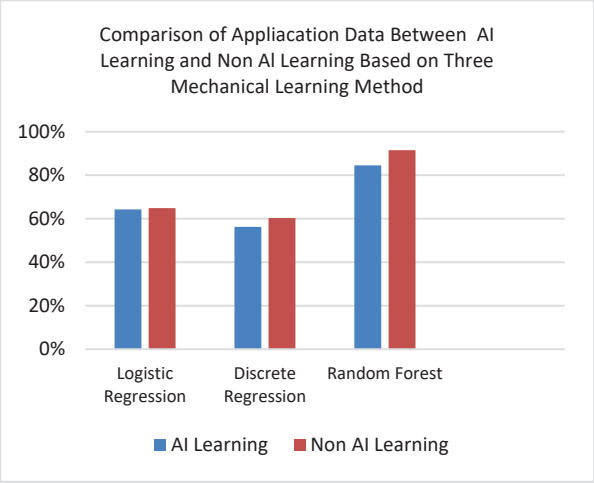

Fig1. Comparison of Application Data Between AI Learning and Non AI Learning Based on Three Mechanical Learning Method

4 Pathways for Artificial Intelligence Technology to Enable Double Reduction Policies

4.1 Analysis from teaching perspective

Using the cognitive diagnostic method of machine learning, and relying on computer vision, we are able to develop and apply algorithms in the field of education. By analyzing the interaction between teachers and students in the classroom, we can diagnose and evaluate their performance. This enables us to make timely adjustments to teaching methods as well as provide individual students with reminders, resulting in the efficient development of classroom teaching activities. Teachers can utilize the data analysis code automatically generated by ChatGPT to examine teaching data. Relying on the smart classroom to collect students' learning data for generating learning reports, teachers can use relevant reports and data to focus on explaining common issues, thereby enhancing classroom efficiency. By utilising AR technology, abstract concepts are conveyed through digital modelling, which is more effective in aiding students' memory. Based on a deep neural network for learning situation analysis, this study analyses the actual needs, ability levels, and cognitive tendencies of students. Characteristics of the students are comprehensively assessed and the advantages of interest are explored.

The use of augmented and virtual reality technology as a supplement to formal teaching not only engages students in a unique way and enhances their ability to learn visual information, but also decreases the risks of extending school hours. ChatGPT can offer guidance for extracurricular activities such as programming, reading, writing, and more, enriching the range of after-school services.

4.2 Analysis from student perspective

Using the "Smart Homework" system, homework assigned by teachers is personalised and structured hierarchically by utilising the big data of students' learning conditions. This method guarantees the accurate fulfilment of teaching requirements whilst avoiding redundant assignments that could demotivate students from learning. Relying on the "learning community" to overcome the limitations of time and space in providing homework explanations, this system uses natural language processing (NLP) technology to categorise and store incorrect questions. Subsequently, it presents the related questions to students to verify their comprehension. Developing the "Error Book" tool involves utilizing big data from homework evaluations, the forgetting curve, NLP technology, and "intelligent questions" to compile students' incorrect answers for targeted practice.

As AI is continuously being applied to educational scenarios, students can receive knowledge education at home without specific spatial constraints. Artificial intelligence can be integrated into educational activities in various ways as needed by students, teachers, and parents. This results in a transformation of the original subject-role relationship, with all three individuals assuming the roles of learners, knowledge transmitters, and supervisors, as per the specific learning requirements.

4.3 Analysis from family perspective

It is imperative to supervise the course syllabus and employ semantic analysis techniques to assess audio and video recordings in order to thwart the proliferation of

unlawful or unsuitable educational resources. Regulations concerning illegal advertisements for tutoring require extracurricular tutorial institutions, whether online or offline, to advertise on major platforms using text, voice, and images. To aid supervision, ASR/NLU technology must be employed to identify and analyze reviews. Any distress caused by unauthorized advertisements should result in their expeditious removal and the pursuit of responsibility. The external training institutions must install cameras and an intelligent AI analysis system to capture faces and perform analysis during the entry and exit of students.

The integration of AI can mitigate family conflicts resulting from the shift towards home-based formal education. Furthermore, ChatGPT's capacity to produce simulations of family interactions permits training in psychology and pedagogy to enhance relationships within the family. The intelligent correction system, which fuses image recognition and natural language processing, may assist in alleviating the pressure on teachers and parents whilst reviewing homework. The incorporation of artificial intelligence and a pupil's family allows parents to engage more actively in their offspring's education, amplifying their comprehension of advancement and facilitating productive guidance.

The development of open courses in "smart classrooms" aims to facilitate learning for faculty members across different locations while complementing each other's skillsets. AI has the potential to replace costly one-on-one private tutoring, accommodating students who cannot afford this aspect of their education, and eventually bridging this gap. AI tutoring programmes, such as Khanmigo at Khan Academy, are based on OpenAI's ChatGPT technology. [7]The practical application of Multiple Intelligences theory is constrained by certain conditions. However, the emergence of new technologies liberates educators from rudimentary, repetitive tasks, like using ChatGPT. This tool can enabling a more diverse and effective approach to pedagogy.

5 Conclusion

The emergence of AI products highlights constraints in the initial evaluation system. The development of a more accessible means of learning and consolidating knowledge has rendered aptitude for AI, such as creative thinking, emotional intelligence, leadership, etcetera, highly significant, and fostering these capabilities is of critical importance in implementing a more dynamic training approach and enhancing the adaptability of the educational evaluation process. The Double Reduction policy presents an opportunity for transformation and is a significant step in education reform. Advances in new-generation information technology, including cloud computing, artificial intelligence, big data, virtual reality, augmented reality, and 5G, have the potential to enhance the effectiveness of policy implementation. The establishment of a smart learning environment, which includes process recording, precise analysis, intelligent counselling and immersive learning, will comprehensively enhance the integration of information technology and education. This will reduce the burden on all educational participants and increase efficiency. Artificial intelligence technology presents a two-fold scenario, and one must not overlook the possible hazards whilst utilizing such innovative advancements prudently. No changes needed as the text lacks context and already adheres to the principles.

Therefore, there are feasibility and problems in the expansion of the scale of case disclosure and collection in the field of education, information and data security, horizontal and vertical data comparison and even cross regional and national comparison. With the further evolution and development of machine learning and big data analysis, it will certainly be more applied and developed in the field of education in the future. We can expect it to play a greater role in the field of education and promote the further development of education.[8]

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