



# Learning Analytics: Enhancing the Quality of Higher Education

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### Abstract

The regular gathering of student information has created a high level of complexity, and also an incredible opportunity for teachers to enhance student learning experience. The digital information that learners leave online about their interests, engagement and their preferences gives significant measures of information that can be mined to customise their learning experience better. The motivation behind this article is to inspect the quickly developing field of Learning Analytics and to study why and how enormous information will benefit teachers, institutes, online course developers and students as a whole. The research will discuss the advancement in Big Data and how is it useful in education, along with an overview of the importance of various stakeholders and the challenges that lie ahead. We also look into the tools and techniques that are put into practice to realize the benefits of Analytics in Education. Our results suggest that this field has the immense scope of development but ethical and privacy issues present a challenge.

### Keywords

Learning experience; Analytics; Big data; Digital transformation

### Introduction

In higher education, the general purpose is to offer programs and experiences, which help learners to think and learn throughout the process. The decision-making carries much importance within this increasingly complex and competitive environment, which makes it a must to make wise and accountable decisions. As a result, the use of learning analytics has gained some attention from institutions of higher education. According to a research report written by Randall Stiles, the decision makers are exploring various aspects of analytics as a new area to help make a better decision. Due to *“increases in the value of higher education to economic competitiveness and upward mobility, sustained increases in the cost of higher education, growing scrutiny and accountability (by accrediting agencies and the government), and the transformative ‘disruptive innovation’ forces of online learning and outcomes-based assessment”* [1]. It has long been highly suggested to being critical as well as analytical while making decisions in higher education, yet there have not been enough practices using relevant tools and techniques of learning analytics.

Learning analytics enables us to record learners’ learning behavior, track learners performances, offer information and analysis

to stakeholders and improve the outcomes of higher education [2]. It helps us to make use of the large data sets by analyzing the data using skilfully designed tools and techniques to utilize our past experiences for gaining visualization of the future. By adopting various types of techniques, learning analytics can help to alert us what matters are going towards the wrong direction; it can help us to create models of processes which can better deliver the results of learning and teaching; and it can help us to get visions of the future [1].

In support, the uses of learning analytics, one study by a group of researchers have found out that, there is a widening performance gap between the businesses that have successfully employed tools and techniques of analytics and those firms that have not yet done it [3]. In brief, with the help of vastly developing technology, learning analytics offers support for decision-makers to come up with intelligent and accountable solutions, which ultimately contributes to the better outcomes of higher education. However, there also can be some disadvantages and challenges coming along with the adoption of learning analytics. Consequently, it is of vital importance for the stakeholders to understand it and be aware of its both positive and negative sides. We are aiming at offering useful information and adequate advice for the better use of learning analytics.

### Literature Review

#### What is Learning Analytics?

With the ever-increasing amount of information available, analytics is being used widely in various fields. In simple language, analytics means discovery or interpretation of meaningful patterns in big data. These discoveries can help people in business to predict market trends, customer preferences, purchasing behavior and other useful information, which can contribute to improving performance, such as effective marketing, improving customer service, and other advantages. This advent of big data and its accompanying analytics also gave rise to a term known as Learning Analytics. Learning Analytics is defined *“as the measurement, collection, analysis, and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs”* [4]. Higher education institutions are operating in an increasingly complex and competitive environment and are under pressure to respond to global political, economic and social change [5]. The decisions required for dealing with these changes are very complex and can get simple with the help of data. Availability of data helps us understand the situation much more clearly and learning analytics makes it easier to draw patterns and make careful decisions.

In higher education, learning gets enriched by interactions of learners with instructors or teachers. Many teachers spend numerous hours to design courses and curriculum to maximise the learning from this interaction [6]. However, there are several challenges to this approach, first being the effectiveness of this method. Does it meet the need of students and how can interaction be further improved? Traditional methods to improve learning involve student evaluation, analysis of grades, attendance and graduation rates. However, the data generates from these methods is limited and takes the time to implement recommendations based on them. With learning analytics, data is being available every minute and in abundance, and its

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evaluation helps generate patterns that are used to predict future events better and make informed decisions aimed at improving outcomes [7]. Faculty uses statistical tools and techniques to analyze student data and identify learning weaknesses student could be intervened with corrective action [8]. The basic idea behind learning analytics is to provide the students with enhanced, personalized learning. Software's record data left behind by students online, which shows how or when they study, giving us a chance to modify their learning practices and improve teaching and learning and the environments in which these take place [9]. Students need to learn and develop skills that will be helpful thought their life. They need critical skills to assess new situations and information, reflective skills to consider and develop their activity, and networking skills to function as competent team members or team leaders [9]. Learning Analytics should help them develop these skills. Increasing number of students in Massive Online Open Courses (MOOCs), where a single subject has more than 30,000 students, enhances the availability of data. These digital breadcrumbs left by the students on online platforms are analyzed to identify the patterns, which helps teachers to identify students at academic risk, predict student behavior, and take corrective action.

Techniques of pattern recognition and predictive analytics are used extensively in businesses, - for example, to generate a recommendation on Amazon or Netflix, or to find prospective dating partners on online dating websites. These can be used in education as well, to help select courses and identify at-risk students [10]. Interest in learning analytics continues to grow as more and more tools, and techniques emerge and our understanding of analytics increases. This paper reviews the literature related to this emerging fields and seeks to define learning analytics, big data as a catalyst to improve higher education, its application in various spheres and the tools and techniques associated with it.

### Advent of big data

The blast of Big Data has changed the way we work whether it is our own lives or the place we work. At the point when Internet appeared, it modified business and government operations, and our lives. It was a piece of the innovative insurgency, which still proceeds, and the approach of enormous information, where a considerable measure of data is broadly accessible and used for new employment opportunities. The idea behind big data is that we can learn from a large body of information things that we could not comprehend when we used only smaller amount [11]. Before 2000, data was stored on paper, films and along with other media, but the expansion of information technology at a massive speed led to the growth of big data getting digitalized. Less than two percent of all stored information is non-digital. The information available today is so massive, that if it were placed in CD's and stacked up, it would form five separate piles, all reaching the moon [11].

Mear availability of data does not mean that processes and operations will automatically become effective. The analytics of big data is another huge industry that helps to put data to incredible new uses. With the onset of affordable technology, such as inexpensive computer memory, processing systems, intelligent software's, and statistical tools, data is being modified continuously to be useful in one way or the other. The information database is expected to grow from 3.2 zettabytes today to 40 zettabytes in only six years. (One zettabyte is roughly a billion terabytes.), and more surprisingly, only a mere 12% of the data available is analyzed by companies [12]. With the help of this data, predictive analytics is booming. The combo of

big data and analytical tools helps analysts to explore new behavioral data, such as websites visited and products searched by the people [13]. Big data is not only about vast amounts of data, but it also brings along the power to process this data in meaningful terms. Big data is used everywhere, ranging from supermarkets, hospitals, shopping malls, cinema, E-commerce and now in education. However, there are limitations to this as well. It cannot explain everything and can be used only as a tool to inform and understand, and sometimes it may lead to misunderstandings [11]. Availability of too much information makes tasks harder for analysts, as they have to segregate significant information from the bulk of information available.

### Importance of learning analytics

The importance of learning analytics is growing due to the positive impact on fields like education. Learning analytics can help companies and learning institution, by collecting data, to save time analyzing the customers and future students. In higher education, learning analytics is gaining more and more importance, due to the new possibilities which are arising in the field of data collection. According to edtech-magazine, institutions can target those students who are most likely to enroll. Further, that will save time and money for the institutions since they target the right type of students and don't need to expand their research to find the right students. Also, the institutions investigate the social network and go through the accounts of future students to increase the scope and find more likely students to enroll. Despite helping the institutions saving time and money, learning analytics a highly affect the student's performance, as well. Edtech magazine mentions that institutions can better analyze, whether a student is at risk, analyze their performance and help the students in need. That decreases the rate of dropouts and increases the number of graduates. According to the Washington Post, the Virginia Common Wealth University introduced the new way of learning analytics, where they leveraged data to zero on students who were at therisk of failure, The exciting result of the first semester was that the University saw a 16% increase in the number of students, who completed courses.

Also, the University of Tennessee discovered, with the help of analytics, that the actual problem their nurse students does not lie in science classes like math or chemistry, but much rather in English courses. With the help of analytics, the University of Tennessee found the root of the most prominent problems of their students and can use that discovery to improve the student's knowledge in those courses and help them to succeed. Those examples shows in what way an Institute of higher education can increase their scope of potential students by doing more efficient research. Further, that saves time for the Institute. Moreover, it especially saves money for the institute, since they do not have to target a broad audience, but just the potential students for their marketing and over due to the cost of time they end up saving that money for their institution as well, which they can then invest in a more professional faculty. Also, learning analytics is having a huge positive impact on the performance of a student in higher education. Through the data collection, institutions keep track of the student's performance and help out the students as they did in the Virginia Common Wealth University.

### Application in education

Today's generation has easily collaborated with the digital technology and is using it widely in higher education. Gone are the days when students came to class with pens and notebooks, now they work more with laptops and tablets. Technology has changed the way students learn, and teachers teach [14]. Sophisticated systems

of learning management are used in schools and colleges to enable smart teaching. Distant learning programs are conducted online with the help of technology, and much information communicated through these mediums. Automated software's reduces administrative work, enhance student life and improve course registrations [14]. Technological innovations promise to have an enormous impact on teaching approaches. A significant amount of data is generated through these online portals and distance education as well as in-class programs. With the development of technology, the collection of data gets bigger and bigger. It is easier to collect data nowadays, and then it was 15 years, which has an enormous impact on learning analytics. Only because technology is such a fast-growing market and potential market, which offers many opportunities, learning analytics gets popular in education. According to [pewinternet.org](http://pewinternet.org), teens share more information than ever before. Due to that reason, it makes it more attractive to the learning institutions to collect data and analyze their students. There are more and more Universities and other learning institutes, who start using analytics to get better off.

One of their ways, as already mentioned above, is by analyzing the potential student, which saves time and money. Additionally, institutions go through the potential friend's accounts on social media, to widen their range of potential students. According to [pewinternet.org](http://pewinternet.org), an average Facebook user has 300 friends on Facebook, which means, that it is a fascinating way to find more potential students. Besides the ways of targeting their new potential students, institutions can use learning analytics to use ways like the Virginia Commonwealth University did, to increase the success rate of students, who were at risk of failure (Washington Post). That use of learning analytics is perfect for the student, who gets help and is more likely to graduate. However, also, the Institute benefits from that, because the success rate goes up, which is good marketing for the Institute. Another way to use learning analytics is also focusing on the students learning the outcome. In this way of analyzing the student, the institute can find out where exactly lies the strength and weaknesses of the students and can change the number of classes accordingly and the way they teach the class as well to guarantee a better understanding of the problematic class for students ([edtechmagazine.com](http://edtechmagazine.com)).

Also, institutions already go beyond the ways of analyzing a student's performance or finding the most potential student to enroll and focus on collecting data onto the students' free time and their outside classroom activities. According to the ed-tech magazine, the Ball State University focuses on keeping track of the student's campus activities. They also use a tracking system in the form of ID cards to analyze the attendance rate and act accordingly in case the rate drops. Furthermore, the institutions can track students who study. In other words, they can find out, whether the student studies every day or if the student just studies the night before an exam. Institutions can bring the data collection to a new level where they find out about starting salaries and other information of students, who graduated from the Institute. They can know the starting salary of the graduate students and calculate the average starting salary of their graduate students for their purposes as well as for marketing purposes. As we can see, technology and the use of analytics can be used in multiple ways nowadays, and it affects the students in a lot of different ways. It helps the institution financially and increases the learning outcome of students and even tracks down the student's activities after graduation.

### **Impact of learning analytics**

Learning analytics has integrated into many aspects of higher

education. However, many applications are quite new and require more in-depth research as well as research. This part of the paper examines the application of analytics in various academic views including student learning, teachers, institutes, and course developers.

**Student learning:** Regarding higher education, academic analytics and big data help to create a better-blended learning environment, which facilitates student learning process by providing a handy range of technology and media in collaboration with the traditional face-to-face method of teaching in class. The benefits of applying learning analytics to studying environment are critical to support student learning outcomes and their success. According to Campbell et al. [15], to improve student success, Data will be collected from a wide range of sources like the course management system, e-portfolio, student response systems, and similar applications to be analyzed academically. Then making use of the predictive model generated from the data to figure out the most effective instructional methods for all students learning demands and process. This view also suggests the earlier fundamental principles of higher education. Students will have to keep working collaboratively and be in charge with their studies; the continuous feedback; expectation for learning outcomes keeps increasing. Applying learning analytics to this progress can highly produce positive results concerning the condition of student success of any courses. Anorld et al. [16] has focused on the implemented systems that will fulfill the learning environment with the application of academic analytics: First, using the technology of academic analytics can enable a significant source of efficient and more actionable information. These data will alert the student to focus on their performance and the factors that impede their accomplishment of the course. Second, the engagement of the analytical information to academic education will encourage students to monitor their learning habits, empowering themselves actively. Third, predictive model regards the real-time performance to ensure student success. Some intervention might be needed to aid the progression of student learning, and other supportive resources will be there for the demands of students to satisfy the requirement of the course. Data mining and resources will be likely to bridge the gap in the transition from a student from high school level to higher education, which requires more in-depth research and knowledge for students' successful academic career. An example of implementing academic analytics to improve student-learning experience of Purdue University in 2003 is the myriad of institutional data, The Purdue Early Warning System (PAWS), which identify the at-risk students to send them an alert and needed a suggestion for their study plan. Although, there was a limitation for matching the resources available for a particular course, this example demonstrates a significant contribution of academic analytics to student higher education path.

**Education institutions:** Today big data is critical applied in higher education and will continue to contribute the institutions in the future. Its applications take a considerable scope for expansion featuring the administration, resource allocation, management and research strategy. Tulasi et al. [17] urged that implementing analytics could enable the institution to be more knowledgeable and intentional with data and evidence. Some of the most significant value it adds to the higher education is:

- a) It can enhance decision-making and resource allocation.
- b) The productivity of the Institute gets improved through better responses generated due to real-time information analysis available.

- c) Making the use of social networking, technology, and network data could assist in handling complex issues.
- d) The innovative pattern can be figured out for transforming the college or university system.
- e) “What if” experiments would facilitate the decision-making process?
- f) Determination of the soft and hard value of the institution, respectively brand building and patents attributed to the faculty activity could be feasible.
- g) The institutions can efficiently enhance their healthy growth as well as tackle challenges by using available transparent data.

Goldstein et al. [18] promoted five stages of applications of academic analytics by institutions, including Extraction and reporting of transaction-level data, Analysis and monitoring of operational performance, What-if decision support, Predictive modeling and simulation, Automatic triggers of business processes. His research concluded that 70 percent of the 380 institutions in the United States and Canada apply academic analytics for reporting transaction data, which is the first stage of its application [18]. However, the use of academic analytics varies by departmental areas. Many higher education institutions have applied analytics to facilitate student enrollment management. Campbell et al. [15] pointed out that institutional researchers cooperating with admission officers had come up with complicated formulas-featured with standardized exam course, high school assessment and other information- to identify which applicants would be suitable. The “actionable intelligence” produced from these analyzed statistical data will allow institutes to correctly set up the limited admission financial allowances and human capital for this process. Many institutions’ admission teams can also give an initial guidance to the students’ application with the given analytics, which gathered all the data from previous years such as, for examples, about the student enrolment rates and balance in areas, enrolments within programs, student demographics and so forth. Based on current information, admission teams will be able to identify a predictive model as well as improve the future enrollment decisions. Besides, enrollment management, another important application of analytics is in the fundraising projects for many institutes. Based on the information of the alumni and friends, data is gathered to constitute a predictive model identifying the major donors who are most willing to give. Apart from academics and coursework, data can also get collected from other response of an individual to past solicitations; employment in, contribution and achievement in a field related to the academic programs; interest in the specific organization; and participation in social events [15].

Institutions can utilize the application of analytics just like any other different business organization [15]. Furthermore, higher education sectors always require a high demand for innovation and revolution. Therefore, the implementation of analytics will continue to replace the traditional view of functioning and create an enormous impact on the existing processes of teaching, learning, administration and academic work of many academic institutions.

**Instructor/Facilitators:** It appears to be clear that learning analytics is obtaining momentum and is likely setting down deep roots. There are numerous advantages to learning examination; most eminently that it can advise how we assist our students towards success. In educational institutions, we have a large measure of information available to us. Our ability to handle this data and use

it to instruct in the classroom, whether interacting (face-to-face) or on the web, is at the heart of learning examination. Institutions, for example, Purdue University, Rio Salado Community College, and the University of Michigan are pioneering the trail and exhibiting the tremendous advantages of learning analytics for understudies and staff. Many studies have demonstrated [19] that individual faculty can make proper utilization of the data they have access concerning their courses. To influence change and enhance students’ achievement and success these endeavors, although seemingly “small scale” can largely affect students’ achievement and success. As the educational scene changes, so will teachers needs and job responsibilities. We have to guarantee that teachers have the tools that they have to best serve students in this new educational environment. Learning analytics will serve a particular function for teachers, offering them some assistance with detecting student’s needs more rapidly so that they can settle on educated choices on the most proficient method to most successfully serve them. In this new scene, teachers and instructors may be depended on less to transmit knowledge. Instead, they will probably recapture a part of a more Socratic nature: direction through knowledge. The educator will be in charge of delivering well-rounded, inquisitive, and thoughtful citizens, instead of actuality repositories. Instructing will turn out to be a great deal more about creating and developing critical thinking tools and designing collaborative interactions and innovative situations, and less around a primary transmission of concept.

### Tools and techniques

Known as one type of technologies, learning analytics is usually involved with “powerful computers and sophisticated programming capable of processing vast quantities of data” [6]. As far back as the year of 1993, technology foreseen as a mix that required a combination of Technoware, Humanware, Infoware, and Orgaware [20]. More simply put, it requires the hardware as well as operators’ knowledge-skills-abilities. One further research written by Bogers et al. [21] suggested that technology is a body of knowledge. After combining these two theories, these four components are considered as the resources of technology, as shown in Figure 1 [22]. In short, learning analytics constitute of “computers, people, theory, and organizations” [6]. After comparing various frameworks and models of learning analytics, Elias has come up with a general process of learning analytics which consists of seven steps [6]. According to this, many tools and techniques get involved in each step of the process. First of all, the data gathering tool are needed. Usually, there are two approaches known as quantitative and qualitative methods. Quantitative data often is collected in the forms of surveys, while qualitative data will adopt various methods that are more time-consuming. Figure 1 below show some types of data collection tools concerning both the approaches [23]. The next step is to process the information by adopting reporting and predictive techniques. Corbit et al. [24] suggested such tools as data visualization, decision trees, and regression analysis and so on. To be specific, data visualization gets done by using digital dashboards such as charts, graphs, etc. Another visualization tool gaining popularity is to make use of SNA-social network analysis in learning analytics. After that, it is time to take advantage of these analyses to refine the education systems and share insights among stakeholders to improve the outcomes of higher education. There are also a few comprehensive tools for learning analytics gaining popularity, if not yet widespread, which help to satisfy the learners, educators, and administrators better. Plateau Analytics, an advanced analytics tool that “provides comprehensive learning and performance metrics, dashboards, and

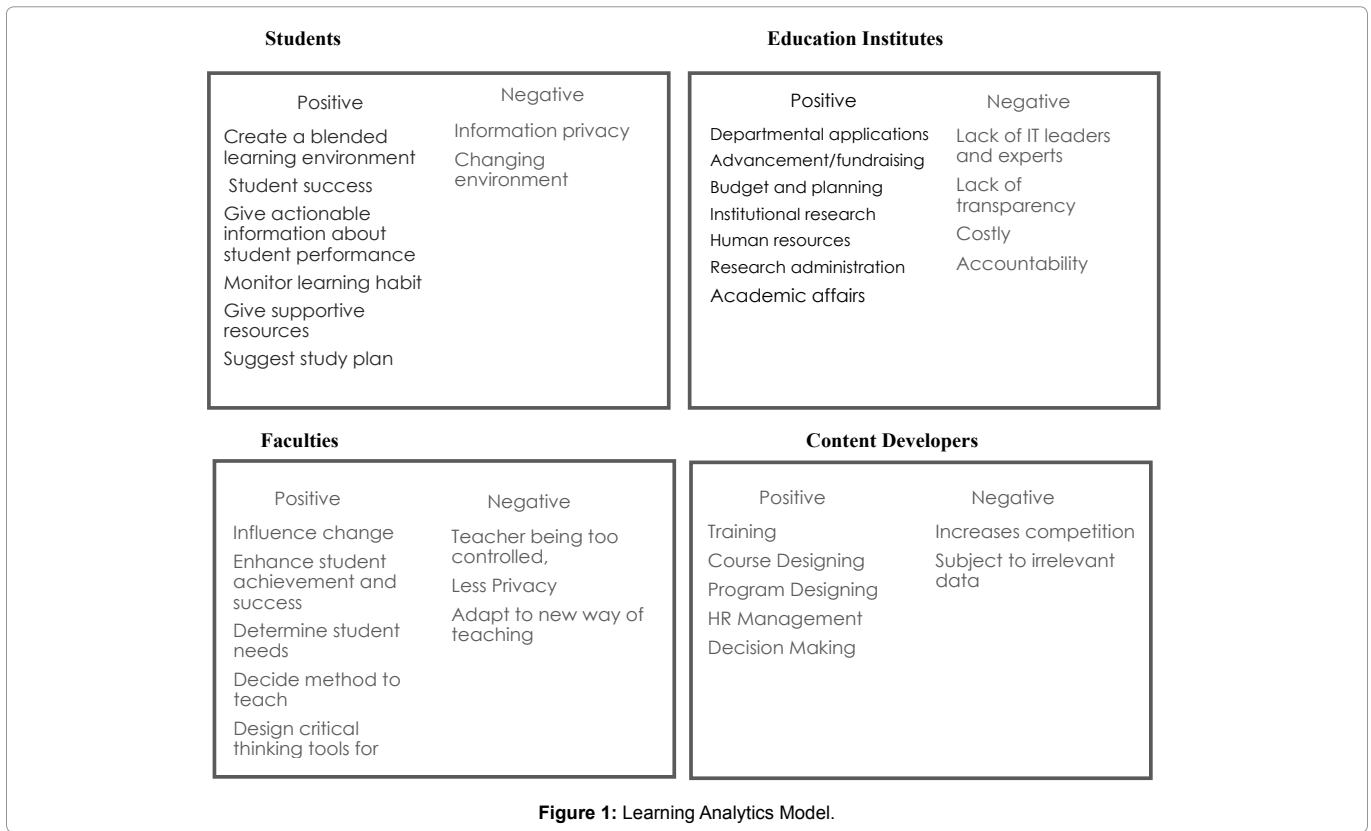


Figure 1: Learning Analytics Model.

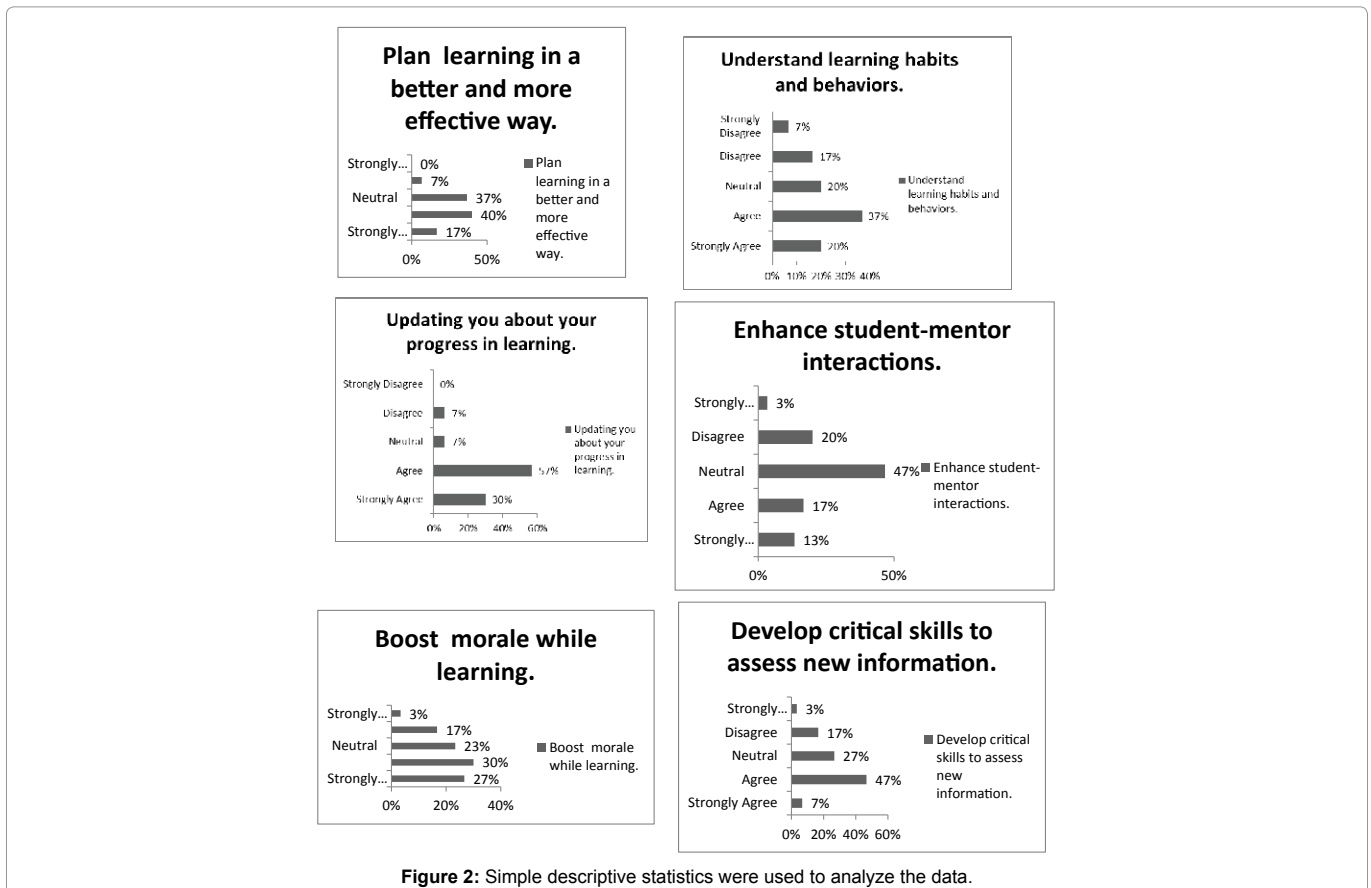


Figure 2: Simple descriptive statistics were used to analyze the data.

reports”, is provided by Plateau, a leading provider of web-based software [25]. Plateau Analytics 5.5 enables the tracking of the impact and maximising the outcomes of training, learning, and performance management. Originally, though designed for the workplace also used in higher education. Course Smart, given the name Best New Product by IMS Global Learning Consortium in 2013, is recognized as a valuable tool for education success [25]. It is designed to offer higher educators and administrators “valuable student engagement insights based on e-textbook usage statistics” [26]. The statistics include session lengths, pages viewed, and other learning activities, and it provides comprehensive metrics of learners’ interactions with course contents and materials. The paper PR Newswire [26] also mentioned about the situation of Course Smart application in higher education in the year of 2013, as indicated below:

Course Smart Analytics is currently being piloted at nine institutions and scheduled for a public launch in late 2013. Institutions participating in the beta include Ashworth College, Algonquin College, State University of New York-University at Buffalo, Career Point College, Central Carolina Technical College, Clemson University, Rasmussen College, and the State University of New York-Stony Brook University and Texas A&M University-San Antonio. Smarter Education Solution, a combined work of IBM and Desire2Learn, is introduced to K-12 and higher education [27]. The Smarter Education Solution will leverage IBM’s and Desire2Learn’s technologies, enhancing the information educators can collect about their students by anticipating and addressing learners’ needs in a proactive manner.

## Methodology

### Data sources

Our study depended on two types of information sources in gathering the necessary information and data to lead this study: Secondary sources related to the information acquired from the available literature and the results of previous studies to build up the study model and survey. Primary sources are about collecting data obtained through a primary questionnaire distributed to a group of students (100 students) who have taken online courses. To understand the benefits of Learning Analytics on students, we interviewed students from the graduate program who have had experience with this tool. Our questionnaire was designed according to the Likert Scale: 1-strongly disagrees and 5 to strongly agree.

### Method of analysis

Simple descriptive statistics were used to analyze the data, based on our study on Learning Analytics and our understanding of the relation it has with the two primary stakeholders: Students, Teachers, Institutions and Businesses, to identify and visually illustrates how it can have a positive and a negative impact on them (Figure 2).

### Advantages

Improve the rate and quality of successful outcomes. With the help of learning analytics, learners can keep an eye on their status and progress concerning different courses. For example, education institutions such as Purdue or Rio Salado have performance dashboards in their LMSs as a tool for students to continually monitor the performances of their own [19]. Moreover, it is also helpful for learners to realize what should get improved to get better learning outcomes. Increase learner retention. Learning analytics allows learners to understand their situations during the process of the courses, and generates warnings

to participants for getting interventional help from faculty and institutions in time improves learner experience. Learning analytics provides learners with various tools and techniques to monitor as well as enhance their performances. Equally important is for educator/faculties; they can continuously monitor learners’ learning activities and performances and then provide help accordingly. Greller et al. [28] point out that LA can inform faculty about “the gaps in knowledge displayed by their students”. Such information can help educators find better focuses during their interactions with learners. Contribute to identify at-risk learners and give effective interventions in time. It also transforms teaching approaches and methods and improves learning and course design. If indicated by learning analytics tools that some performances of learners on specific learning activities is not much related to the outcomes, administrators may have to consider about modifying them [19]. Furthermore, it is also possible to establish a model of high-performance learners’ learning activities, behaviors, and traits. Moreover, the institutions and educators can encourage learner engagement with these specific traits, leading to possible improvement in outcomes and improving decision-making.

## Challenges

At a quick glance, Learning Analytics might seem very promising and fruitful for enhancing the learning experience, but by studying in depth about it brings out several of shortcomings, the first challenge is to solve the problem the ethics underlying the learning analytics. What are the outcomes of advanced education organizations gathering learners’ information and arranging a large number of reports based upon their online clicks, site hits, time signed on, and electronic notes? Do educators have an obligation to tell students what they are doing? There is a possibility of the collected data gets manipulated. Questions like who can have access to student information and what type of information should get collected need an answer. Moreover, most importantly students should be aware of their institute’s data collection procedure [29].

Another challenge to this can be learners and educators inability to be at par with the technology. Some students and teachers might have problems understanding the new system of online learning and how to interpret data analysis. Lastly, to successfully implement Learning Analytics, faculty must be ready to change. If they are reluctant to accept the change in classroom structure and teaching patterns, it could be challenging to improve the learning experience, and the quality teaching would degrade [30-33].

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