Chapter 11
Using Big Data to Improve the Educational Infrastructure and Learning Paradigm

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ABSTRACT

In higher education, the demand for improved information in relation to educational and learning outcomes is greater than ever before. Leveraging technology, new models of education have emerged that are not only improving modes of lecture delivery and information retention, but also generating huge amounts of data. This data is potentially a gold mine that needs to be explored to uncover patterns associated with student behavior and how information is processed, retained and used by the students. This chapter proposes a generic model that uses the techniques of educational data mining to explore and analyze Big Data being generated by the education sector. This chapter also examines the various questions that can be answered using educational data mining methods and how the discovered patterns can be used to enrich the learning experience of a student as well as help teachers make pedagogical decisions.

INTRODUCTION

Big Data has been used in fields ranging from business, consumer marketing and banking to fraud detection, social network analysis, health care and climate science. Today, there is one other field generating huge volumes of data (Baker & Inventado, 2014b). The introduction of advanced modern day technology in classrooms is reshaping the modes of learning and the sector of education is generating massive amounts of data using varied sources including, surveys, assessments, feedback, online software and metric based learning tools (Siemens & Baker, 2012).

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The emerging Big Data from the education industry has the potential to produce equally striking results as the other fields benefitting from the methodologies used in Big Data. It is also the key to reshaping the educational and learning paradigm. There is an ever growing need for a generic model that incorporates the various forms of data being generated by educational institutes and in turn generates intelligence that can be used by these institutes to enhance learning and teaching infrastructures.

This chapter begins by reviewing evolution in the modes of education in the past decade and new formats of education being endorsed in educational institutes. A further analysis on the introduction of technology in the sector of education, the addition of advanced metrics and analytics to the learning systems and the kinds of data that are being gathered using these metrics has also been provided.

The main focus of this chapter is the exploration of patterns and features associated with student learning that are emerging from Big Data being produced by the education sector (Baker & Inventado, 2014b; Romero & Ventura, 2007). The approaches of Educational Data Mining (EDM) including prediction, regression, classification, latent knowledge estimation, causal mining, associative rule mining and network analysis have been discussed to provide an overview of how big data in education can be mined for intelligence that can help discover how learning takes place, predict learning patterns and understand student behavior.

BACKGROUND

Education shapes nations; for many years the traditional method of educating students has been by providing them instructions. These instructions have been delivered to a vast number of students in a classroom. The focus of the education system has always been on the teacher; who has almost always used lecture delivery as the focal method of conveying these instructions (Mazur, 2009; Romero, & Ventura, 2007). The teachers or instructors would keep themselves updated in their disciplines through seminars, workshops, trainings and other professional and academic development programs.

Learning has always been the sole responsibility or the burden of the student, and its measurement has not been given a high priority. This has been the archaic model of transferring information from the teacher to the student since centuries and in many parts of the world this traditional mode of education has changed very little over the course of time. In its true spirit this mode of learning may be referred to as teacher centric.

The authors John Tagg and Robert Barr in their article, “From Teaching to Learning: A New Paradigm for Undergraduate Education.”, emphasize that the archaic model of education has imprisoned our faculty and scholars. The faculty follows the guidelines of the system instead of having the freedom to create a system that promotes learning. Grading systems perfectly disregard the academic potential of individual students (Barr & Tagg, 1995). The courses are designed keeping an average student in mind without efforts been taken to enhance the abilities of the below average students or help the outstanding students reach their full potential. Educational institutes today focus more on picking talent instead of devising mechanisms to develop talent.

According to Bransford et al. (1999), feedback loops are fundamental to learning. A student attempts to solve a task given by a teacher and seeing this attempt the teacher uncovers how well the student has grasped the concepts delivered in class. The teacher not only discovers what the student has understood, but more importantly, what the student has not. This understanding helps the teacher revise or modify