Role of Dimensionality Reduction for Optimization in Education Field: Application of COOT Algorithm

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ABSTRACT

Education has an important role in shaping our lives. Since last few years, especially after COVID-19 pandemic situation teaching learning process is undergoing lot of changes. Education is the systematic acquisition of values, attitudes, skills, and information (either informally through schools or formally through life events); it is a personal developmental process that fosters greater self-confidence, respect, good jobs, and improved life quality, and it promotes social progress, poverty reduction, equality, and more peaceful communities. Education is a way to achieve all of these things on both a personal and social level. Education optimization is a difficult task at all levels or stages, whether preliminary or advanced. In the digital era, learning isn't difficult. However, to acquire quality education is a tough task. From course selection to teaching learning material selection, optimization is critical in education. Multiple characteristics or dimensions must be considered when carrying out these actions. The study focused on the importance of COOT dimensionality reduction algorithm for better selection of education options available.

Keywords: Optimization, Dimensionality Reduction, Quality Education, COOT, Sustainability Development

INTRODUCTION

Education is important aspect in this competitive era. It is a key parameter to get opportunities in the life. Education builds the confidence, improves the understanding about the concept and knowledge. It is responsible to gain the variety of skills for strengthening the future. It facilitates individual, society development. Education sector has been implementing lot of drastic changes after COVID-19 pandemic situation. Classrooms facilitate more personalized and outcome-based learning. At every level or phase, preliminary or advance education optimization of resources is the biggest challenge. (Arora et.al 2022).Acquiring knowledge is not a challenging thing. However, from course selection to teaching learning material selection, optimization plays a vital role in education. For these activities, multiple parameters or dimensions are necessary to take into consideration. Government of India is also including new policies for the improvement of a student.

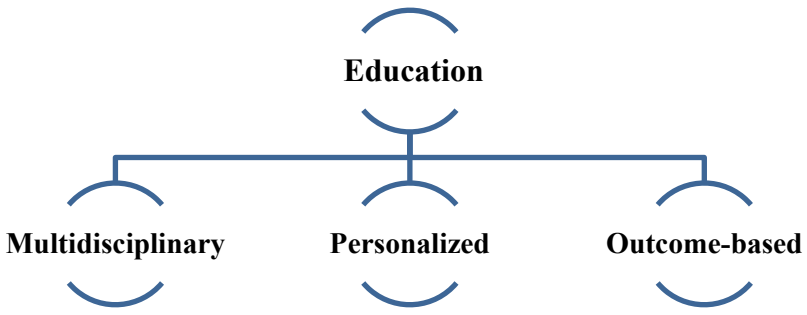

Figure1. Characteristics of modern education

The goal is to modernize the education system. It is fostering multidisciplinary, outcome based, technology based education. Education is essential for sustainable development in the life. It removes poverty and inequality and contributes to a better society. In sustainable development, human beings focus on growth by utilising natural resources. There is balance of environment, economic and social aspects in sustainable development. Selection of appropriate skills and resources responsible for quality education is difficult task. Machine learning, technology making machines more and more intelligent with the help of variety of algorithms. It provides assistance for deciding dimensions for optimization of features resulting into sustainable development of a learner. For deciding variety of parameters, this study applies the steps of COOT algorithm to improve skills and knowledge.

Objectives

- To understand the need of quality education
- To know the importance of dimensionality reduction in education sector
- To apply COOT algorithm for providing recommendations for learning resources

What is quality education?

Quality education is the bridge for sustainable and empowered future. It represents an educational journey that successfully fosters and enhances the overall growth of students. It entails meaningful learning, relevant information, effective teaching methodologies, evaluation in line with e ducational goals, and the development of critical thinking, problem-solving, and lifelong learning skills.

Figure 2. Parameters of Quality Education

Numerous essential elements play a vital role in delivering quality education. Initially, qualified and dedicated educators are essential.Welltrained, enthusiastic educators equiped with cuttin gedge teaching techniques can have a significant impact in the classroom.They motivate and involve pupils, res ulting in an enjoyable and impactful learning experience.Furthermore, the curriculum must offer relevant and c urrent information, concentrating on the skills and knowledge needed in a rapidly changing environment.This in cludes a strong foundation in literacy and numeracy, as well as proficiency in science, technology, and global a wareness.

Need of optimization in Education

Optimization is improving a system, product, or process to reach maximum effectiveness, efficiency, or perfect ion by selecting the optimal solution or result from among available possibilities.(Patel et al, 2021; Rahman et al, 2020).This process often uses a mathematical or computational method to methodically modify an objective function (such as lowering costs or improving performance) by changing input variables to determine the opti mal value while adhering to particular constraints or limitations. In this competitive era, multiple factors are responsible to decide best suitable

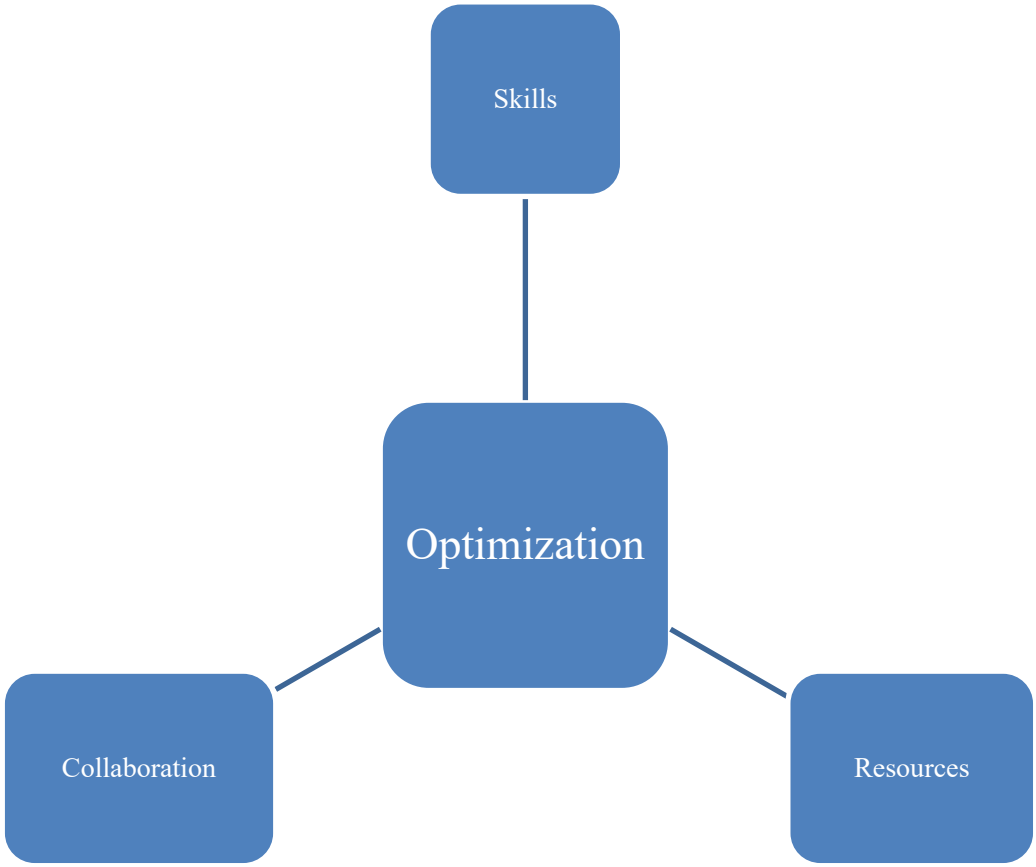

Figure 3. Optimization in Education

option in education sector. This selection will determine opportunities in the future and provide growth of and individual and society.

Role played by dimensionality reduction for quality improvement in education

Selection of relevant features or attributes, will determine single or combination of resources for better outcomes in education.

Dimensionality reduction improves educational data analysis by reducing complex datasets, increasing the effe ctiveness and efficiency of machine learning models, leading in better insights and projections on topics such a s student performance and learning platform effectiveness.(Xu et al., 2019; Li et al., 2020).

It accomplishes this by removing unneeded or duplicate information, improving algorithm precision, reducing training time, and simplifying high-dimensional data for display and comprehension. Feature selection and feature extraction are two distinct, but related, dimensionality reduction techniques used in machine learning to improve model performance. In feature extraction, new, transformed features are created, whereas feature selection retains a subset of the original features. Since chosen features directly correspond to the original input

variables, they are typically easier to understand than extracted features. Feature extraction involves a transformation process , feature selection does not.

Application of COOT Algorithm for Optimization

The COOT algorithm is a metaheuristic that facilitates dimensionality reduction by adjusting its optimization procedure to recognize and choose the most relevant features from a dataset with high dimensions. (Mirjalili et.al, 2020; Singh,et.al 2023). COOT algorithm works based on Swarm leadership concept. It focuses multidimensional, collaborative and agile approach to provide best suitable solution for the problem.

COOT algorithm has following characteristics:

- **Swarm leadership:** The algorithm directs the swarm by using a leading group of birds.

  In educational context, Leading groups or clusters will guide for a learner.

- **Chain movement:**
  Following the birds in front of them, the coots at the back of the swarm go in a chain. A learner will understand the dependent dimensions and continue the selection.

- **Metaheuristic nature:**
  It is a technique for solving problems that can be used to determine the answers to a wide range of opti mization issues.

Applications of COOT algorithm in education sector:

There are variety of applications mentioned below for which multiple factors are responsible to provide optimized solutions.

- Learning resource recommendation
- Course recommendation
- Timetabling
- Student performance prediction
- Curriculum design

A learner will obtain required guidance in a timely manner regarding resources, courses, curriculum etc.

COOT optimizer for learning resource recommendation

A student's profile can be defined in three dimensions: speed, style, and performance.Speed correlates to the st udent's ability to comprehend new concepts rapidly; style reveals their preferred learning approach (e.g., visual , textual, or problemsolving); and performance represents their consistency in obtaining results across exams.

Together, these characteristics form an outline for understanding how an individual learns best.Next, instructio nal resources are classified according to their difficulty level, presentation style, and relevance to the student's program.For example, a textbook chapter may be challenging and textual in nature, whereas an interactivesimu lation may be somewhat difficult and highly visual.

Relevance guarantees that only resources related to the student's academic goals are reviewed.To assess the ma tch between student and resource, a fitness function is used.This function calculates compatibility by comparin

g student attributes to resource attributes.A greater fitness score suggests a closer alignment example, a quick l earner with a visual style may perform better with animated lessons than with long text.

Finally, a COOT-like optimizer is used to find the optimum possible resource combination.
The optimizer uses cooperative hunting tactics to iteratively test resource allocations, share knowledge across p ossibilities, and converge on the resource that maximizes the fitness score.

This guarantees that the student receives the most effective learning material based on their individual profile.

Based on above description, each coot recommends next learning path with the help of available resources by following leaders which results into personalized recommendations.

CONCLUSION

The main goal of the study is to apply dimensionality reduction concept to education sector. In education field, there are lot of challenges for various activities. For acquiring quality education variety of new approaches, policies will be implemented with the help of technology-based leaning. Machine learning assists at various education levels to automate personalized learning, evaluation, recommendations etc. COOT optimizer is suitable option for providing best dimensions for different educational activities.

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