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# DATA MINING BASED CLOUD COMPUTING IN EDUCATION

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## Abstract

Distributed computing based architectures such as cloud computing had brought wide possibilities and scopes for the information processing practices, developments and transformational shifts in the standards of technology based learning system especially in e-learning and technology enabled teaching-learning environment. Distributed computing architecture cloud computing significantly influences the academic culture, educational and learning paradigms, empowering their very own stakeholders i.e. students, educators, and administrators, to play out their roles viably with less cost by using the accessible cloud-based applications and services offered by the cloud service organizations. Cloud computing platforms offers scalable system to the educational data mining to the evolving need of the contemporary educational models adopted by the institutions for catering their academic purposes. This article discusses about the utilization of data mining based cloud computing applications and services in the educational and learning fields, and more specifically stressing on its potential advantages for all the stakeholders of the educational and learning system. This paper tests whether the data mining based cloud computing applications and services could be utilized to upgrade or alleviate the educational and learning for example it centers on the advantages of data mining based cloud computing for education system.

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**Keywords:** Data Mining, Cloud Computing, Distributed Computing, E-Learning, Learning System, Application, and Services

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## Introduction

Electronic learning system is also known as E-learning basically incorporates all the possible electronic communication mechanism and virtual learning resources such as digital libraries, website, digital learning material repositories, forums, etc interconnected through the channel of web based services. Application of e-learning platforms and applications had observed significant growth in all the possible education processes accepted by the academic institutions and other stakeholders of the learning system. E-learning as a ubiquitous learning system can be approached through the wireless channel, mobile devices (smart-phones especially), and also through the context technologies to the educators, learners and provides supplementary flawless qualitative support to all its stakeholders beyond the formal teaching- learning processes (Sharma P., 2014). So, in order to assist teaching-learning practices and contemporary academic methodologies, just as an assortment of heterogenic learning resources within courses, pervasive learning situations should be founded on an amazing IT infrastructure. Concurrently, in order to be productive, teaching-learning systems should be

based on electronically enabled learning management systems and incorporated with the current e-learning conditions and environment of educational institutions (Despotovic-Zratic et al., 2013).

As the teaching-learning in the education system has witnessed revolutionary change and expansion centering the learner as the major stakeholder of the system in order to improve their learning experience and to offer them the most advance set of knowledge available throughout the globe on the fingertips. Such learning practices in totality is called as innovate learning, and teaching tools. Turning from the physical class room to virtual class rooms for the learning and knowledge building cloud computing frameworks are being used as the virtual resources with the high scaling and sharing capacities for the diversified users. The growing need of the cloud services and information repositories especially in the e-learning environment and other educational system is resulting into voluminous amount of the data, and digging out the most appropriate meaningful information with corrective decisions from the available datasets. It can be improved through the integration of educational data mining tools and practices. As mentioned by the several researchers while studying the cloud in education system it was clearly stated that cloud computing forms through several public, private clouds as well as the “cloud as a service” (Almajalid, n.d.) is scaling according to the need of the system and in such situation when higher interaction of the users with the cloud services and application, and rapidly expanding repositories application of data mining can be resourceful for all the stakeholders of the e-learning environment (Srivastava et al. (n.d.)). Incorporating the cloud computing and data mining applications and services in the electronic learning environment and physical teaching-learning environment leads into:

1. Incorporation of cloud and data mining in the information technology strategies of the learning system increases overall capacities of educators and learners through offering them high interactive form of teaching-learning experience.

2. Helps into the development of usage of traditional mode of data and assemblage primarily produced through the forms, teaching-learning statistics etc. Cloud and data mining offer several advanced data analytical capacities like aggregation, comparison, analysis etc which is useful in generating meaningful outputs.
3. In concocting and creating scholastic educational experiences and studying the educational program according to individual learners or the stakeholders' capacity, learning approach, inclination, and overall performance.
4. Integrated use of cloud and data mining applications and services may lead into predicting the academic future by helping to identify the strength and weak points of the individual participants.
5. Fusion of the cloud and mining practices offers reasonable, expository and powerfully driven real time teaching-learning system for better exchange of skills and knowledge.
6. Helps in maintaining requisite level of security on minimal infrastructural investment, and also helps to get balanced provisions for academic tools and research practices between the cloud and on premise services.

Incorporation of above mentioned advantages of integrated framework of cloud computing and data mining in electronically enabled learning and conventional teaching-learning environment is helpful to offer the best knowledge driven practices to education system and can help all the stakeholders through technologically rich learner centric environment. The integrated and technically rich such educational system can offer educator or learner tailored teaching-learning means, through modeling of individual's objectives, mind-sets and knowledge. Applications of the data mining based cloud computing for all of its stakeholders are different, such as:

- **For Students:** This technical integration in the learning system helps students to explore wider educational activities, learning resources, and practical activities and tasks which improves their practical as well as theoretical knowledge base, based on their mind-sets and fondness.
- **For Educators:** Such enriched teaching practices can help the educators to have confined feedback from the learners about the course content and structure, its effectiveness and usability for them, and efficacy of study material and practical content according to the course, and many more. It is also helpful to identify the students on the basis of their needs and to discover the information relating the revision and customization of the course content and structure etc.
- **For Institutions:** It is cost effective as helps to minimal the resources, helps to improve the teaching quality and pedagogies, tools and techniques in the institutions according to the global standard. It helps in offering the computer integrated interactive learning methods. Identifying the future needs and customization of the courses according to the global requirements and also helps to generate employable students for the future and current openings.

### Objectives of The Paper

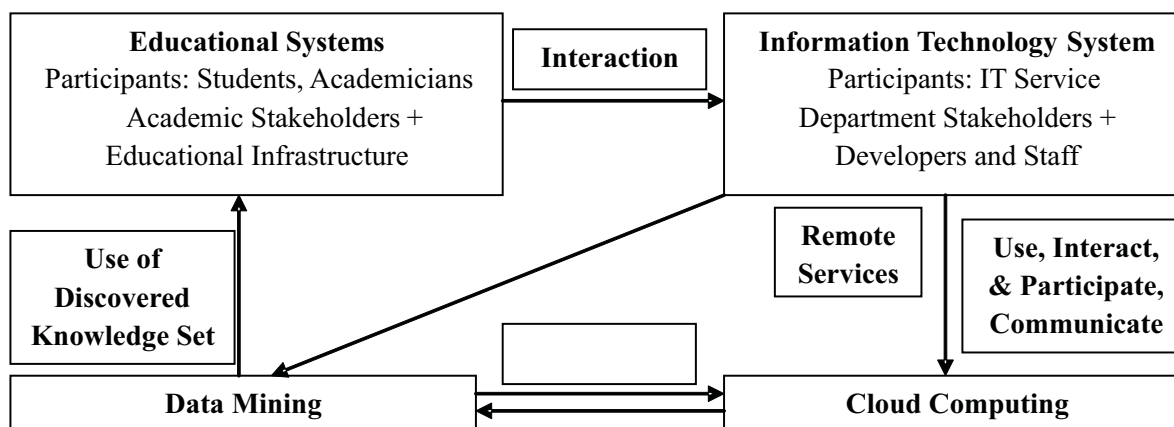
Use of data mining techniques with the cloud based technologies helps the institutions in reducing the overall infrastructure and data storage cost, improving the academic excellence of both the educators and students, and also offers several potential advantages of contemporary learning system to all its stakeholders. As data mining is helpful in producing the meaningful information and cloud allows performing information retrieval and data analysis work from

any location, so in such case integration of both is beneficial for the education system. This paper presents the primary concepts of data mining and cloud integration in education system.

### Educational Data Mining Based Cloud Computing

Educational Data Mining based cloud computing allows exploring advanced and more complex set of knowledge and learning sets to all the stakeholders of the education system especially in the new research based educational fields. The wide spectrum growth observed from primary education to higher education, data mining with cloud computing tools can help to predict student's performance and future career stream can be done in quite right manner. It also helps in future estimations, characterization, affiliations and groupings likewise be possible with flawlessness utilizing statistical and programming tools. The Education framework can be outfitted with more data identifying with future drop out of students and their achievement in selected courses. Students as well as other stakeholders of the education system could be profited by the application of data mining based cloud computing tools and services. These days' intelligent learning strategies and tools have opened a chance to gather and investigate students' related academic information. In the teaching-learning field, data mining methods can create helpful examples that can be utilized both by instructors and students. Not exclusively EDM based cloud computing and services may help instructors to improve the instructional materials and to build up a choice procedure that will alter the learning condition or teaching approach, however it might likewise give suggestions to students to improve their learning and to make singular learning situations. Figure 1 below depicts the integrated data mining with cloud computing for educational system.

Figure 1: Integrated Model of Data Mining with Cloud Computing for Educational System



Source: Author Presentation

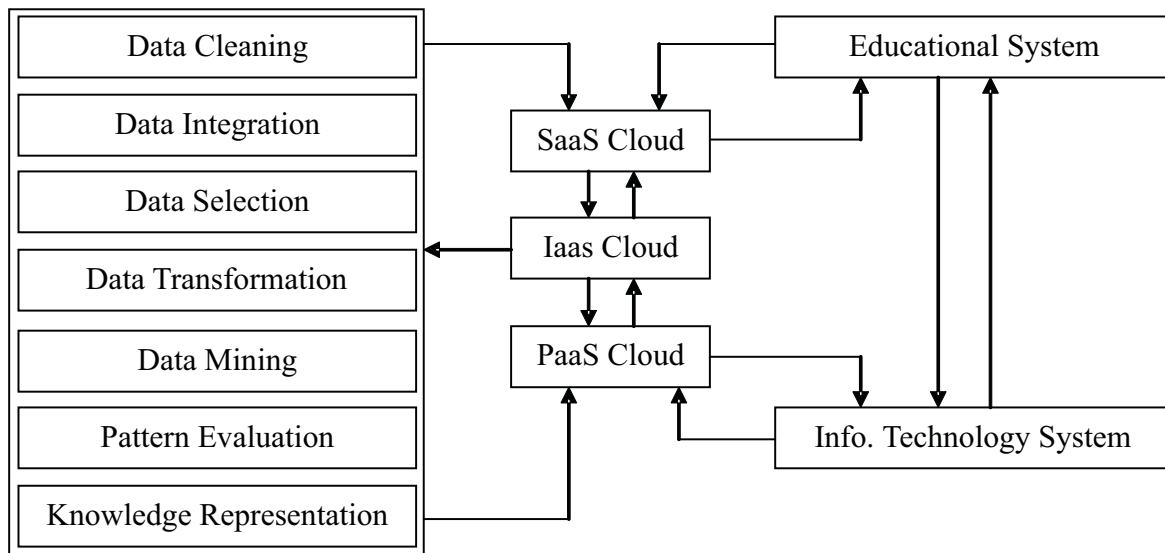
The integrated model of the data mining with cloud computing tools and services comprises of few iterative processes that present the raw data into meaningful and new knowledge sets for the education system stakeholders. The steps are as follows:

1. **Cloud based Data Cleaning** : To reduce the irrelevancy and noise of the data.
2. **Cloud based Data Integration** : Aggregation of data or information of homogenous and heterogeneous sources.
3. **Cloud based Data Selection** : Filtering and retrieving the relevant data sets from the data collection.
4. **Cloud based Data Transformation** : It is also known as data consolidation, in this step all the relevant and filtered data set is transformed into the required and appropriate forms.
5. **Cloud based Data Mining** : Identifies the useful or potentially useful patterns and trends of the information or data sets.
6. **Cloud based Pattern Evaluation** : Most interesting and useful pattern is used for the data measurement and knowledge representation.
7. **Cloud based Knowledge Representation** : Information is presented to the users in a graphically rich and interpretable form. It makes data more understandable for users.

Figure 2 below presents the data mining knowledge processing steps integration with cloud computing and educational system. Integration of cloud based tools and services with the data mining steps lead into more user oriented and advanced knowledge driven data generation techniques accepted and used at global level.



Figure 2: Data Mining Knowledge Processing Steps Integration with Cloud Computing and Educational System



Source: Author Presentation

## Review of Related Work

Thilagaraj et al. (2017) recorded that the advancement of educational information mining procedures makes tremendous development in the field of teaching-learning and training. The most encouraging tools and procedures in educational information mining for future would be helpful for the scholastic accomplishment of student is the significant issue for the administration. So, the early forecast to improve the student performance through advising and additional instructing will assist the institute management with taking opportune activity to regulate the level of performance showed by the students. The characterization and clustering tasks are utilized to foresee increasingly precise outcomes for improve the degree of progress pace of the students in technical and higher education. To build up a supportive network and help the specialists for timely action activities on weak students these educational data mining procedures can be used.

Dhote et al. (2016) for the integration of cloud and data mining showed their concern about the security of information. They concluded that

cloud computing services offers several advantages to associations and people but there are likewise protection and security concerns while using them. On the off chance that if you are thinking about a cloud service application you should consider how your own data, and that of your clients, can best be secured. In reality cloud computing and data mining should be deployed for the development and learning with greater security for information to reduce the possibilities of information loss.

Padmapriya et al. (2015) while studying the mining techniques and algorithms for the educational data identified that data mining have greater impact on the overall academic performance of the students and also enrich their academic experience. It was also claimed in the research that higher academic satisfaction and performance of the students may positively influence the educational communication and success of the educational institutions. Data mining is a set of significant meaningful data preparation techniques which can be helpful in educational monitoring, and evaluation and integrating the cloud based services may add several advantages to it.

He and Wu (2013) inspected students' support and learning conduct by utilizing LVS (Live Video Streaming) of data mining and content mining methods. They found that students use text messages to convey positive feelings, negative feelings, and articulations of social help, and there is no positive relationship between's the number of text messages and grades scored. Maqsood (2013) stated that data mining can be utilized to report and investigate the information that help in getting ready advertising techniques for focused students.

Kardan et al. (2013) in their study stated that in cloud based data mining can be useful for developing the model to determine the effect of several variables such as students' personal traits, workload, grades and type of courses, tenure of course, type of examination pattern and students' demand on their selection of the particular course. Such services can lead into higher level of student satisfaction for the particular course. Srivastava et al. (n.d.) stated that the use of data mining and other advanced technical practices by the institutions for their stakeholders lead into higher level of satisfaction, and prescriptive nature of data mining and cloud services also allow to find the suitable action for the particular teaching-learning problem or issue. Accurate profiling and predictions increases the quality of education by improved teaching-learning experience of students' fraternity.

Samira et al. (2012) discussed about the interaction between the data mining and higher education, and legal implications such interaction over data. It was mentioned by them that few researches have focused on the applications of data mining and other advanced information technology tools to improve education system data in holistic way for all of its stakeholders. The study recommended that educators can deploy the practices and tools of data mining and cloud computing to find innovative way to help improving and teaching as well as develop assessment procedures.

Benefits and Guideline for Integrated Data Mining Based Cloud Computing in Education:

With the high rate of data volume generating activities approximate in all areas of education system especially in research and project works,

learner look for the right and precise information related to their educational need. So, it is required to categorize, systematize, the data resources to produce the excellent results for the search performed with the relevant data through the application of cloud computing services coupled with technically rich and scientifically proven data mining procedures to make certain that the information offered encapsulates the exact and required teaching and research resources. Following benefits and characterizations are offered by the integrated framework in the education system:

1. **Integrated learning and assistance** between the institutions through sharing of technological infrastructure.
2. Adoption of advanced technologies such as data mining and cloud helps in **keeping pace with continuously evolving need of energy and resources**.
3. **Resource distribution also allows sharing the projects and workloads** which are bulky and massive in nature for the expert assistance.
4. **Extended reach** is helpful for students and educators to get new ideas of learning and teaching and also allows being the part of global force by learning new and advanced technologies in education.
5. Institutes can manage their information and learning resources in online mode without worried about the **data management and security of the data**.
6. Data mining and cloud tools and services confirms **secure and reliable communication and data sharing links** for sharing and publishing of all kind of academic information.
7. **Limitations can be bridged:** Limitations such as lack of infrastructure, teaching resources, geographical distance, adequate infrastructure, lack of technological tools and services, exploration of right information, reliable source of learning materials and many more can be bridged through the integration of data mining and cloud.

8. **Easy and convenient maintenance and upgrades** with advanced information pools and resources with any time any day availability.
9. **Good and accurate accessibility** of service and data through integrated mining and cloud framework.
10. **More easy and user friendly data management** allows to create the customized learning modules and environments for the stakeholders of the education system.
11. **Omnipresence of learning resources.**
12. **Scalable and portable** learning platform capacities lead into location independent learning environment such as mobile learning apps.
13. **Content Growth and Up-scaling** as the information is just a few clicks away.

So, in totality integration of data mining and cloud based framework in educational system is shifting the traditional teaching modules into e-learning modules with secure, flexible, scalable, integrated connectivity with diversified online resources, and libraries of universities and research labs to all its stakeholders and driving the new age of teaching-learning. As data mining and cloud services integrated deals with a large volume of data so it is recommended that data should be handled properly and privacy laws should be critically handled by the service providers. Some of the most common challenges which influences the adoption cloud and data mining are:

1. **Security and Privacy issues** : Cloud and data mining algorithms present the information to its stakeholders from various sources and in such case maintaining the security and privacy of the data for each party sharing the information is critical.
2. **Potential Benefits** : Yet the potential benefits are not revealed by the institutions especially in the fields of research collaboration and project expertise sharing. So, several such benefits is yet to be explored by the institutions and it result into lack of understanding the role of cloud and data

mining in academic excellence and performance of the institutions.

3. **Lack of Appropriate Service Quality** : Quality of the learning contents and materials depends of the sharing resources and in such case service providers hesitate to guarantying the performance, availability and scalability which influence the institutions to adopt it.
4. **Lack of Network Bandwidth** : High and quality bandwidth network is required for the cross platform integration and adoption of cloud based services and data mining application, and improper network resources may affect the performance of the integrated framework.
5. **Integration of Legacy or Complex applications** : Integrating legacy applications with the advanced technology premise as well as cloud and data mining applications is quite complex. So, seamless integration framework is required for different-different institutional platforms.

So, to ensure the successful and seamless integration, performance competence, consideration of security and privacy, following critical steps while integration of cloud and data mining should be followed for successful establishment in the educational institutions:

1. **Identification of SaaS schedule** : Plan of institutions' technological advancement arena and infrastructure.
2. **Deployment of Ongoing Resources** : Identify the integration of ongoing resources and their usages with the application support.
3. **Automation and Infrastructure Provisioning** : Identifying several possibilities of the cost reduction and speeding the automation of the institutional infrastructure according to most advanced cloud and data mining services.
4. **System Integration and Performance Monitoring** : Measurement of the system performance with real time application of cloud and data mining tools and services for the institution.



5. **Security Priorities and Schemes** : Well defined security proprieties and strategies for data privacy and confidentiality should be integrated before the implementation and launch of the cloud and data mining tools and application in the institution.

So, any educational institution that looks to get cloud and data mining services should have a determination criteria list, which they will provide for cloud and data mining service suppliers and should also have their feedback.

## Conclusion

The information technology advancement and web interface development throughout the globe is generally kept up and upgraded to keep pace with the global educational evolution, and to match the global educational quality and level. Cloud computing and data mining is an energizing advancement in today's educational framework. It offers students and other stakeholders of the educational system a road to get to various applications and resources through web pages and links effectively, at negligible cost and on finger tips. Several institutions have taken the advantages of diminished operational costs, better effectiveness and usefulness because of the slow expulsion of cost brought over licenses, maintenances, equipment and software services. The adaptable part of cloud computing and data mining alleviates IT staff of support costs and obligations, in this way taking out high operational expenses and debacle recuperation dangers and its expenses.

Cloud computing and Data mining makes a widespread stage with rearranged versatility. Subsequently it will be crucial for academic institutions and people to move to the cloud, to encounter the modest and advantageous road to data and technological services, particularly the advantages and capacities, for example, access to complex applications, insignificant expenses of cloud information stockpiling, adaptability and adaptability of an e-learning stage that is cloud computing and data mining empowered. In any case, electronic platform based learning reconciliation in colleges and universities have some few inadequacies that must be considered

before the selection and coordination of the framework.

The above discourse has revealed an insight into the selection procedure of cloud computing and data mining tools and applications into the education with deployment rules. The couple of difficulties that are probably going to be experienced can be settled by new and better approaches and procedures. A proposed hybrid cloud and data mining tool (algorithms) model for educational organizations of learning should be explored diversely with security viewpoints so as to execute it for learning institutions.

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