Journal of Theoretical and Applied Information Technology
31st March 2022. Vol.100. No 6

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

THE CONTRIBUTION OF DATA MINING TO THE EDUCATION SECTOR

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ABSTRACT

Data mining refers to the process of analyzing massive volumes of data and big data from different angles in order to identify relationships between data and transform them into actionable information. The Revolution through the digitization of the economy and the circulation of various data, in volumes never before reached and in record time, is probably fundamentally shaking up the functioning of our organizations. Organizations are thus faced with a gigantic wave of data both endogenous and exogenous to their own environment. Artificial intelligence represents, for its part, the impacting part for employment of this new industrial revolution, promising the conversion of a new category of tasks, previously performed by humans, towards a new type of robotization even more elaborate than that of previous industrial revolutions, in volumes that no one can still fully appreciate today. In the interest of having a much broader and clearer vision on Data Mining and its impact on education, it is necessary to draw up a judicious plan for the realization of the project by answering the following problem: How Big Data can influence the education sector?

Keywords: *Data Mining, Performance, Intelligent System, Education.*

1 INTRODUCTION

Data Mining is, as the name suggests, the exponential amount of data we face. This digital data is often a gold mine for analysts trying to make sense of it. The issue of data, its storage, proliferation and use by those who collect it has become one of the major concerns of the decade. There is no shortage of examples of scandals and controversies surrounding data. However, beyond the fear and interest it can arouse, big data can be extremely useful in facilitating the daily performance of certain tasks. At the same time, the development of information systems and the possibilities offered by Big Data are opening up new perspectives for education departments in managing their performance: observation, modeling, monitoring. In the case of education, organizations have huge amounts of data relating to people (skills, performance, age, seniority, safety record, performance of student qualifications, training, past roles, etc.). The objective is to know how to analyze them, exploit them in order to make the best decisions.

At this level we must start with the importance of the decision which can be defined as a process leading to a choice among many. The choice can be good or bad, it follows that the decision too. Moreover, the importance of decision-making for a company is clearly perceptible, especially since if it is carried out badly, its consequences will be negative. So, in the remainder of our chapter on decision-making, we will try to highlight what decision-making is and what it consists of. Our approach will consist first of enumerating the types of decisions, then the decision models, then determining the process that is generally associated with decision-making as well as the tools associated with it.

A decision corresponds to a process of choice concerning the objectives of action and the procedures intended to achieve them and ensuring the regulation of the activity. In common parlance, the term decision refers to the result of a process of choice. In its psychological acceptation, it designates the process itself which leads to this result, that is to say the way in which the final decision is worked out and the mechanisms which presided over this development.

In this sense, we have focused on the basics of research by presenting a brief overview of the concept of Data Mining, Big Data and Machine Learning practice, particularly in the education sector.

2 MATERIALS AND METHODS:

In this study, data collection will revolve around the qualitative approach, questionnaires based on research work already published, literature reviews based on data mining and big data have been analyzed and studied. Secondary information is collected to form an overall framework for the study and identify gaps in previous studies and support findings.

2.1 Principle of operation:

The organization merges with a single, homogeneous, rational actor, aware of himself and his environment, and endowed with stable objectives and / or preferences. The decision is assimilated to the reasoning of a single actor (individual or collective) whose conduct is said to be rational because he seeks to maximize the achievement of his ends, using the means at his disposal. The degree of purity or sophistication of this rationality can be very variable according to the actors and the situations, but it is a mono rationality which excludes any conflict on the objectives and on the way to decide. The decision-making process comes down to a succession of logically linked steps:

- Formulation of the problem;
- Identification and explanation of all possible actions;
- Evaluation of each action by criteria derived from objectives or preferences;

The organization is made up of sub-units; each sub-unit has its own rules and procedures, which condition its perception and guide its behavior. All of these sub-units are headed by a directorate that gives them objectives. The sub-units treat these objectives as constraints, and therefore try to formulate them as according to the known diagrams on which they can apply standard rules and procedures. As a result, the sub-units tend to reduce complex and original situations to simple situations, easily interpretable and close to situations already encountered. The procedures consist of carrying out research until the first satisfactory solution is found, that is to say the one whose level of performance is deemed acceptable by management. This solution is adopted, and the search for other solutions is then stopped. Thus, most of the solutions found have already been used previously to solve other problems and new solutions are only sought when the old solutions are not likely to solve the problem.

2.2 Big data and Data Mining:

Currently the world is witnessing an incredible increase in the volume of data with these various types of structured and unstructured, resulting from networks of sensors and GPS systems, and those generated by users through the sharing of their data. The current problem is that the growth of data exceeds the power of traditional DBMS, because of the volume of data, the diversity of the data, and the processing time which must not exceed the duration acceptable by the user. As such, developers are challenged to develop technologies that can process huge amounts of various data in a short period of time, called Big-Data.

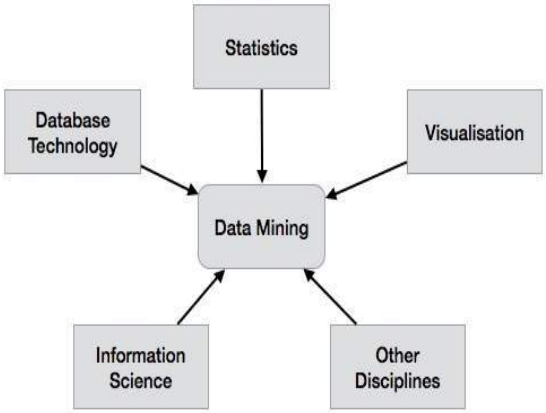

Figure 1 : Data Mining system classification.

In this chapter, we will study the meaning of huge Big Data and its importance, the fields of use notably in education, their tools and some Big Data technologies. Big data, literally big data, is an English expression used to refer to data sets that become so large that they become difficult to work with with traditional database management tools. It is therefore a set of technologies, architecture, tools and procedures allowing an organization very quickly to capture, process and analyze large quantities and heterogeneous and changing content, and to extract information from them. relevant at an affordable cost.

2.3 Big data technologies:

We have cited some technologies that use Big Data:

2.3.1 Hadoop:

Hadoop, a framework developed by the Apache Software Foundation in order to better generalize the use of massively parallel storage and processing of Map Reduce and Google File System. Of course, Hadoop has its limits. Either way, it is a very widely used Big Data solution for performing analyzes on very large amounts of data.

2.3.2 Bases no sql:

Relational databases have a very specific data organization philosophy, including the SQL query language, the principle of transaction integrity (ACID), and the laws of normalization. Although useful for managing qualified company data, they are not at all suitable for very large storage and ultra-fast processing. NoSQL databases allow redundancy to better serve flexibility, fault tolerance, and scalability needs.

2.3.3 Storage "in-memory":

For even faster analyzes, processing directly in memory is a solution. A technology although still too expensive it is true to be generalized.

2.4 Big data management:

Big Data Management or Big Data Management is a new discipline in which data management techniques, tools and platforms including storage, preprocessing, processing and security can be applied.

The role of data management is to ensure a high level of data quality and help businesses cope with the growing amount of data.

2.4.1 Data storage:

To store data on petabytes in a distributed way uses Cloud services, storage consists of three main operations (Clusting, Replication, indexing).

2.4.2 Pretreatment:

Before big data analysis we need to check the quality of the data and repair the data during processing by applying the following steps (data cleaning, transformation, integration, transmission, reduction and discretization).

2.4.3 Treatment:

It is the ability to process a large volume of data regardless of the type or structure and location of this data, this processing can be classification or prediction.

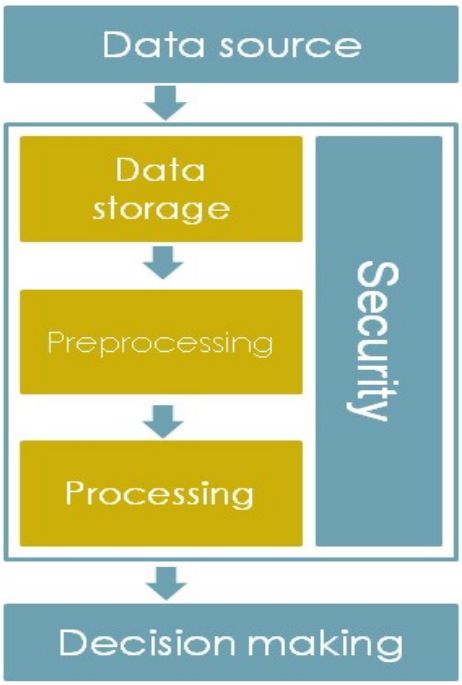

Figure 1 : The Big Data management Process

However, with the advent of Big Data, the challenge for data warehouses is to think about a complementary approach with Big Data, one could design a hybrid model. In this model the remains of highly structured operational optimized data will be stored and analyzed in the data warehouse, while data that is highly distributed and unstructured will be controlled by Big Data (Hadoop or NoSQL).

We can therefore interface Big Data with the DataWarehouse (DW), indeed unstructured data from different sources can be grouped together in an HDFS before being transformed and loaded using specific tools in the DataWarehouse and traditional tools of BI.

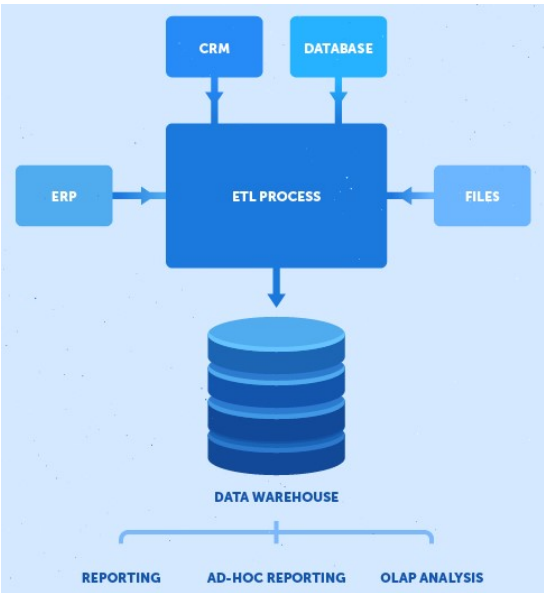

Figure 2 : Data Mining and DataWarehouse links.

3 THE DATA MINING IN THE SERVICE OF EDUCATION

DATA Mining is a phenomenon that today permeates many fields: marketing, biology, justice, etc. sources and degree of structuring, real-time updating of data… This definition may seem restrictive, but other more recent and more encompassing definitions make it possible to identify some devices introducing Big Data in education. By mobilizing the concepts of devices and practices in the education sector, we seek to qualify the objectives of modifying practices in the education sector driven by Big Data devices.

3.1 Big data in education:

Big Data has become a major part of the business portfolio of many solution providers, to the point where it has supplanted the analytics of improving education at some, which can sometimes create confusion among professors and students, who confuse them. However, there are important differences between the two approaches. Big Data in Education mainly uses unstructured data, most often external to society ... It is clear that professionals place greater confidence in Big Data, in response to certain areas of education. These results can also be compared to the objectives of the projects studied above.

3.2 Data Mining strategy in education:

First, like Lavelle et al. As stated, "It is extremely difficult for people to move from making decisions based on personal experience to one based on data, especially when the data conflicts with prevailing common wisdom." There is therefore a kind of paradox that will be created when setting up a project in which a significant part of the actions will potentially be carried out from reworked data or aggregation of data.

Nevertheless, Lavelle et al. also note in their study that "overturning the status quo is much easier when everyone can see how it could contribute to a major goal." Support for the project and the possibility of providing significant added value are therefore important in the context of value creation. This point takes up a prerequisite taken up by numerous articles, in particular Falletta and more recently DalleMulle and Davenport, in the form of the data strategy.

DalleMulle and Davenport develop the fact that this data strategy revolves around a "carefully considered compromise between defensive and offensive uses of data". They then qualify the data strategy by taking into account the current data universe, whether it is positively experienced through technological progress (eg data visualization and interactive dashboards) or negatively perceived with, for example, computer hacking or in a more global way the cyber risk.

It is all the same important to integrate the notion of stakeholders into this data strategy reflection. Thus, Falletta recalls that it is "vital to determine the needs of the stakeholders" and he adds that it is not a question of being only in circles of influence but of truly showing the added value of the data in relation to to the activity of the company. The stakeholders then play an "essential role of legitimacy and credibility" of the approach undertaken and they make it possible "to identify the strategic research to be carried out, to define the necessary data and information as well as the expectations and priorities".

For Heppelmann and Porter, this data strategy is also taking shape through the emergence of new organizational structures in which "we are seeing the emergence of a new functional unit specializing in data management". The data is then no longer specific to a department but is managed transversally within a company. "At the head of the data director - Chief Data Officer - ensures for the entire company the aggregation and analytics of data, assists the various departments and in their own analytics, shares his information and observations with everyone". According to the

authors, "a quarter of large companies have already set up this type of specialized unit".

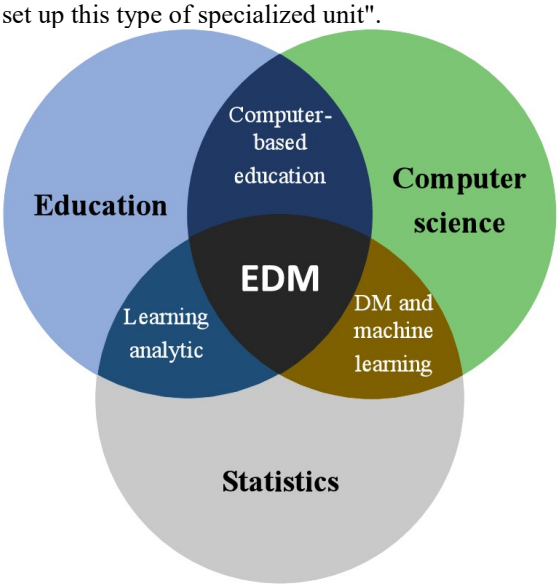

Figure 4 : Data Mining in Education model. (Source : Cristobal Romero & Ventura, (2013))

At the same time, also facilitated by increasingly advanced technologies, data can really become a creator of value by its simple governance and organization through “data lakes”. These data lakes are unique storage locations while being aggregators of raw data in various forms. The data coming from the company but also from the outside (ie its environment whatever it is) are stored to then be transformed in order to serve a set of indicators classified in different forms (description, diagnosis, prediction or even prescription) to be able to form in-depth observations that we can relate to information.

Upstream of any process of transforming data into a valuable element within a company, it is necessary to set a framework mainly defining the stakeholders and the objectives pursued. It is therefore a matter of defining a data strategy attached to the overall strategy.

From a macro point of view, transforming data into a value therefore requires the prior definition of a structured and administered framework, both to optimally orchestrate the data and to set objectives to be achieved. However, to fully understand this transformation mechanism, it is necessary to look much more closely at the elements constituting the data universe.

A data strategy provides a framework and objectives by:

- Taking into account the needs of stakeholders, encouraging their support for the project, and quickly providing evidence of interesting added value;
- Promoting the emergence of new organizational structures and data governance, particularly within "data lakes".

Another very important concept linked to Big Dat that of Artificial Intelligence, Since March 2016 and the triumph of AlphaGo - software developed by Alphabet - against Lee Sedol (star of the game of Go), Artificial Intelligence (AI) is has become the trending topic on everyone's lips. AI has aroused enormous interest among businesses, filmmakers, politicians, and also the general public, since personal assistants developed by Apple (Siri), Microsoft (Cortana) or Alphabet (OK Google) have entered our lives. streams through our phones.

AI stirs up all fantasies but also its share of fears and reluctance. But the first question we must ask ourselves is to define what is behind this term and what is its origin.

The term AI dates back more than sixty years and is associated with John McCarthy who introduced the concept at the Dartmouth conference in 1956. According to him “all intellectual activity can be described with sufficient precision to be simulated by a machine. "In his article" Computing Machinery and Intelligence ", Turing proposes a test called" imitation game ". A human (the judge) must, through questioning, determine if his interlocutor is human or if he is dealing with a machine. This article is considered one of the precursors of AI and asks the question of whether a machine is capable of thinking.

Marvin Minsky is also considered one of the founding fathers of artificial intelligence and in particular of neural networks. For him, AI is “the construction of computer programs that engage in tasks that are, for the moment, performed more satisfactorily by human beings because they require high-level mental processes such as: 'learning perception, the organization of memory and critical reasoning'. This same Marvin Minsky defined artificial intelligence as "the science of doing to machines what man produces a certain intelligence." "

Since these precursors, the discipline has experienced ups and downs, in particular linked to the computing power of machines but also by seeing the ambition to have a strong AI, that is to say capable of thinking, on the decline. and to equal or even exceed human consciousness. But with the evolution of the power of computers which doubles every 18 months (Moore's law) as well as a

lowering of expectations related to AI by focusing on more precise tasks, new advances have been made. been made possible.
The most recent landmark was presented at Google I / O 2018. Google's voice assistant (technology dubbed Duplex) managed to make an appointment with the hairdresser by conversing naturally, without the person on the phone realizing that they were dealing with a robot.

3.3 The transition from data to information in education :

DalleMulle and Davenport provide additional clarification regarding the structuring of data through what they call "the enabling architecture". In fact, in addition to the defensive or offensive approach proposed, they explain that, in the current context of increasingly massive and also increasingly unstructured data, “a number of companies have attempted to develop data architectures. highly centralized and control oriented data and information ”.

These architectures then find "their usefulness in the standardization of data in the company" but the downside is "that they can hinder flexibility, making it more complex to adapt data to the needs of the company or to convert it into information capable of finding its strategic application ”. In other words, the centralization of data offers more control but de facto this leads to fewer possibilities in their interpretations. These notions, control and flexibility, are then included in "the single sources of truth" and "the multiple interpretations of truth".

Unique sources are necessary to constitute a common framework and they are often attached to the IT department to guarantee security but also optimal availability. However, these unique sources are not sufficient to constitute value for the company, the word value being understood here as the achievement of an objective in the service of a company strategy.

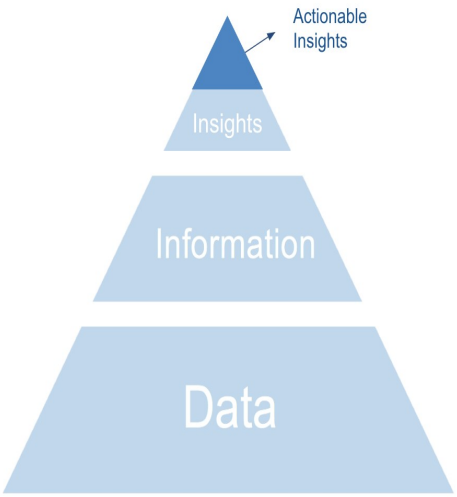

Figure 5 : Transition levels from data to information in education.

The link between the two truths is then a transformation of the data into information since "it is from the single source that the multiple interpretations of the truth are developed. The latter result from the transformation, for specific business needs, of data into information with relevance and purpose. "

Falletta completes this analysis by specifying that "the data is basic and raw and that it consists of indicators and measures giving little or no value or idea". He then qualifies the information as being more "descriptive" with "added value and utility but lacking actionable ideas."

Even though we fully understand this first mechanism of data transformation within a company, the information still needs to be reprocessed to allow ideas to emerge :

- The centralization of data offers more control but leads to less possibility in their interpretations.
- Unique sources are necessary to constitute a common framework but insufficient to constitute value.
- Data needs to be organized and linked together, balancing control and flexibility requirements.

3.4 Datafication or reprocessing of information:

This element adds little to the definitions provided previously and in particular by Power, but what is interesting is the understanding of this notion of Value. Indeed, Lycett specifies that in order to deliver value "you have to take into

consideration what is needed to deliver value and the challenges, as well as the opportunities, that characterize the creation of value". This is when the term "datafication" is explained under three main characteristics aimed at "rethinking the logic of value creation".

Datafication therefore resembles a reprocessing of information, or even an improvement in this reprocessing because, in fine, it pre-existed in a specific context. From an organizational point of view, Sharma, Mithas and Kankanhalli consider that “analysts or managers engage in a process of creation of meaning based on computer science in which they use analysis to understand the phenomena represented by the data. themselves ”. Thus, those involved in this reprocessing use pre-existing repositories to articulate the selected data in order to describe the phenomena and the relationships making it possible to connect them to each other. The information is then constituted and "is then used to give narrative meaning to the world and to build repertoires of actions that make these interpretations explicit."

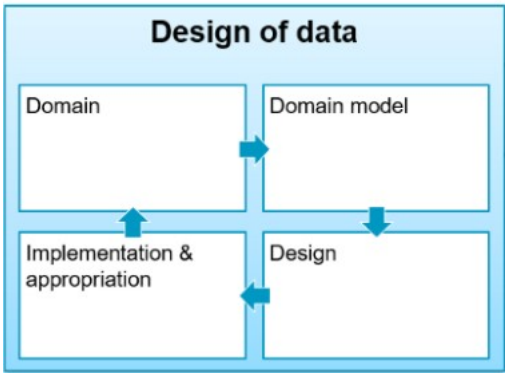

Figure 6 : Design of Data

In addition, Lycett specifies "that from the technological tools of analysis" which we now have, "it is easy to define models, trends or even statistics and correlations". However, "the next crucial step is to understand the causes behind these models to take actions that generate value."

3.5 Turn ideas into decisions:

Sharma, Mithras and Kankanhalli point out "that it is just critical to generate understandable ideas just as it is vital to turn those ideas into decisions that will create value". This notion of data accuracy and comprehension is echoed by Ingham who adds that "those concerned in education must ensure that the measures inform actual decision-making and do not simply result in data considered to be interesting, but not not lead to specific actions ”.

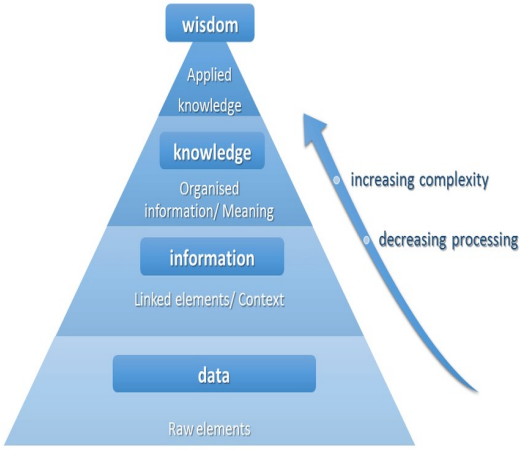

Figure 7 : Pyramid of Knowledge

It is also important to remember that the decision-making process is part of the organizational environment of the company. Indeed, many good ideas can sometimes be rejected by organizations but a few years later they become successes in other companies. Among the best known of these good ideas passed to the competition, we can cite Xerox which did not believe in the breakthrough of personal computers for the benefit of IBM or Kodak which did not take into consideration the arrival of the digital world. . But Sharma, Mithas and Kankanhalli still point out that "notwithstanding the problems associated with deciding about a good decision, good ideas do not necessarily have to lead to a good decision and a bad decision can also be income."

Moreover, as pointed out by Davenport, Barth and Bean, it is also very important to consider time in the process of creating value. Indeed, "given the growing volume and speed of big data, when the organization has the information necessary to make a decision, new data is often available, making the decision obsolete". This idea of planned obsolescence of the decision, due to the increasingly large volumes of data processed in increasingly rapid deadlines, is taken up by Power, which also specifies that these two characteristics of big data "should increase further in the future. the future ".

The articulation of ideas makes it possible to pose options that allow in a particular context the emergence of decisions that it is necessary to consider in a rather short time frame given the speed of development of technologies and the abundance of new data in record deadlines.

This is the AI of science fiction films, that is to say an AI capable of concentrating on several tasks at the same time and capable of acting in full autonomy, that is to say equal human consciousness. The study "When will AI Exceed Human Performance? Evidence from AI Experts ", conducted by a group of researchers at Oxford and Yale universities with AI experts, aimed to determine when machines could, without human assistance, perform tasks better and at less cost than humans. To do this, they used the notion of HLMI (higher intelligence machine that approximates strong AI). For 10% of respondents, this superiority will occur within 20 years and for 50% within the next 122 years. The following infographic traces for some tasks the estimated dates when the machines will have caught up with the humans.

It shows that HAL, the robot from "2001, the Space Odyssey" - directed in 1968 by Stanley Kubrick - who decided by himself to eliminate the astronauts accompanying him for fear that they would compromise the mission, still has a good lead - according to the various researchers surveyed - before the appearance of strong AI.

The hype around AI is nearing its peak, as shown in the 2017 Gartner annual study called "Hype Cycle." This study follows the progress of all new emerging technologies as well as their potential to become part of household habits. According to this study, Deep Learning and Machine Learning are at "Peak of Inflated Expectations" but are only two to five years away from their adoption. General AI is still in the innovation stage and has more than ten years of adoption.

Regarding the control methods used, the in-depth documentary analysis allowed us to understand the importance of Data Mining within the education sector, we can say that the activities adopted by users of this concept in education are the one of the organization's many attempts to adapt and engage in the development of the sector.

3.6 Machine learning in education :

Machine learning is a branch of artificial intelligence. It is also called machine learning, in other words it is about analyzing data, finding classification, "patterns" and being able to make predictions. This is a "probabilistic" statistical approach.

As we have just seen, the value generated by machine learning comes from data as Clive Humby says: “Data is the new oil. It’s valuable, but if unrefined it cannot really be used. It has to be changed into gas, plastic, chemicals, etc., to create a valuable entity that drives profitable activity; so must data be broken down, analyzed for it to have value. ”

Data as such is therefore like crude oil, it must be processed, analyzed for it to gain value. The underlying question is to identify the mechanisms (algorithms) to transform this raw material into a valuable commodity.

Machine learning will make it possible to exploit data from Big Data; indeed, the more important the data, the more relevant the learning will be. Some people agree that a good algorithm trained on a small amount of data will be less efficient than an algorithm of lower quality but trained on a larger volume of data.

And if finally Big Data and its big data could be magnified by the use of machine learning in order to better analyze, use the data, discover new trends, in order to create value but also meet the expectations of business customers and this in increasingly rapid processing times.

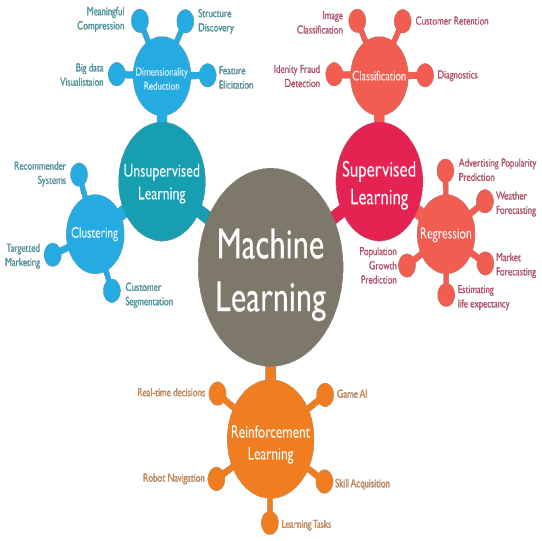

Figure 8 : Machine Learning.

We can say that the quote from Tom Dietterich “The goal of machine learning is to build computer system that can adapt and learnfrom their experience.”

Learning systems are therefore not directly programmed to solve a given problem; they go, relying on defined algorithms and for example examples of the expected result, through numerous iterations in order to try to solve the problem.

4 CONCLUSION

The adoption of data mining in the education sector as a policy must be increasingly adopted by the institutions concerned to achieve sustainability

and meet market requirements, but the model requires corrective measures such as the implementation of fair opportunities through the implementation of the necessary technologies. Our research tends to show that Data Mining is a tremendous opportunity for the education sector to reposition itself on forward-looking strategic roles. Indeed, Big Data offers the possibility of a better understanding of the construction of the performance of human capital, in particular, an optimized and accelerated knowledge of employees and work contexts. Nevertheless, this use of Big Data must necessarily be done within a transparent ethical framework and taking into consideration the General Data Protection Regulations. Finally, from this study, we can also say that this opportunity is real but visionary in view of the important issues of transformation in the education sector that it involves. It is therefore in the proper orchestration of the transformations to be carried out that the education sector will be able to strengthen their contribution to the value chain. The study of real cases and the sharing of practices are, in this regard, an interesting accelerating in education sector.

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