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BI as a Solution To Boost Higher Education Performance
La BI Comme Solution Pour Améliorer la Performance De L'enseignement Supérieur

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Abstract:
From a wide literature review, the reader can conclude that BI can be considered as the best mean to create knowledge in order to develop the insights and understanding needed to make informed decisions. When we talk about the higher education sector, the issue is not different where its purpose is to equip students for success. While HEIs facing increasing pressures from social and economic change, academic quality and performance become more critical than ever. Higher education is under pressure to meet greater expectations, whether for student numbers, educational preparation, and workforce needs, or economic development. Thus, institutions seeking through educational intelligence to gain a competitive advantage that is related to performance indicators and quality indexes. This research in its objectives attempts to impose the idea of how BI concepts can be implemented in the higher education sector as a response to enhance quality and performance levels.
Keywords: Educational intelligence, higher education, performance.
(JEL) Classification : H 11, H 52.
Résumée:
À partir d'une revue de la littérature, on peut conclure que le BI peut être considéré comme le meilleur moyen pour créer des connaissances afin de développer la compréhension nécessaires à la prise des décisions; pour le secteur de l'enseignement supérieur, l'enjeu n'est pas différent, car son objectif est de donner aux étudiants les moyens de réussir. Alors que les établissements d'enseignement supérieur sont confrontés à des pressions croissantes dues aux changements sociaux et économiques, la qualité et les performances académiques deviennent plus critiques que jamais. L'enseignement supérieur est sous pression pour répondre à des attentes, qu'il s'agisse du nombre d'étudiants, de la préparation à l'éducation et des besoins en main-d'œuvre, ou du développement économique. Ainsi, les institutions qui recherchent par le biais de BI un avantage concurrentiel lié aux indicateurs de performance et aux indices de qualité. Cette article, dans le cadre de ses objectifs, tente d'imposer l'idée de la manière dont les concepts de la BI peuvent être mis en œuvre dans le secteur de l'enseignement supérieur afin d'améliorer la qualité et la performance.
Mots-clés: l'intelligence éducatif (BI), l'enseignement supérieur, la performance.
(JEL) Classification: H 11, H 52.

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Introduction

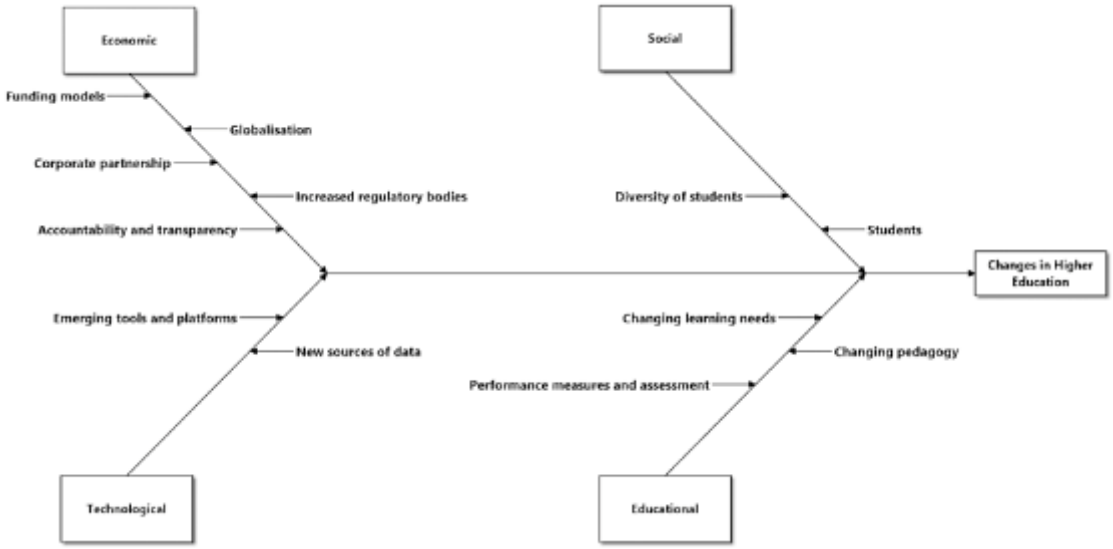
Education in its general sense is a form of learning in which knowledge, skills, and habits of a group of people are transferred from one generation to the next through teaching, training, research, or simply through autodidacticism. Higher education is one of the main engines of progress around the world through its well-known functions of education, academic training and research, and the provision of public service. Higher education is the last and most important phase in members' formation; it provides directly special qualifications into the labor market.

David Perkins' 1992 book contains an excellent overview of education and a wide variety of attempts to improve any educational system. He analyzes these attempted improvements in terms of how well they have contributed to accomplishing the following three major goals of education ***(D. Moursund: 2006, P: 11)***

1. Acquisition and retention of knowledge and skills.
2. Understanding one's acquired knowledge and skills.
3. Active use of one's acquired knowledge and skills.

In his paper research, ***(B. Daniel: 2015, P: 905)*** identified the key global challenges affecting institutions of higher education as illustrated in the figure:

Current trends affecting institutions of higher education



Source: (B. Daniel: 2015, P: 905)

In today very changeable environment and with globalization, no matter where you turn that Big Data will have an impact; the education sector is no different. Higher education sector relies heavily on student data for making critical and strategic decisions. HEIs have been collecting and tracking more student data than ever before, from student admission to student departure, even after departure, such as application data, course registration data, attendance data, online learning data, performance data, internship and employability data. Universities already collect vast amounts of data, so, the academic data of university has been growing significantly and become a big academic data, it requires a significant size of effort to extract and turn it into something useful and meaningful. Generally, Big Data has come to be identified by ***(B. Daniel: 2015, P: 908)*** in a number of fundamental characteristics. Keys among them are:

- *Volume:* a large amount of information: is often challenging to store, process, and analyze and present.
- *Velocity*: relates to increasing rate at which information flows within an organization.
- *Veracity:* refers to the biases, noise, and abnormality in data. Veracity also covers questions of trust and uncertainty.
- *Variety*: referring to data in a diverse format both structured and unstructured.
- *Verification*: refers to data verification and security.
- *Value*: most importantly, has the data been utilized to generate the value of the insights, benefits, and business processes, etc. within an organization?

However, in spite of the large volumes of data available at universities, managerial decisions are rarely taken based on it. There is a continuously growing need to transform the data into information and knowledge, in response to this need, a great number of new information technologies, methods and tools have been introduced.

1. Applying BI in HEIs

According to ***(A. Mutanga : 2015, P : 122)*** BI can be as a solution of the higher education sector in regard to adding much needed efficiency in all levels of decision making, so, a successful and effective implementation of BI in higher education leads to make intelligent decisions that will enhance the student success rate. As shown in their works ***(D. Guster and C. G. Brown: 2012 & T. Beckett and B. E. McComb: 2012)***, many institutions of higher education still have administrative information systems for the student, finance, human resources (lecturers and administrative staff) and usually find it costly to provide data for decision making. The reason is that most operational

information systems for HEIs are transactional in nature as they process transactions rather than provide information.

In his research paper about BI application in Bulgarian Universities, ***(D. Kabakchieva: 2015, P: 107)*** mentioned that most of the university BI initiatives are focused in three main areas as illustrated below:

- ***Supporting administrative and management activities:*** From admission campaigns, BI systems are used to analyze student applications and offers and enrollment trends. The BI system is also used as a planning and monitoring tool, such as modeling the student number plans and then monitoring during the plan period, for planning courses, for budgeting and financial planning and then monitoring the year outcomes. Here, managers depend on Key Performance Indicators (KPIs), e.g. Progression and Achievement, Student Satisfaction, Research Assessment, Graduate Level Destination, the International proportion of students. These indicators can be used to enable management to compare their current performance against expected strategic targets. Monitoring daily transactions and operations is also another indicator used to improve performance evaluation and decision making.
- ***Academic performance:*** Some of the most important aspects that need accurate information for better decision making include a better understanding of departmental loads, disciplines and academic outcomes; establishing areas that have performed poorly. Here, managers conduct the so-called academic performance evaluation, that is widely supported by the BI solutions, in order to take early measures or to identify the best practice; finding the reasons for retention and monitoring progression; analyzing institutional research performance and standing; financial contributions
- ***University relations:*** are also very often supported by the university BI systems, thorough analyses and by providing accurate information BI solutions are helping to ensure organizational sustainability and capability, university environment and engagement. Decision making is based on dashboards, scorecards, and reports, allowing graphical sharing of important data with the stakeholders.

2. The importance of BI in HEIs:

BI data warehouse has an important role in educational data analysis, and applying academic data warehouse supports the decisional and analytical activities regarding the three major components in the university context: didactics, research, and management. ***(S. Mirabedini: 2014, P: 1441)***. According to (***Dell'Aquila & al: 2008 and Muntean & all: 2011)***, BI in HEIs can help in:

- Develop a high-quality education.
- Achieve a proper management of all human resources independently of their role.
- Maintain a stable economy.
- Analyze students' unemployment rates after finishing their studies.
- Analyze students and employers expectations.

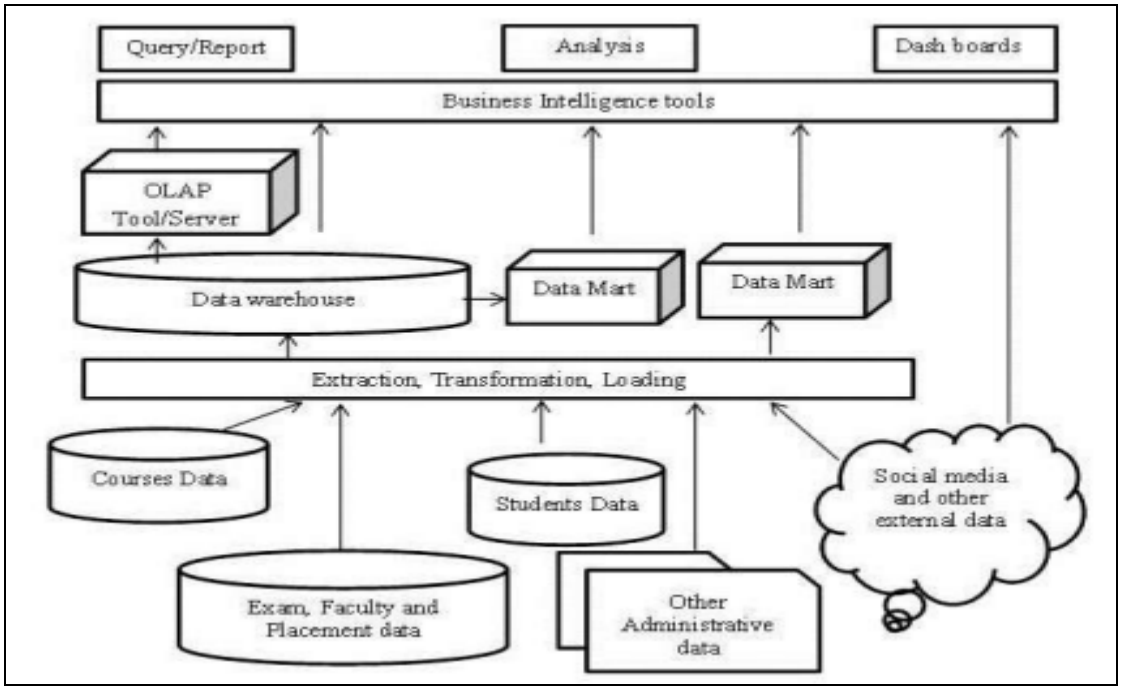
Furthermore, ***(Kabakchieva: 2015)*** argues that HEIs that want to stay competitive have realized the need to analyze the available data to thoroughly understand their organization in regards to their students, administrative staff. Combining data from different systems in a single BI solution facilitates cross-functional analyses and leads to higher quality decision making and efficiency improvement. ***(V. K. Ong: 2016, P: 68)*** investigates how Big data analytics can make sense of large and complex datasets. Institutions must embark on various types of analytics, such as discovery, iteration, flexible capacity, mining and predicting and decision management.

On another hand, BI can enhance strategic planning by providing better insight into institutions' operations and students' activities through enabling data-driven decision-making that leads to more focused and effective strategic planning, it is also reported to improve communication regarding strategic planning (***Kovacheva: 2013, P: 14***).

Performance management is focused on a subset of the information delivered by a BI system; this information indicates business success or failure and enables organizations to select the important task of optimizing performance. Like business performance, academic performance is also an area that is widely supported by the BI solutions developed at universities. Accordingly, ***(A. L. Barranco & all: 2015, P: 45)*** posted that through BI technologies it is possible to extract useful knowledge from huge amounts of existing databases of an educational institution to help decision making on issues of educational management information.

Educational Data warehouse (EDW): ***(P. Muley: 2016, P: 61)*** summarized major feed for the educational data warehouse **as shown in Figure** in various documents such as students records, number of courses university offers, industrial visits and events held record, faculty records, university ranking, accreditation, affiliation records, records of facility such as buildings, computer labs and other various assets, staff records, students' performance records, placement records and accounts related records.

A proposed framework of EDW and BI in the higher education sector



Source: (P. Muley: 2016, P: 63)

Apart from these regular standard sources of data, with actual environmental change, the education sector is also witnessing a great influence of Social Media and internet. Integration of data from these heterogeneous sources in the data warehouse is a real challenge. Like a business data warehouse, an educational data warehouse is also designed and developed according to the requirements of end users in the university.

In HEIs, EDW plays a very important role. Its main benefits in an educational institute are listed as follows: (***(M. Goyal1 & R. Vohra2: 2012, P: 114)***

- It provides an integrated and total view of an institute.
- It makes current and historical information easily available for the decision making and in detail form.
- It provides the facility to students to get their different subject notes from a web-enabled database.
- It provides the information about student's attendance.
- Students can get their results easily and very quickly.

Educational Data Mining: Data mining, often called knowledge discovery in the database. Within the educational research which commonly known as Educational Data Mining (EDM) EDM is defined as an emerging discipline, concerned with developing methods for exploring the unique types of data that come from the educational setting, and using those methods to better understand students, and the settings which they learn in ***(S. K. Mohamad & Z.Tasir: 2013, P: 320)*** .

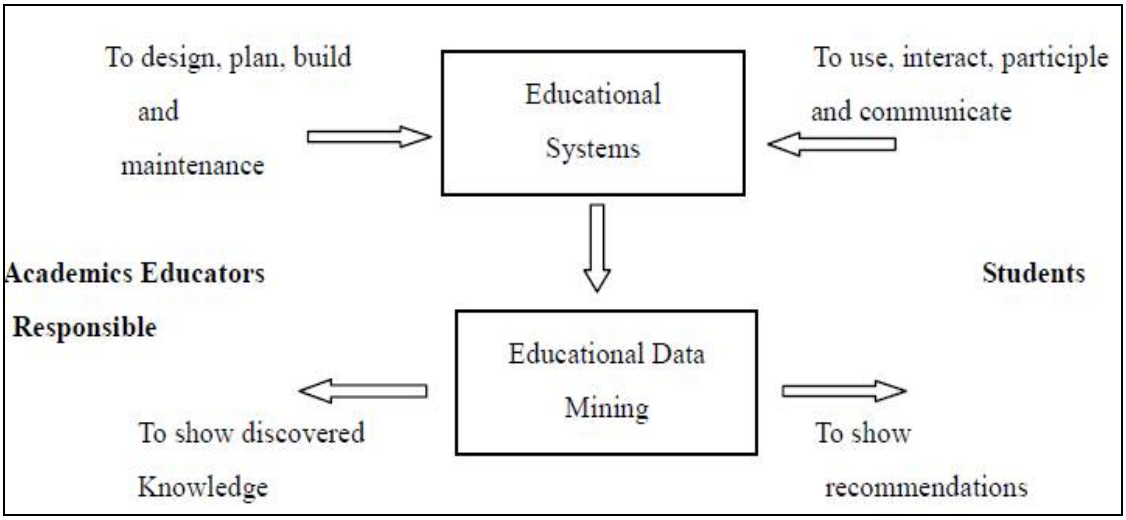
As explained shortly ***(J. Liebowitz: 2017, P: 9)*** Data mining techniques and statistical analyses were used to analyze the integrated data to identify relationships among variables and is focused on uncovering hidden patterns and relationships to drive student learning outcomes. He shows also that EDM is applied to identify the critical "at-risk" in order to provide the necessary support services to help them succeed toward graduation.

EDM access data from the data warehouse and convert it into meaningful reports will be presented in multiple forms according to the need of academic users.

Consequently, Business Intelligence can help management determining which students should get admitted, what special training required for students of a particular course, How to improve admission rate, what special skills market requires, how to improve curriculum to meet industry demand, what can be the other location to expand, what new courses to start, what courses can be started as e-education, which area of the country has more demand for e-courses ***(P. Muley: 2016, P: 62)***. These critical points and many other queries can be addressed by Data warehouse and BI tools and can help education management of universities to take more evidence-based decisions.

In 2007 Romero and Ventura presented EDM concept in a process cycle as continuous complementary actions, the figure below adopted from their research show the cycle of EDM.

The cycle of applying EDM



Source: (Romero & Ventura: 2007)

3. The concept of Educational Intelligence:

According to ***(S. Khan & all: 2016, P: 29)*** frameworks used for business intelligence can be adapted to the education sector, this is exactly the reason why the term '*Educational Intelligence'* can be used to describe the use of techniques, reporting applications and, analysis tools to gain insights into critical operations in the wider education system. They add in their research that applications of big data analytics concepts like recommender systems, social network analysis, skill assessment tools, adaptive content, and personalization and data visualization can be integrated and used to develop a comprehensive system for Educational Intelligence. Don't forget that available internal and external data can be used to improve decision making, at the organizational, team and individual level.

Simply, the term of Educational Intelligence refers to the application of BI as process and technology in the education sector in order to monitor educational data. Several features that EI needs to have as listed by ***(A. Abdul Aziz1 & all: 2012, P: 141)*** are:

- The ability to integrate various data from different sources in one large pool of database/Educational Data Warehouse (EDW). The implementation of EDW will improve the process of handling a large volume of data and rapid changes in educational data. Designing a physical design of a database in multidimensional format is improving

the query taken for producing reports**.** Furthermore, applying cube for OLAP engine provides efficiency and flexibility in educational data reports.

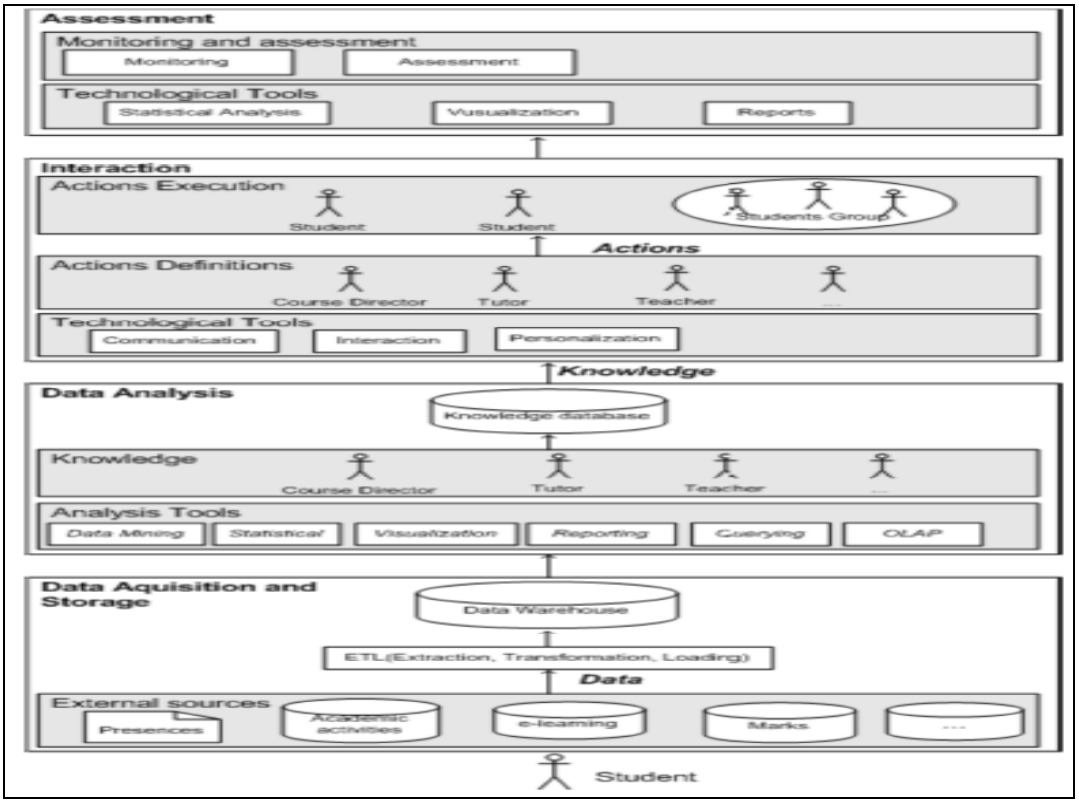
- The ability to perform multiple analytic processes whether descriptive analysis or predictive analysis.
- The main importance of EDM is the ability to provide a comprehensive analysis of students' data. Lecturers may understand students' individual behavior and could devise strategies to improve their achievements.
- The analysis provided by EI whether descriptive or predictive will help improving learning and teaching process. In traditional ways, it is difficult for educators to know each of their students. Therefore, the ability to produce meaningful reports is important in the learning process.

A framework of EI of ***(A. A. Aziz & all: 2014, P: 52)*** illustrates major components and tools of this system and monitor how data is gathered and transformed, and how knowledge is created to be used intelligently in the decision-making process.

A core management system in EI called student relationship management (SRM), this concept introduced firstly by *Piadade and Santos* as an adaptation from Customer Relationship Management (CRM) concept ***(A. A. Aziz & all: 2014, P: 51)***. SRM was used to promote students success and to closely monitor their academic activities. The CRM is a holistic strategic approach to manage customer relationship in order to create value using a specific technology solution. ***(Payne, A: 2006, P: 2)***

Consequently, The SRM system suggested by is based on this principle and mainly supports activities related to the students and those particularly associated with the teaching and learning process. BI technology has been proposed as the main pillar technology to support SRM ***(A. A. Aziz & all: 2014, P: 52)***, and the figure below shows the framework of SRM fundamental concept.

Student Relationship Management system



Source: (A. A. Aziz & all: 2014, P: 52)

4. Benefits of Educational Intelligence:

Proper implementing of EI can deliver many benefits to stakeholders by providing real-time meaningful information to appropriate user in the right format. For example, ***(R. Luckin: 2016)*** suggested that BI can help solve the big higher education challenges, which is about an enormous rise in the amount of educational data about students that are available to universities.

From the viewpoint of ***(C. Vento: 2017)***, EI impacts key stakeholders across the student lifecycle, where the student experience lifecycle is comprised of three overarching areas: teaching and learning, student success, and recruitment and enrollment. According to his research, some of the benefits of EI in educational systems are:

For students

Students generate a wealth of real-time activity data that should be at their disposal. With data analytics, students can see the status and progress down to specific learning activities, allowing them to identify strengths and weaknesses. They can also benchmark themselves against anonymous peer activity and leverage the patterns of students to influence their own learning path. Furthermore, the cumulative achievements, competencies, and skills are driven by insights along the way to equip students with higher value qualifications needed for increasingly skill-demanding career and job market.

For instructors

With instructors, they commonly desire to access timely insights about students. These instructors seek EI to optimize student performance as well as curriculum efficacy. EI facilitates the intervention with struggling students and making the necessary curriculum adjustments to improve results before the course is complete.

EI capabilities also help to know which students are at-risk in particular areas of the course and enable instructors to better intervene and assist their students in a more timely and targeted way. Similarly, EI can help instructors determine the strengths and weaknesses of the curriculum itself.

For Curriculum Designers/Developers

For them, the data from a predominantly digital courseware environment is a valuable product that opens new possibilities. The EI provides these stakeholders with the real-time insights needed to enhance their analysis of the curriculum structure and its discrete learning activity elements at a detailed level. These insights determine the strengths and weaknesses of individual learning activities that then inform any adjustments needed for current and future versions of the curriculum to deliver the best results. Also, such insights identify effective learning activities.

For Administrators

BI capabilities can help administrators take informed actions in areas such as recruitment, enrollment, program/curriculum efficacy, student retention, as well as academic and career advising in a more effective and timely fashion.

For Advisors and Success Coaches

Specifically, advisors can benefit from EI for course/degree selections and performance, comparative insights relative to historical and current peer cohorts, academic paths are taken and available alternatives, as well as how to achieve the best outcomes.

As an example, from multiple academic and operational data sources, EI can create comprehensive, multi-dimensional online student profiles that inform success coaches. Lastly, insights derived from the core academic experience, combined with current labor market data, can enhance the advisor's ability to intervene and assist, ensuring a student's readiness and fit for the increasingly demanding employment landscape.

For Researchers

The EI capabilities required for researchers is less about having canned insights, but rather providing a comprehensive data management and analytics toolset that supports standards-based interoperability and transparency. Furthermore, researchers would have the ability to aggregate, manage and iteratively analyze large volumes of granular data.

In a report of IBM about analytics for best results in higher education, Major of the key advantages of EI are as follow:

- Creating a better, more cost-effective curriculum
- Course revenue performance comparisons.
- Enrolment trends year after year.
- Faculty workload and performance information.
- Cross-college or departmental comparisons.
- Improving student achievement.
- Ensuring viability.
- Boosting financial performance.
- Managing the student lifecycle.

Furthermore, as each individual stakeholder's contribution and impact is enhanced by EI, the academic and operational impact on the overall educational

experience and outcomes will continue to improve incrementally. Major of the key advantages or benefits include was summarized above, some others can illustrate in:

- Understanding student demographics and behaviors
- Optimizing use of resources
- Helping student and graduates learn more effectively
- Creating data transparency sharing/ Federation
- demonstrating HE's effectiveness and efficiency
- Improving administrative services
- Containing /lowering costs of education
- Enhancing faculty performance
- Reducing administrative costs
- Ability to engage all major departments electronically

5. Barriers to success:

(J. Joseph: 2012, P: 432) showed major barriers in:

- Cost implications.
- Availability and access to information can lead to increased cheating and plagiarism.
- some degree of resistance
- Barriers of poor computer skills and lack of availability of access; a lack of awareness and culture.
- Lack of confidence, competence and a lack of access to resources.
- Departmental silos remain the biggest barrier to data sharing.
- New obstacles such as data access and clean data are also causing problems.
- Resistance to the adoption of new technology, fear of misinterpretation of data.

As ***(J, Bichsel: 2012, P: 13***) notes, identifying the barriers to use data proactively to make decisions is key to making progress in analytics. In broadest terms, those barriers include concerns about:

- ***Affordability and resource:*** the biggest barrier to BI/analytics in higher education is the presumed cost, a critical issue focused not only on computing and storage but also on all expenses of staff, training, and tools required for BI.

- ***Data management*** **(***quality, ownership, access, and standardization):* Many institutions are concerned both about the appropriate use of the collected data as well as the potential inaccuracy of the data. Who owns the data? Who should have access to it? Are the data standardized? How accurate are the data?

These are just the main questions that create successful adoption of BI/analytics program. To confirm data characteristics as end users need.

- ***Legal and ethical considerations:*** the legal and ethical concerns about collecting, storing, and using the data raise a variety of significant issues about data stewardship and privacy.

- ***Technical and behavioral challenges:*** Self-service analytics is potentially very powerful. But currently, many faculty and staff feel that learning how to access and interpret the data is too difficult or time-consuming. For many, they would prefer to rely on their intuition, gut instinct, and experience. Furthermore, understanding how to access and use meaningful data to help inform their intuition and experience can also play a critical role in the advancement of performance enhancement.

6. Creating an effective EI plan:

According to ***(C. Rouse: 2010, P: 13)*** a comprehensive BI solution involves:

- ***People:*** Create a BI Center of Excellence includes analysts in the different functional area.
- ***Process*****:** Design a database that includes daily updates.
- ***Technology*****:** any BI solution provided by vendors (Microsoft, Business Objects, SAS, Cognos, and many more)
- ***Data*****:** Turn data into meaningful information.

On the basis of these key attributes, ***(J, Bichsel: 2012, P: 22)*** developed an analytics maturity model for higher education, identifying five factors that are essential to a successful, advanced academic BI system/analytics initiative. The five factors comprise:

- ***Culture/process*****:** needs professionals who have specialized analytics training to be able to support and know how to use analytics.
- ***Data*****:** Data needed must be in the right this is about leadership, means that senior leaders (including faculty and administration) need to be publicly committed to the use of analytics and data-driven decision making.
- ***Expertise*****:** Any initiative
- quality, kind and quantity and to be standardized to support comparisons across areas within an institution and across institutions.
- ***Governance/Infrastructure*****:** Information security policies and practices need to be in place and clearly articulated.

- ***Investment*:** Funding for analytics must be viewed as an investment rather than an expense.

6. Conclusion:

With these attributes as a framework, institutions can develop an advanced analytics program that can help meet the numerous challenges that face higher education in the future and create positive change across all functional areas. Nevertheless, applying academic analytics can penetrate the fog of uncertainty around the future of higher education, and shed light on how to allocate resources, and improve the quality and value of the learning experience which is the main objective of all HEIs. As a result, universities will become more intentional, intelligent institutions where data, evidence, and analytics playing the central role in this transition.

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