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**An integrated Business Intelligence Model to Enhance
Learning Processes in Higher Education Institutions**

نموذج ذكاء أعمال متكامل لتحسين عمليات التعلم بمؤسسات التعليم العالي

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الآية

(بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ)

قال الله تعالى:

(يَا أَيُّهَا الَّذِينَ آمَنُوا إِذَا قِيلَ لَكُمْ تَفَسَّحُوا فِي الْمَجَالِسِ فَافْسَحُوا
يَفْسَحِ اللَّهُ لَكُمْ وَإِذَا قِيلَ انشُرُوا فَانشُرُوا يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنْكُمْ
وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ) 11 (المجادلة)

صدق الله العظيم

Dedication

To my beloved mother, who taught me patience and tenderness and called me Doctor while I was in the cradle a girl. And to the spirit of my father in the Immortals.

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ABSTRACT

Business Intelligence (BI) and learning analytic (LA) are drawing substantial attentions recently, and being one of the most competitive advantageous-themes areas in universities nowadays. The revolution of ICT and the vast amount of data that has been generated accordingly, makes it significant to gain the maximum benefits of these datasets, in proportion to retention, students' success as a key research topic and students' satisfaction. And to improve individual performance, that lead to improve the overall organization's performance, increase profitability, novel insights and stronger innovations. Although BI systems have a great impact on strategic, informed and high-quality decisions based, there is a lack of evident based practical guidance, on how effectively deploying LA to improve learning outcomes and students' success, as a big challenge in HEIs. The objective of this research, is to fill the void in literature by developing and validating a framework. The model is expected to integrates BI software solutions, LA and students' performance. Predictive analytics is used for analyzing useful knowledge from the student learning experience, to improve learning outcomes for the students and the society. A student satisfaction survey via a questionnaire is conducted, to capture student requirements, and for well understanding of their educational needs, as well as individual learning characteristics. The understanding of quality office requirements, gathered by interviewing quality affairs dean, studying university's documents and distributing questionnaire to academic and administrative s-taff member's representatives, for many key regions. Researcher conducted a systematic literature review (LR), in LA field action researches, design and development LA models, universities' BI initiatives and big data generated in HE as a big challenge. Using design and development research methods, a novel but practical model was constructed. The model is validated, deploying a real students' dataset of "1034" undergraduate active students (students' mean age 19.5, 65% females), studying for degree of computer science in Computer Science and Information Technology College in SUST, one of the public universities in Sudan. Starting with extracting the variables, from heterogeneous resources (student information system, students' grading, enrollment and biography information), to populate warehouse systems, which used for performance measurement and decision support by analyzing facts produced, using Tableau BI software tool.

The findings explored that, how technology captured data of students' performance for prediction, to identified at-risk students, for the purpose of consulting and withholding them before being drop out. Findings also investigate a profound domain knowledge about students and their context, and effectively differentiate the overall performance per college/departments per years/semester, giving implication of the retention, completion rate for graduated students and to detect defects to be corrected using and implementing effective informed decisions. Finally, a comprehensive evaluation is conducted, by surveys and interviews, determining the efficiency and influence of the proposed framework. This research identifies five main phases of this integrated framework: Data warehouse population, Data analytics, Visualization, Operational insights and assessment data phase. Each stage involves several key fundamental factors.

ملخص البحث

أخذت كل من ذكاء الأعمال (Business Intelligence) وتحليل التعلم (Learning Analytics)، اهتماماً كبيراً في الآونة الأخيرة، كونها واحدة من أكثر السمات التنافسية في الجامعات في الوقت الحاضر. ثوره تكنولوجيا المعلومات والاتصالات والكمية الهائلة من البيانات التي تم توليدها نتيجةً لذلك، تجعل من المهم الحصول على أقصى الفوائد من هذه البيانات بما يتناسب مع الاحتفاظ بالطلاب من خطر التسرب، ونجاحهم كموضوع بحث رئيسي مع تحقيق رضا الطلاب، تحسين الأداء الفردي، تحسين أداء المنظمة عموماً، زيادة الربحية، الرؤى الجديدة والابتكارات القوية. على الرغم من أن أنظمة ذكاء الأعمال (BI) لها تأثير كبير على القرارات الاستراتيجية، المستنيرة العالية القيمة، المثبتة، ذات الجودة العالية والقائمة على الاهتمام بالمتعلمين في معاهد التعليم العالي، إلا أن هناك نقصاً في الدليل العملي القائم على مدي فعاليته نشر تحليل التعلم (LA) لتحسين نتائج التعلم ونجاح الطلاب كتحدي كبير في مؤسسات التعليم العالي. والهدف من هذا البحث هو ملء الفراغ في الدراسات السابقة من خلال تطوير والتحقق من صحة الإطار الذي يدمج حلول البرمجيات BI و LA وأداء الطلاب، لتحليل المعرفة المفيدة من تجربته تعلم الطلاب من خلال التحليلات التنبؤية، لتحسين مخرجات التعلم للطلاب والمجتمع. أُجريت دراسة استقصائية عن مدى رضا الطلاب عن طريق استبيان، لاستيعاب احتياجات الطلاب التعليمية بشكل جيد، فضلاً عن الفروق الفردية، وفهم متطلبات مكتب الجودة، التي تم جمعها من خلال مقابلة عميد قسم الجودة، ودراسة وثائق الجامعة وتوزيع الاستبيان على ممثلين من الموظفين الأكاديميين والإداريين في العديد من القضايا. أجرى الباحث استعراضاً منهجياً للدراسات السابقة (LR)، في البحوث العملية في (LA)، وتصميم وتطوير نماذج (LA)، ومبادرات الجامعات في (BI) والبيانات الكبيرة المتولدة في التعليم العالي كتحدي كبير. وباستخدام أساليب التصميم وتطوير البحوث، تم إنشاء نموذج جديد وعملي وقد تم التحقق منه، باستخدام مجموعة بيانات حقيقية لطلاب كلية علوم الكمبيوتر وتكنولوجيا المعلومات في جامعة السودان للعلوم والتكنولوجيا (وهي واحدة من الجامعات الحكومية في السودان). بدءاً من استخراج المتغيرات، من الموارد غير المتجانسة (نظام المعلومات الطلابية، والدرجات، ومعلومات التسجيل والسيرة الذاتية)، لملء مستودع البيانات، والتي تستخدم لقياس الأداء ودعم القرار بتحليل الحقائق المنتجة، وذلك باستخدام أداة برنامج "Tableau" BI Tool. واستكشفت النتائج أنه، كيف استولت التكنولوجيا على بيانات أداء الطلاب من أجل التنبؤ، وتحديد الطلاب المعرضين لخطر التسرب، لغرض تقديم الاستشارة وتوجيههم قبل أن يحدث ذلك، وتعميق المعرفة عن الطلاب وسياقهم، والتميز بشكل فعال بين الأداء العام لكل كلية/قسم في السنة/الفصل الدراسي مما يعطي أثراً للاحتفاظ بالطلاب، ومعدل الإنجاز للطلاب المتخرجين وللكشف عن العيوب التي يجب تصحيحها باستخدام وتنفيذ اتخاذ قرارات مستنيرة فعالة. وأخيراً، أُجري تقييم شامل، عن طريق الدراسات الاستقصائية والمقابلات، يحدد كفاءة الإطار المقترح وتأثيره. ويحدد هذا البحث خمس مراحل رئيسية لهذا الإطار المتكامل: وهي تجميع البيانات، وتحليل البيانات، والنتائج المرئية، والرؤى التشغيلية وبيانات التقييم. كل مرحلة تنطوي على العديد من الأساسيات الرئيسية.

TABLE OF CONTENTS

ABSTRACT	v
ملخص البحث	vii
TABLE OF CONTENTS	viii
List of Tables	xi
List of Figures	xii
Search Terms and Abbreviations:	xiv
List of Appendices	xvi
CHAPTER 1	1
INTRODUCTION	1
1.1 Background:	1
1.1.2 Major benefits of (BI&A) systems concern:	2
1.1.3 Business Intelligence/Analytics field:	3
2. Motivation	6
3. Problem Statement and its Significance:	11
4. Research Objectives:	14
5. Research Question/Hypothesis/philosophy:	15
4.1 Research Question	15
4.2 Research Hypothesis	17
Summary	18
REVIEW OF LITERATURE	19
2.1 Review Scope:	19
2.2 Learning Analytics field (LA):	19

2.3 Action Researches:	22
2.4 Design and development LA models:	26
2.5 Universities' BI initiatives	31
2.5 "Big Data"	34
2.6 Open Issues	36
Summary	36
CHAPTER III	37
METHODOLOGY	37
3.1 Overview	37
3.2 Model Construction	38
3.2.1 Data preparation (Phase I)	43
3.2.2 Analyzing knowledge (Phase II)	45
3.2.3 Visualization (Phase III)	46
3.2.4 Operational Insights (Phase IV)	47
3.2.5 Assessment Data	48
3.3 Case study	50
3.3.1 Validation method	50
3.3.2 Instruments:	51
3.3.3 Data Sources:	52
3.3.4 Data Collection	55
3.3.5 Data Analysis and visualizations:	56
Summary	61
CHAPTER 4	62

DISCUSSION OF RESULTS.....	62
Main Contribution and Outcomes:	65
CHAPTER V.....	67
CONCLUSION AND FURTHER WORK	67
Future work	69
Opportunities for further research abound mostly as:	70
Appendices	79
Appendix D: Teachers & Decision maker survey	89
STAKEHOLDERS SURVEY.....	89
Students' Assessment & Feedback.....	89

List of Tables

Table [2.1]: Analytics capabilities for assessment strategy evaluation (Murnion & Helfert 2013)	23
Table [3.1], main methodology using for analytics Source: (Piatetsky 2015)	40
Table [3.2]: Student basic information from registrar	53
Table [3.3]: Students result records description	53
Table [3.4]: Students biography information	54

List of Figures

Figure [I-1] : Business Intelligence framework, Source:(Watson & Wixom 2007)	3
Figure [I-2] : Business Intelligence framework, Source:(Watson & Wixom 2007)	4
Figure [I-3] : BI current approach, source: (Ishaya & Folarin 2012)	5
Figure [I-4] : HE BI Maturity overview, Source: (Cardoso 2014)	8
Figure [I-5] : HE BI Maturity overview, Source: (Cardoso 2014)	9
Figure [I-6] : HE BI Maturity overview, Source: (Cardoso 2014)	10
Figure [I-7] : BI&A related publication trends from 2000 to 2011, Source (Chen et al. 2012)	11
Figure [I-8]: Tag cloud visualization of major topics in the (BI&A) literature , Source (Chen et al. 2012)	12
Figure [I-9]: Tag cloud visualization of major topics in the (BI&A) literature , Source ...	13
Figure [II-1]: Data sources of student engagement tracking system source: (Duan et al. 2013)	24
Figure [II-2]: LA reference model, source: (Chatti et al. 2012)	28
Figure [II-3]: Critical dimensions of learning analytics, source: (Greller & Drachsler 2012)	28
Figure [II-4]: An educational intelligence framework, source: (Abdul Aziz et al. 2014)	30
Figure [II-5]: LA continuous improvement cycle, Source: (Elias 2011)	31
Figure [II-6]: Course adapted student learning analytics framework , source (Aljohani et al. 2018)	32
Figure [II-7]: Context aware BI framework for South Africa, source: (Mutanga 2014)	34
Figure [III-1]: CRISP-DM phases source: (Piatetsky 2015)	41
Figure [III-2]: Model development procedure	43
Figure [III-3]: View of some respondent's answers to the student satisfaction survey	44
Figure [III-4]: Business Intelligence Enhance Learning Analytics (BIELA) framework	45
Figure [III-5]: 1 st phase in BIELA	46
Figure [III-6]: 2 nd phase in BIELA framework	48
Figure [III-7]: Phase III in BIELA	49
Figure [III-8]: Phase IV in BIELA	50
Figure [III-9]: Model validation procedure	52
Figure [III-10]: Gartner MQ_analysis_and_BI_2017_HI_res source: Gartner (Feb. 2017)	56
Figure [III-11]: Overall summary analysis	59
Figure [III-12]: Graduated students analysis	61
Figure [III-13]: Student details	62
Figure [III-14]: Students distribution computer science and engineering	63

0[IV-1] : Three examples of at-risk students	68
0[IV-2] : Most frequent words in the author research resources	70

Search Terms and Abbreviations:

AR	(action research),
BI	(Business Intelligence),
ICT	(information and communication Technology),
OLAP	(Online Analytical processing),
OLAM	(on-line analytical processing using data mining),
DM	(Data Mining),
EDM	(Educational Data Mining),
EPM	(Educational Process Mining),
DW	(Data Warehouse),
CBLEs	(Computer Based Learning Environments),
EDW	(Educational Data Warehousing),
IOT	(Internet of things),
HEI	(Higher Educational Institutions),
LA	(Learning Analytic),
QA	(Quality Assurance),
BIELA	(Business Intelligence Enhance Learning Analytic),
SoLAR	(the Society for Learning Analytics Research),
EUNIS	(European UNiversities Information System),
ETL	(Extract, Transform, Load),
JISC	(UK Joint Information System Committee),
DM	(decision making),
CRISP-DM	(Cross-Industry Standard Process for Data Mining),
DSS	(Decision Support System),
SIS	(Student Information System),
LMS	(Learning Management System),
IS	(Information System),
MIS	(Management Information System),
KPI	(Key Performance Indicator),

NCAAA	(National Council for Academic Assessment & Accreditation),
CRM	(Customer Relationship Management),
SO	(Services Oriented),
IU	(Indian Universities),
TEL	(Technology-Enhanced Learning),
RFID	(Radio Frequency Identification Devices),
CIO	(Responsible of Information Systems)
UCISA	(Universities and Colleges Information Systems Association),
SRM	(Student Relationship Management),
EI	(Educational Intelligence),
MOOCs	(Massive Open Online Courses),
GPA	(Grade Point Average),
SUST	(Sudan University for Science and Technology).

List of Appendices

Appendix A	Student satisfaction survey results	79
Appendix B	(SUST) Students' assessment and feedback survey results	82
Appendix C	The dean interview questions	88
Appendix D	Teachers & Decision maker survey	89
Appendix F	National Academic Accreditation	100
Appendix G	Teachers and decision makers summary	101
Appendix H	Graduation Rate case study (registrar office SUST)	103
Appendix I	Quality assurance dean interview	105
Appendix J	Academic adviser report	108

CHAPTER 1

INTRODUCTION

1.1 Background:

Higher Education recently has a strong demand for, and perfect strategic transformation toward using innovative technologies in complex decision making, students' retention and quality control environment (Mutanga 2014); (Bichsel 2012). These trends plus globalization and ICT evolution that enhance obtainability of different data sources, lead to the big datasets that are growing recently with new problem (Murnion & Helfert 2013); (Wu et al. 2014);(Bichsel 2012). In last two years hundreds of hour's videos and Petabytes of data are uploaded through YouTube and Facebook every minute (Mamonov et al. 2014). \$14.4 trillion market and over 10 billion devices being connected to the Internet, expected to grow up to 50 billion by 2020, and this will lead to the Internet of Everything (IoE) that lead to improving quality of learning (Hughes & Dobbins 2014), and giant number of higher education students could experience learning in Computer Based Learning Environments (CBLEs) (Bogarín et al. 2018). 90% of all existing data is performed in the past two years (Wu et al. 2014) , In addition, most of the existing data is unstructured which points out a difficult and complex process in handling such data (Mamonov et al. 2014).

All the above mentioned reasons lead to the urgent need and strong competition between HEIs (Aljawarneh 2016) ; (Hughes & Dobbins 2014), for the importance of the preparation their "big data" foundation for further analytics, transforming it to a useful information and gaining the most benefits of advanced analytical technologies including (BI) tools (Elias 2012); (Bichsel 2012); (Murnion & Helfert 2013).

In recent years the idea of BI and analytics (BI&A) has obtained a substantial amount of importance in research according to the number of published success cases (Universitaria 2013).

1.1.2 Major benefits of (BI&A) systems concern:

Information quality: One of the major benefits and major concern of (BI&A) systems is the delivery of high quality information that is certainly reachable; therefore, usage of these systems will highly evidence big data quality as needed in HEIs (Universitaria 2013).

Speed: another major benefits of (BI&A) systems is the time saving in accessing to information and also in speeding up and having a positive effect on the decision processes (routines by which decisions are made in organizations) (Universitaria 2013).

Enhancing collection of raw data, which can be structured/unstructured, and in various formats. For example, document text/electronic-tables/database-structure, excel format ...etc., from all angles that may need special, difficult and complex process in handling. Integrating data from all angles make it more reliable and increases accessibility, availability, visibility and effectiveness (Bichsel 2012); (Hughes & Dobbins 2014).

Enhancing the transformation of raw data to informed reports and allowing for high-quality data by eliminating doubts before uploading and getting started with building performance models, decision making process, and providing more timely, informed, fact-based, high-quality decisions, future planning and efficiency improvement (Universitaria 2013); (muntean & muntean 2012).

1.1.3 Business Intelligence/Analytics field:

BI is generally defined as, an umbrella of a broad category IT initiative of fast growing effective subjects, such as talents or skills, tools, uses, methods, extract, technologies and practices, that focuses on enhance, gather, stock, organize, report and analyze gained business knowledge from multiple platforms (Yahaya et al. 2018), to help people foretell visions and make educated, informed, significant, well-timed, clever and evidenced decisions and transform data into high-valued, accurate and easy access awareness using IT systems such as DW, Metadata, DM, Data Marts, ETL, OLAP, Query and Reporting Software, visualization and artificial intelligence (Fig. [I-1]). To increase performance, throughput and effectiveness, and boost the use of information providing access to data to help enterprise users make efficient business decisions, supporting decision-making requirements for both teachers and students. Considering student as a decision maker who should be empowered to see a visual representation for their learning experience (Atkinson 2015) in addition to other decision makers for future planning (Abdul Aziz et al. 2014); (Mutanga 2014); (Kabakchieva 2015); (Mamonov et al. 2014); (Rouhani et al. 2012); (Aljawarneh 2016), (Yahaya et al. 2018).

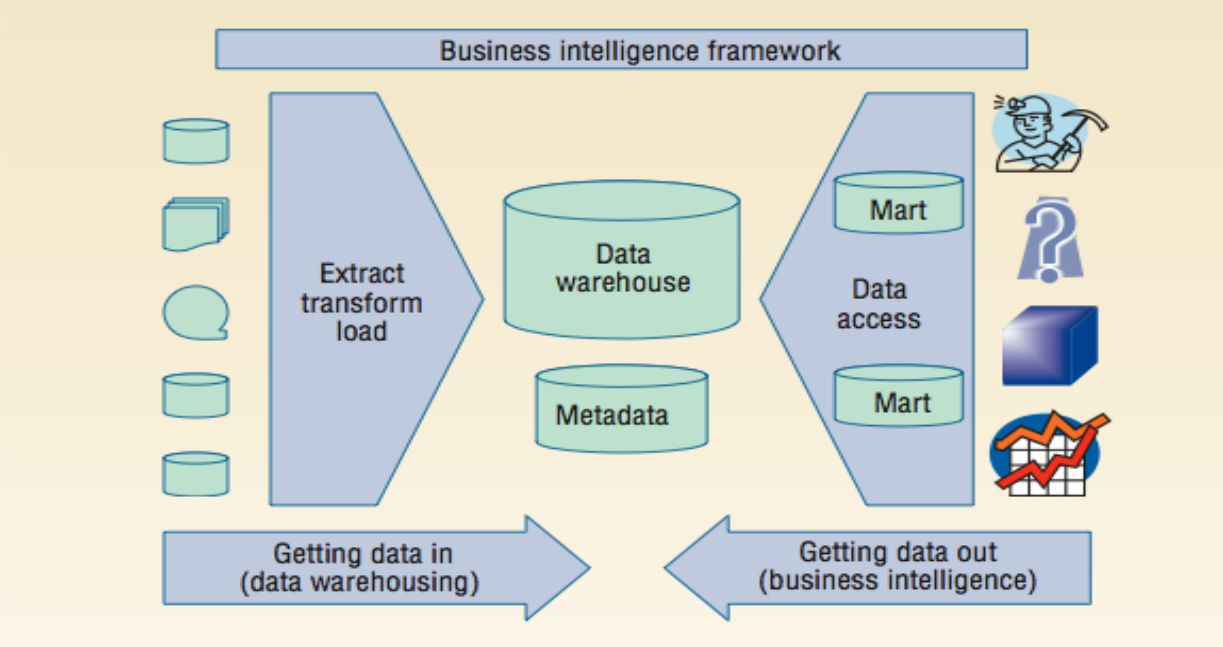


Figure [I-1] : Business Intelligence framework, Source:(Watson & Wixom 2007)

BI stages include: Investigation, watching/observing, key performance indicators (KPIs) and consoles (Kabakchieva 2015). BI can also be used as a checking and forecasting tool in education (e.g. SIS) or business marketing (e.g. Customer Relationship Management (CRM)) etc., through reliable, fine and multi platforms supporting user interfaces (Kabakchieva 2015). In addition, integration of BI & CRM or BI & SIS is the most popular approach rather than integrating BI with AI and Data Mining (Uma & Sankarasubramanian 2014).

In data preparation, (DW) integrate data from all positions (inside, outside, historical and fresh data) and transform it to build a solid foundation for processing and analyzing knowledge (Kabakchieva 2015).

Although DW facilitates the BI system functions, data can be extracted directly from data base resources in a more inconvenient way (Kabakchieva 2015). Three steps are needed for constructing the BIS architecture, the first level is the "Data Management" in which relational databases or ETL or DW (as most researches do) or any other data foundations are used. The second level is the "Data Modelling" using Metadata, Data Marts, OLAP, DM, OLAM (OLAP systems using DM) or any technologies for foretelling data by "drill down" for details or "roll-up" to aggregations. The third Level is the "Data Visualization Tools", in which the query and reporting Software is included, and "BI portal" tools that provide secure, user-friendly, web-based integration point and simply present the access point to the widespread public (Kabakchieva 2015); (Kowalczyk et al. 2013).

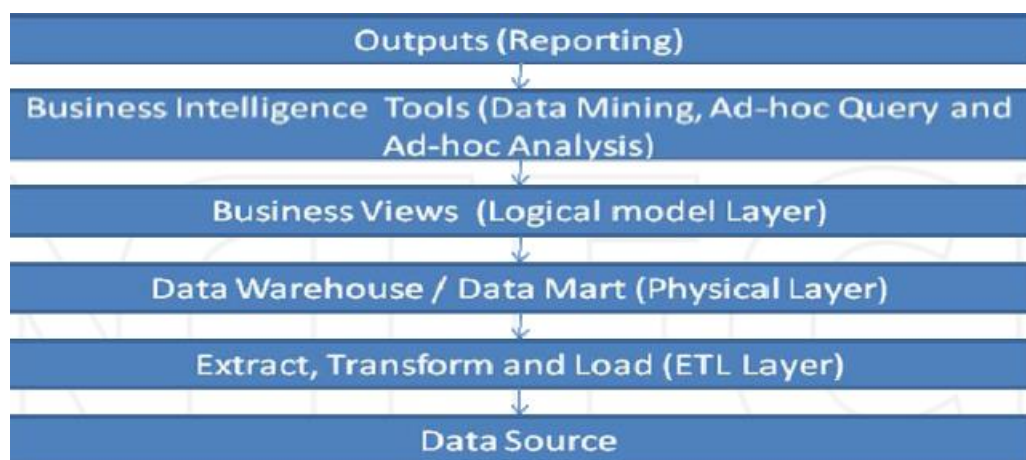


Figure [I-2] : Business Intelligence framework, Source:(Watson & Wixom 2007)

As shown in (Fig [I.2]), BI tools such as DM, OLAP and ad-hoc query are used to foretell and vision data after collecting it from a number of data source using the "ETL process" to extract business data (Ishaya & Folarin 2012), transform it and upload data into the DW's foundation (getting data in);(Kowalczyk et al. 2013). However, the traditional approach to BI (getting data out) takes much slower time to practice (can take days).

So it lacks a lively style, flexibility, association and reliability of analysis by the growing amount of timely complex data (Mutanga 2014). An enhancement on the traditional approach is made by employing the ETL Layer and Logical Layer as web constituent services, and thus, control OS and BI architecture, as shown in (Fig. [I-3]) (Kowalczyk et al. 2013).



Figure [I-3] : BI current approach, source: (Ishaya & Folarin 2012)

The main technical advantage of using BI systems, is the aggregation of data from all angles and achieving “a single version of truth” that ready to provide the right report at the right time to the right persons of all organization members supporting analysis, monitoring, KPIs and dashboards (Kabakchieva 2015).

2. Motivation

HEIs nowadays are operating in a very complex and dynamic environment. There is a strong competition and excessive interest between them due to globalization and rapid evolution of ICT in the past few years, stressing on a better analysis of their big data available (Elias 2011); (Aljawarneh 2016); (Hughes & Dobbins 2014), in addition, there is growing needs for tools and evidences of action taken by institutions, to ensure and improve quality, and learning analytics expected to mark significant contributions in this (Sclater et al. 2016).

There is a ready need in modern HEIs to get the most benefits of their data available about students from different resources like SIS and LMS where huge amount of useful and easy access students' data and their behavior is recorded (Bogarín et al. 2018), using LMS web platforms like Moodle, and frequently replacing face-to-face interaction (Muntean & Muntean 2012); (Hughes & Dobbins 2014). This big data differs in many ways like data format, data sources and information system used, as well as specific goals and objectives followed, in order to build a better knowledge foundation about their students' learning experience and the learning environment for improving quality and performance in terms of teaching quality, students' satisfaction, boosting retention, engagement, grades and success, attracting more students and researchers by responding to their needs and personalizing their learning experience (Elias 2011); (Dietz-Uhler & Hurn 2013).

Eventually, the goal of any estimation and quality assurance process in HEIs is to advance on preparation to demonstrate in students' learning, requiring certain progress indicators or striking new rules for Quality Assurance (QA), (Abelardo Pardo 2014), (Dringus 2011).

HEIs in USA, Australia and Western Europe, have understood already the impact of the revolution in ICT, and the big growing data with new problem, accordingly, universities to keep competitive, are concentrating not only on high quality education and research but also on methods how to interest more and better students by providing more attractive programs in bachelor, master, PhD and post-doctorate degrees (Elias 2011).

Leading HEIs are completely aware now that they should analyze their available data, (Liu & Huang 2017) to get an effective knowledge about their students to understand their individual learning characteristics and specific educational needs to increase performance in terms of teaching quality and students' satisfaction and thus enhancing the LA opportunities, and QA management, (Murnion & Helfert 2013); (Elias 2011). In addition HEIs have a great challenge in keeping track of their dataset, changing it to large number of variables and attributes, for accreditation and quality requirements (Harman 2013).

Learning analytics can address the need for both quality assurance, that becomes a critical process in HEIs (Murnion & Helfert 2013), and learning perfection requirements' (Macfadyen et al. 2014).

According to (Mutanga 2014), most of the South African HEIs have no unified data structure that acts as a foundation for employing analytics and BI systems. Data sources are reverse to each other, in a raw format and useless for decision-making processes.

Most Bulgarian universities are still using the traditional classroom educational system model and stored their data from admission of new students for managerial reasons, in a paper format. Some or most universities stored their data already in an electronic format, text document or electronic tables or in several relational databases, and online information like web pages, courses information, multimedia databases, etc., are always available. However, there is no integrated data structure suitable for analyzing knowledge, (Elias 2011). Attendance, feedback, monitoring the learning process and many activities are all done manually based on personal observation that couldn't be useful for extracting truly high quality information about students' learning process (Elias 2011).

Web based education interaction is kept in log files and if being analyzed, very important data about the students can be extracted showing their favorite path and most challenging problems and conceptions. (Elias 2011); (Macfadyen et al. 2014).

Most UK universities use at least one generic BI tool for monitoring and planning their business activities. According to a UCISA CIS survey, SAP Business Object is used by 22% of the institutions, Microsoft Performance Point by 19% and Oracle’s BI systems by 14% but “meanwhile I’m not hearing of the SAP, Microsoft and Oracle significant adoption in education” (Uma & Sankarasubramanian 2014).

The following four figures are from the European Universities Information Systems (EUNIS) BI conference, held in Paris March 2014, for evaluating the maturity level of BI in European HEIs (Cardoso 2014).

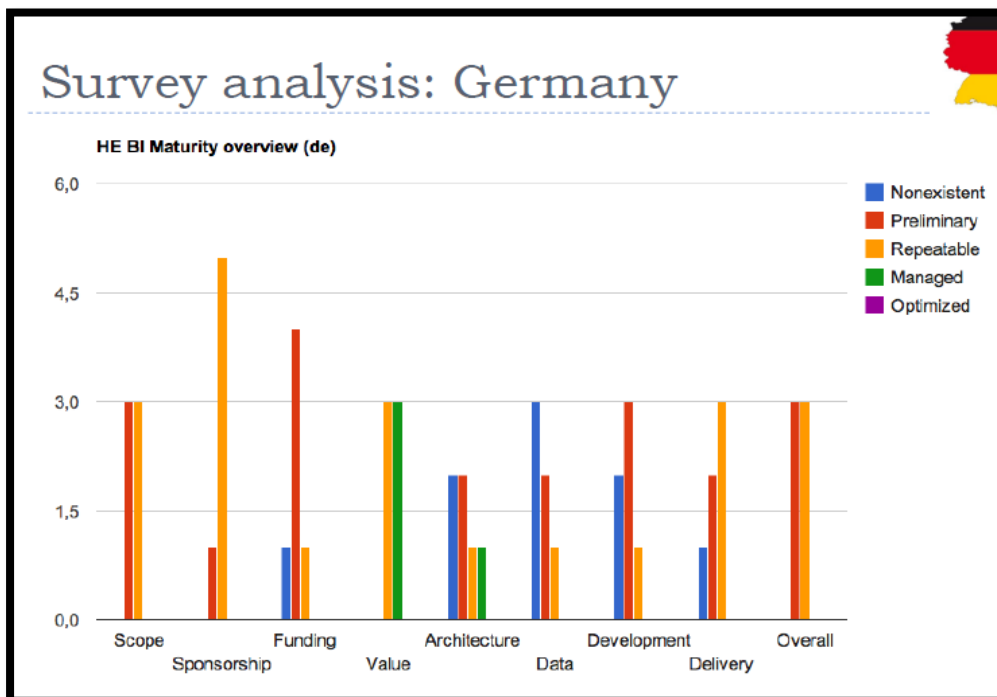


Figure [I-4] : HE BI Maturity overview, Source: (Cardoso 2014)

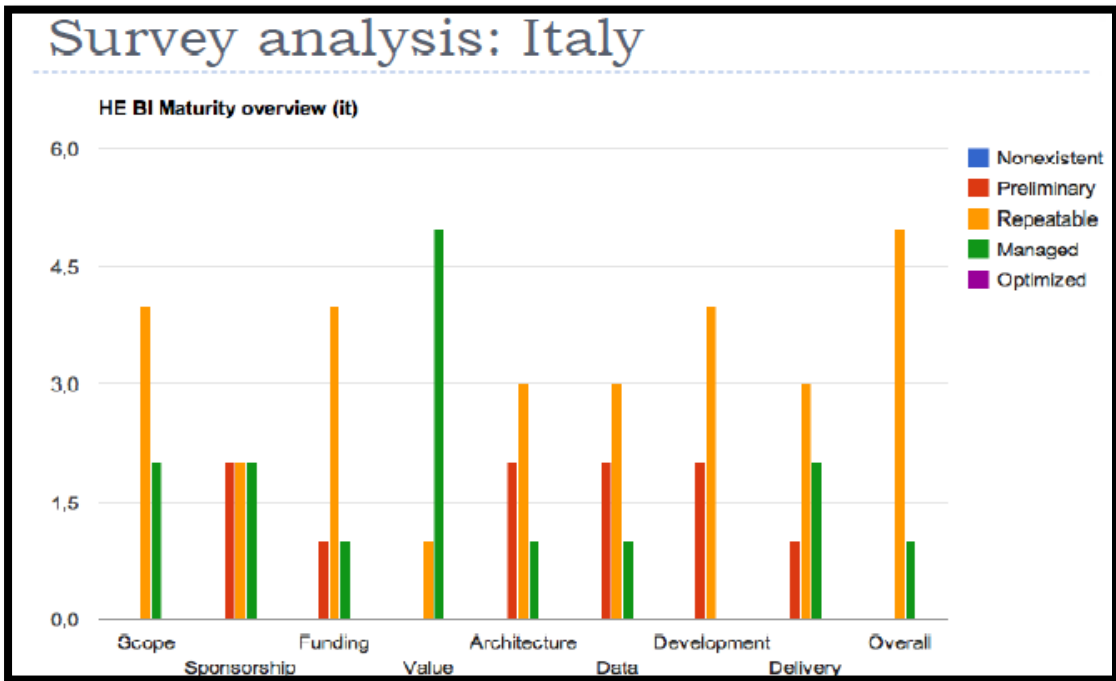


Figure [I-5] : HE BI Maturity overview, Source: (Cardoso 2014)

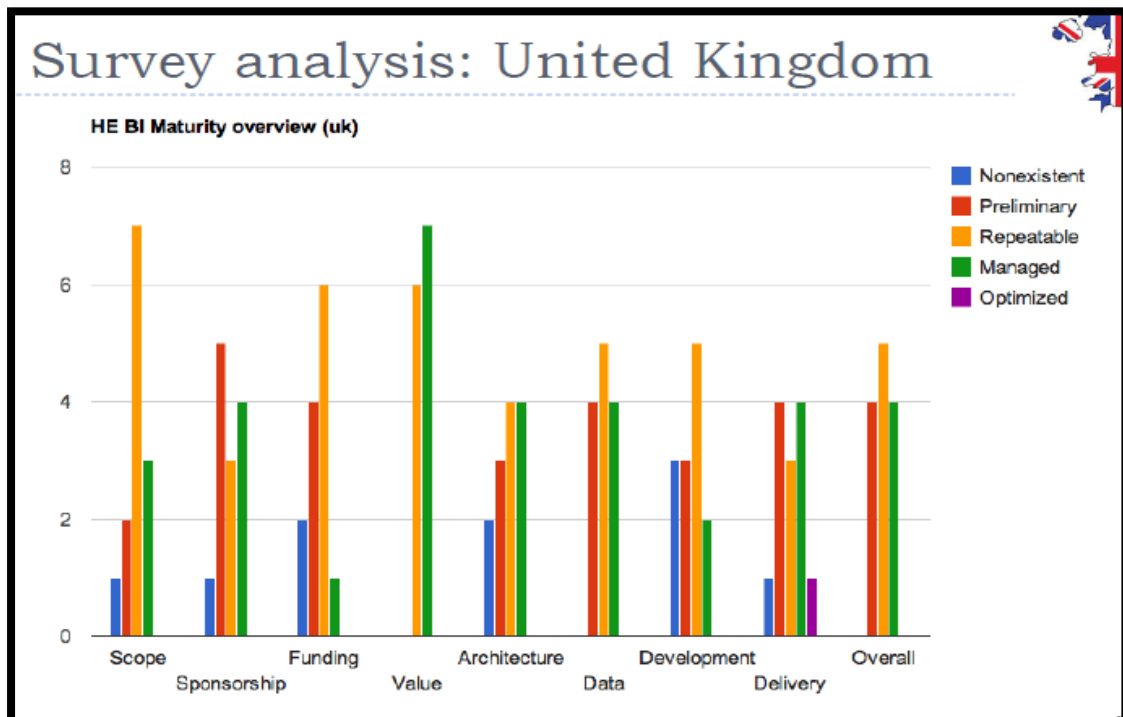


Figure [I-6]: HE BI Maturity overview, Source: (Cardoso 2014)

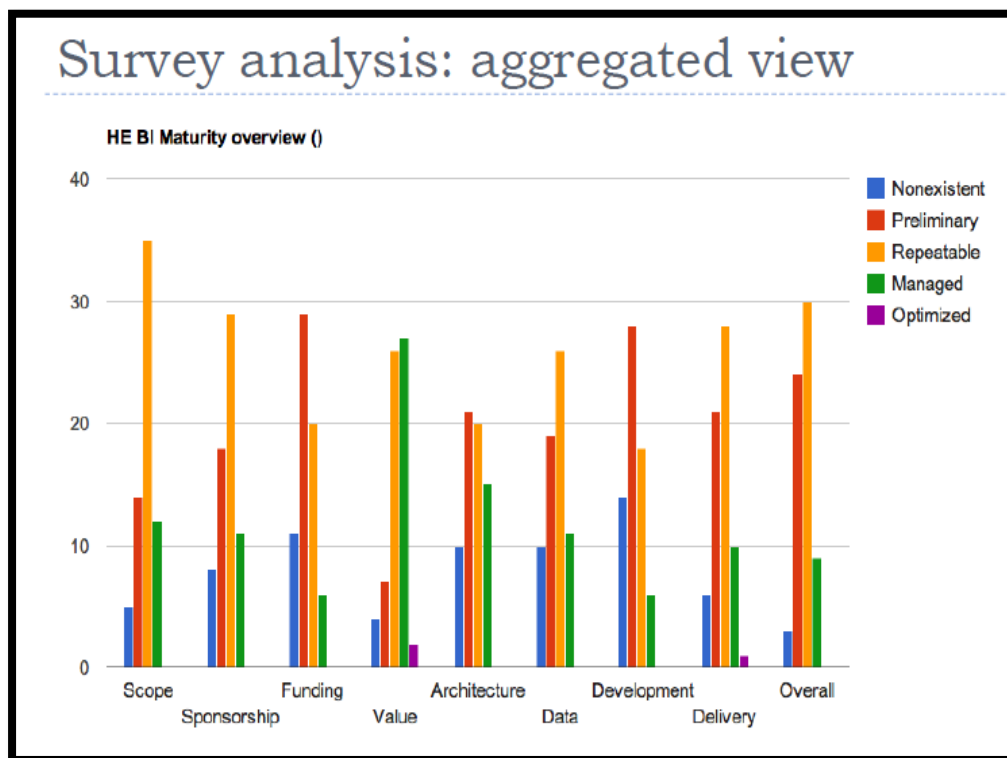


Figure [I-7]: HE BI Maturity overview, Source: (Cardoso 2014)

Fig. [I-4] to Fig. [I-6] illustrate the assessment of the maturity level in some of European universities creating a benchmark for each participant against the total average score (Cardoso 2014), and the aggregated view, showing the truly need of deploying BI tools in education to increase the levels of maturity, to keep competent and attaining institution goals meeting the students' educational specific needs by addressing LA challenges and improving the overall performance in all modern and leading HEIs. In spite of all mentioned needs, research in analytics and big data is limited (see Fig. [13]); (Bichsel 2012); (Daniel 2015); (Chen 2012). Another reason for the limitation in this area in universities, is the fact that it is not attractive moneywise as in marketing and other manufacturing activities (Aljawarneh 2016).

Universities and colleges do not have enough useful data about the students and their learning experience. The data that available in HEIs is not analyzed or interpreted (Elias 2011),

(Bichsel 2012), so, LA&BI in addition to taking the most profits of significant, BI tools is expected to be the solution for improving the situation and can contribute to taking better, timely and informed decisions in developing as well as enhancing the students’ learning process.

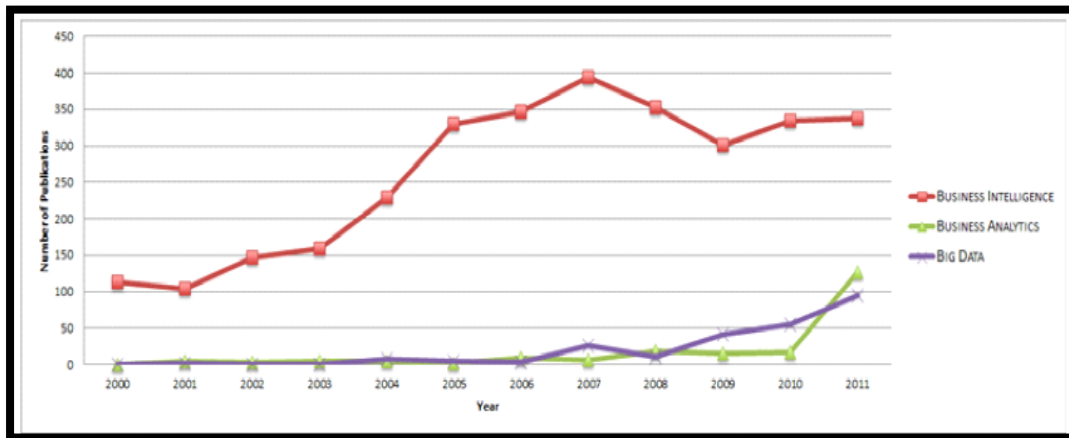


Fig. I-8 : BI&A related publication trends from 2000 to 2011, Source (Chen et al. 2012)

3. Problem Statement and its Significance:

BI is increasingly being one of the top priorities in HEIs (Duan et al. 2013) that used to provide solutions in retention of students or early prediction of dropout of students. In addition, DM tools are used for the prediction of student’s satisfaction, experience and knowledge discovery (Ferguson et al. 2012). However most of them fails to provide an appropriate, successful, associated visions and significant insights for LA (Abdul Aziz et al. 2014).

Till now, data stored in HEIs is not intelligently extracted for the reasons of improving the learning processes, in spite of successful experiences in other fields like health, marketing,

retail and sports and promises of technology that big data (which becomes as important as these BI tools) in universities can positively impact performance, drive system improvement and quality of learning (Macfadyen et al. 2014); (Jantti & Heath 2016), and thus, attracting more and better students, faculties, programs and researchers as well as improving universities’ performance, accreditation and ranking.

In spite of widely successful usage in industry, research about BI and analytics is limited, (Fig 13&14), and needs to become “actionable” in the context of quality assurance, especially in academic environments (Watson et al. 2016); (Murnion & Helfert 2013); (Elias 2011); (Abdul Aziz et al. 2014). Recently, there is emergence of urgent need of an evidenced based learning analytics framework (Rienties et al. 2016).



Figure [I-9] : Tag cloud visualization of major topics in the (BI&A) literature , Source (Chen et al. 2012)

Although the volume of data available in HEIs is big, decisions are seldom built on it (Elias 2011), and the data assimilation ability or capability of integrating data from all sectors or angles to form “one version of truth” or a single framework repository to be the foundation like an Educational data warehouse (EDW), is non-existent in most of higher institutions (Mutanga 2014), so there is an absence of future resources requirements (Elias 2011). Thus actionable knowledge, in most of institutions is suspended at data level (Elias 2011), (Murnion & Helfert 2013).

In addition, the evolution of ICT that produces vast amount of dynamic data makes it hard to measure and clean, to get the right information. As there are a lot of data regarding the students' behavior and activities such as class attendance, results on coursework, tests and final examination that might donate to the students' final outcomes, information retrieval and scope of analytic in the educational context "is still at its infancy", and most of HEIs are in the data-collection or data-monitoring stage (Abdul Aziz et al. 2014); (Bichsel 2012).

This limitation is due to barriers of affordability/economical barriers, data structure, culture, capability and communication (Bichsel 2012). Institutions can overcome these barriers, assigning high priority to analytic (Bichsel 2012).

According to (Mutanga 2014), a number of HEIs record low levels in terms of their "student success rates, graduation rates, enrolment targets, staff retention etc.", therefore, there is a great demand to explore the exciting possibilities of BI & LA application areas.

Because of the above-explained situation, in the education background with reference to reality, obstacles, trends and opportunities, there is a worldwide need to focus on this area of research to create an evidenced-based model/framework that fill the gap between recent BI maturity levels and the desired one towards LA.

In addition, it is required to increase the capabilities to build high or effective-quality EDW in order to satisfy the institution's needs in a variety of analytics, performance measures evaluation, competitive advantages and Decision support matters.

This research, derive implications for the BI performance in the LA application area, by identifying user requirements, challenge and opportunities are explored, targeted at how to solve these problems, based on creating and validating models serving those solutions.

4. Research Objectives:

The main objective of this research is to design, develop and validate a model/framework to integrate BI solutions, LA and students' performance to improve teaching learning process, learning outcomes and get actionable insights of student achievement in HEIs, to avoid student dropout toward enhancing student success, retention as well as performance satisfaction.

The Model is expected to fill the gap between the current maturity level of BI and the desired one in the same area, addressing the challenge of learning analytics for individual students and instructors (i.e. using data and analytics to support students' development), keeping up with the ICT revolution and the dynamic growing of "big data" in universities.

Additional objectives are listed as follows:

Streamline university students' data collected from multiple, often heterogeneous sources into a data warehouse DW/EDW (phase of data-in) by joining transaction and reporting systems (ETL), to get most benefits of the Business Intelligence toolkit and provide comprehensive reporting and analytic, to predict student achievements and allow for instructional action and/or academic advice and/or psychological support, through economically supporting the governmental/HE system, helping saving spending, administratively supporting the governmental/HE system, helping saving management effort, and provide personalized attention improving students' satisfaction and that way improving social welfare, jobs...etc.

Properly analyze facts and anticipate tactical and strategic suggestions getting profound knowledge about the students, their different learning features, specific educational needs and adequate responses to the LA challenging demands.

Allow university administration to view, easy access, highly customizable and freely share data, informed reports and electronic dashboards, which they can use for students' learning decision making, enrollment planning, quality assurance and inform policy.

Implement and Integrate with other student's data systems.

Evaluate the end-users'/stakeholders observed adoption and approve of the rolled-out information system based on the developed BIELA model.

The proposed model will leverage collective knowledge of existing students' information systems to house a university-wide students' management information system (admitted, academic and biography). The system will establish practices and procedures for HEIs students' information systems and operational data delivery to regulate the processes of data integration and propagation on a web portal in a later phase. In this process, the information system will facilitate the establishment of a centralized system of students' data records that ensures legal submission for both internal use and external reporting.

5. Research Question/Hypothesis/philosophy:

4.1 Research Question

What practical transformation techniques can HEIs use, to actively analyzing their students' learning experience for proper predictive analytics? , the answer to this question is the practical implementation of the developed BIELA (Business Intelligence Enhance Learning Analytic) framework, to create a profound knowledge about students, understanding their different learning characteristics and specific educational needs using BI&LA; and to achieve a better learning environment, student satisfaction, support for decision making, retention and increasing the performance in HEIs towards LA and thus overall institutions' performance and ranking as well as attracting more and better students and researchers.

This question was addressed through a needs assessment of the main stakeholder (learners), by conducting a student satisfaction survey and by analyzing needs to be considered in design an effective learning analytics model.

There are various sub-questions deriving from the main research question as follows:

What is the first base step could be done for proper analytics ?

To make data properly analyzed, a unified data structure or “single version of truth” or “one-size-fit-all” approach to facilitate the analysis and the high-quality suggestions/predictions is needed, in the phase of scanning and preparation of data, in the step of “data in”.

Data must be collected from all angles to build a profound understanding and foundation of Knowledge about the students to assess the current situation, using BI technologies that enhance “data talk”. Most of the researchers believe that the majority of the useful students’ data are collected from SIS & LMS. (Elias 2011).

As there is vast amount of data available in HEIs due to the growing technology use, that can be structured/unstructured and in various formats (electronic tables/text document/database structure), the doubt has to be eliminated by joins BI application (Tableau-prep) preprocessing, to ensure data quality which represents the foundation of the predictive visions and allow for appropriate decisions and better suggestions.

How can Data about students improve the prediction of individual performance?

Individual student performance details, such as his personal profile and his results in his complete educational lifecycle, could give a clear vision to realize that the student is improving his scores semester over semester or going down, this process will be effective in picking at-risk students before being dropout by consulting and withholding them, and will be a good tool for the academic and/or psychological advise raising student success, retention and satisfaction for students and society by minimizing the risk of dropout, and better explore and predict individual performance.

Is the existing vast amount of data in HEIs useful to produce information that is really interesting and valued to address LA challenges?

This is the most important research question which can be answered after scanning existing data, collecting raw data, conduct surveys and interviews to both, students and administration staff, and studying documents from the higher education sector to extract requisite variables, investigating requirements specifications, analyzing and deriving reports.

The data collected during the process of answering the first research question will also provide perception on how a BI Enhance LA (BIELA) framework for HEIs (as proposed by this thesis) can be developed.

4.2 Research Hypothesis

BI systems and solutions have a significant and large impact on students' success as a key research topic, strategic fact-evidenced and high-quality decisions, in terms of teaching quality, students' satisfaction, retention, course grades, enrolment planning and any other services that are caring/dedicated to the learners and their context in HEIs. They lead to decreasing the time for making decisions that are fact-based on high quality datasets that are collected from all sectors making a profound awareness and effective knowledge about the students and their learning experience.

Thus, these systems must have the capability to permit decision' makers to vision data in different view, to "drill-down and roll-up" to aggregate levels, to navigate and on-line query data sets in order to discover new factors that affect the learning processes, enhance the student success, massively increase efficiency, refining teaching and learning as well as to suppose and forecast changes inside and outside institutes.

The BI framework that will be developed in this thesis research will be called the Business Intelligence Enhance Learning Analytics framework (BIELA).

Summary

This chapter includes background of related fields like BI, LA and their benefits, it addresses the problem related to the lack of evidence-based step by step practical model, to enhance deploying LA in HEIs, the motivations and significance, objectives of developing and validating a framework to guide HEIs in the implementation of LA tools to effectively use their vast amount of data generated due to revolution of ICT for analyzing knowledge and support decisions, along with research hypothesis and questions. This study contributes to the build of knowledge regarding implementation of management information systems in higher education.

The following chapters are organized as follows: Chapter two provides a thorough review of literature related to action researches, universities BI initiatives, as well as literature related to design and development LA models, “big data” as a big challenge and open issues. Chapter three provides an overview of the research methodology, research methods, instruments development and validation, data source, variables, analysis and analytical method,. Chapter four presents the results of the study, and discussion of results. Chapter five presents conclusions, implications, and a summary of the study.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Review Scope:

Correlation between BI and LA in HEIs, by developing a model to investigate maturity/implementation level, identifying the BI toolkit requirements specification, deriving implication for the BI performance in higher institutions and to care development and improvement of students' involvement throughout their university growth, by incorporating LA and predictive tools into the BI dashboard that derived from vast amount of data available/collected in HEIs. Competitive advantages, decision support, big data, Education (academic context), Retention, satisfaction and student success are also addressed in this review.

2.2 Learning Analytics field (LA):

Analytics is the smart use of historical datasets combined with current one and trends to predict actionable insights and addressing complex issues using technologies from computer science, mathematics and statistic, (Bichsel 2012); (Elias 2011). Learning Analytics in higher education is a promising approach, emergent concept of rapid growth latest datamining technique for understanding and modeling the learning process

(Lu et al. 2017), (Jantti & Heath 2016), evolving many disciplines, like DM, AI, Information retrieval, statistics, action analysis and visualization (Chatti et al. 2012), to discourse, capacity, gathering, investigation, understand, analyze, visualize, assess, advice,

predict and report learners' needs, their context, performance and the learning environment in a verification based decision making, which would ultimately empower teachers and education

institutes to tailor educational prospects to individual student's need, as a vital area of technology enhance learning (TEL), and provide effective involvements and smart learning infrastructure (Aljohani et al. 2018); (Lu et al. 2017);(Atkinson 2015); (Rienties et al. 2016); (Chatti et al. 2012); (Martin & Whitmer 2016); (Ifenthaler & Widanapathirana 2014).

Learning analytics is the evolving field that growing rapidly in which advanced tools are used in analysis and reporting of data about learners and their contexts, for purposes of understanding, predict and optimizing the learning process (e.g. retention, graduation rate and the most challengeable issue in HEIs, students' success as a key research topic, addressing the problem of rates of students drop out) (Elias 2011). (Papamitsiou & Economides 2014), Consequently, LA is an umbrella of all the following fields (web analytic , academic analytic, BI , EDM, EPM and action analytics (Elias 2011), (Ferguson 2012), (Mamonov et al. 2014), (Murnion & Helfert 2013):

- Educational data mining (EDM) concentrated on the "technical challenge": How can we explore/mine unique type of data/value from these big sets of learning-related/educational context to address educational demands, finding interesting patterns (Bogarín et al. 2018). EDM that known now as an upcoming area of research, can help institutions to increase their awareness of students' performance, retention, preferred curriculum, success, behavior and many other parameters, (Goyal & Vohra 2012); (Atkinson 2015).
- Learning analytics (LA) focuses on the "educational challenge" or the processes and tools used to improve services committed to the learners and the integration of these tools and processes to the practice of teaching and learning processes. Academic analytics is concerned primarily to the "political/economic challenge": How can we meaningfully

progress learning and support decisions by intelligent use of business data in educational context (Atkinson 2015); (Murnion & Helfert 2013).

- EPM (Educational Process Mining) is represent the bridge to the break between EDM and educational science, as it pools data analysis with modeling, and insights in educational processes (Bogarín et al. 2018). “PM is “process-centric”, thus making indefinite processes clear. The difference between PM, and DM, is that PM is interested in “end-to-end processes” instead of resident patterns (Bogarín et al. 2018). The main goal of EPM is to mine awareness from incident logs recorded by an educational system platform (LMSs, Moodle, MOOCs, etc.) and EPM algorithms determine process models of student performance (Bogarín et al. 2018).

LA is also derived from and closely tangled to some other fields of study such as business intelligence, web analytic and action analytic defined as follows (Elias 2011); (Ferguson 2012):

- BI: is a creative process in the business field that is based on a cumulative huge amount of data, information and thinking areas using information technology to transform it into innovative dashboards, reports and clear visions to enhance decision making competences.
- Web Analytic: is defined as the process of collecting data and information about the web site usage/interactive with the visitors and customers, and analyzing these information to understand, assess, foretell, vision and predict the customer future needs and on-line initiatives in a scientific way (Elias 2011).
- Action analytics: is defined as an intelligence actions proposed to increase students’ performance and success based on the data collected using BI tools.
- Academic analytics: is defined as an “engine to make decision to guide actions” that involves of five steps: capture, report, predict act and refine (Elias 2011). People benefits from academic analytics are sponsors, administrators and national governments, (Siemens et al. 2011).

2.3 Action Researches:

Researchers in LA as a fresh area of research, and latest datamining technique, mostly concentrated on technical system matters rather than methodological topics, such as "assessment" and "evaluation" (Duan et al. 2013).

BI is the foundation of construction information that is certain, fact-based and actionable (Duan et al. 2013). Cracks in the research field can be recognized by the creation of the conceptual frame work or deploying the model (Duan et al. 2013), so most of the researches in this area are action researches (AR) (Duan et al. 2013); (Murnion 2014); (Kabakchieva 2015).

(Duan et al. 2013), is an action research paper talked about applying BI toolkits in a UK Higher Educational Institutions (HEI), to improve performance of student engagement tracking system (SES) that currently used for collection and processing student's data. SES was made by contribution of both university and vendors, authors were working as stakeholders. Authors, who play an Actors role, used a socio-technical approach, investigating Business Intelligence tools for enhancing decision making for HEIs in UK. This research, also aiming to grow BI maturity level in higher education sector and to realize a fall in student's engagement level before sufficient time for retention or maintaining needy ones. Although "SES" was established in 2009, by both the university and BI vendor, but still used only as an information resource more than Decision Support System and have a poor user interfaces and suffering lack of functionalities, accordingly need of using BI is extremely grown. It connects student's personnel information that stored in a DB with other engagement information as if attendance in class/theater/seminar rooms, visit library, attends exams, summit assignments... etc. **[fig 15]**. Collection information is done by placing fixed Radio Frequency Identification Devices (RFID) in various locations such as library, lecture rooms, theatres; seminar rooms...etc. students cannot enter these places, unless scanning their ID-cards.

The first challenge, was the "big data" that increasingly growing according to evolution in ICT. BI is the powerful technology that can collect spread and diverse data in intelligent way that will be suitable for decision support and strategic organization. To achieve this, authors are carried out three stages in the research methodology.

AR stage one is: Problem Diagnosis.

First interest in this project is, the benchmarking university's BI maturity level using "JISK infoNet BI Maturity conceptual framework" which has six stages of Business employment. Another interest is the user requirement specification, which accomplished using several ways like survey, questionnaire, interviews, group discussion and brain storming session.

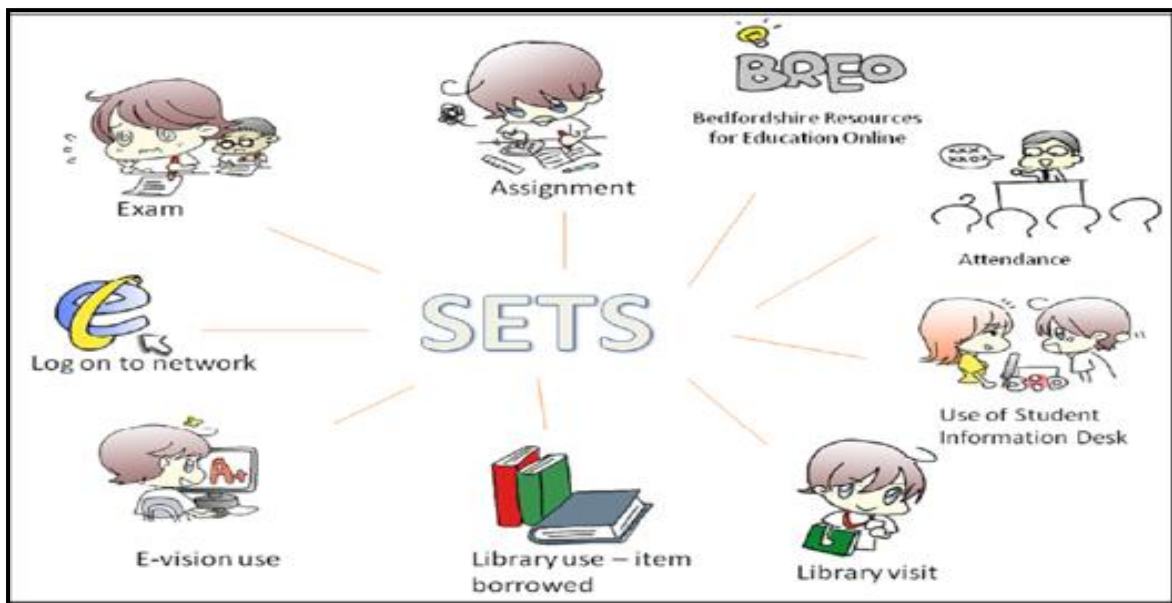


Fig.[II-1]: Data sources of student engagement tracking system source: (Duan et al. 2013)

AR stage two – Action Intervention: Beginning to create upgrading of "SES", using BI keys coping with "socio-technical" approach and based on the notion of "technology-organization-people", working together in order to achieve goals.

AR stage three – Reflective Learning: Action research (AR) means that, the results should appear from the beginning of the project, so it will be observed to recognize the correlation between "technology-organization-people" towards a BI accomplishment.

Profits and Drawback of "SES": In (Duan et al. 2013) paper, "SES" has many benefits like insuring a real time tracking, an approved feedback of the student's engagement, enhancing management and remedy of required situation before a sufficient time, improving of students' behavior, easy comparisons between different groups of students and following the legal regulations.

However "SES" is suffering "bottleneck", poor user interface, other significant areas of student's engagement are not included, correctness & completeness of data, connection with other student's data schemes, poor results and user limitation to adapt his priorities/needs.

User required specifications for successful BI employment:

For developing the current "SES" system, users are underlined the following requests:

- Users want to adapt and customize student engagement measurement key according to their various needs.
- Ranging flexibility in the system so that, users can use the default engagement standards and arrest a mix of different data types to submit their own significances.
- Users expected not only reports which is prepared in a prescribed form according to established procedure, but also interactive "dashboard", trend reports, Periodic Report and demand report.

System early notification to the users, about students that in threat. The notification can be through an email or pop up window in a periodic time, to address the threatened students as early as possible.

Benefits of the New "SES":

The preliminary evaluation of the project shows that the project increases university "maturity level", number of dynamic users and number of fixed identification devices.

Automation and competently gathering of students' data for handling and gives the required and fresh reports for enhancing decision support and student early withholding.

Untouchable benefits of the New "SES" (Duan et al. 2013):

- Increasing attentiveness of users' familiarity and accepting of BI significance and strategic information of "SES".
- Improving students' engagement behavior especially lectures attendance.
- Unmistakable reports of students' engagement and early upholding of students at risk are increasing managers' satisfaction for Decision support.

However, this paper:

- Considering only students' engagement data in a sociotechnical approach, i.e. action research in which authors play as a technical teamwork and actors.
- They did not produce any generic procedure or model for the transformation from old system "SES" to the new one.
- Develop an existence system, which is "SES", i.e. did not begin from scratch.

Another example of an action research (AR) is "Learning analytic evaluation: An Examination of Practice" (Murnion 2014).

The author in this paper investigate a model for estimation of LA by extending the IS Success Model using a theory for incorporating technology with user activity, as an action research (an initial implementation is in a third level institution).

This paper also contributes "concept of appropriations" which means the real type of usage – rather than amount of usage in old measure - of the construction providing by IS, so it concentrated on correlation between construction and practice, and there must be a real implementation of the model to detect and resolve gabs in LA evaluation methodology.

However, the model is:

- Lacking in "operationalization" part.
- Cannot keep up with future projects, because of unsatisfactory statement.

- The model develops an existence model, which is "Success Model", i.e. did not begin from scratch.
- The model is applied in a third level institute.

A third (AR) paper is "Business Intelligence Systems for Analyzing university Students Data", (Kabakchieva 2015).

Research approach:

Data collection and preparation, "Qlikview" Business Intelligence software is used to analyzed the dataset. Investigating results after data analysis, construction of conclusions and References are declared.

(Kabakchieva 2015), is another example of employment of BI tools for student data analysis, to investigate the positive impact and increase performance of learning process and to emphasize the profound of BI tools in decision & managerial support by analysis an existing data so as to increase performance of learning process, teaching quality, individual students' abilities, students' satisfaction and observing information that can help predictions and improving educational issues. However, very little amount of data –in excel format- prepared (as dataset) by one lecturer for exercise class over three years, by using a ready-made software BI package (it is better to change software packages to overcome a limitation with a particular package than to change the analysis procedures), so big dataset can be difficult to take place.

2.4 Design and development LA models:

As learning analytics is a new fast-growing field, promising approach, latest datamining technique (Lu et al. 2017), (Martin & Whitmer 2016), most of the researches are concentrating on developing reference model for defining, , user acceptance , raising responsiveness, and understanding the power and capabilities of learning analytics and it's critical dimensions, (see fig (4 & 5)), (Rienties et al. 2016); (Chatti et al. 2012); (Greller & Drachsler 2012).

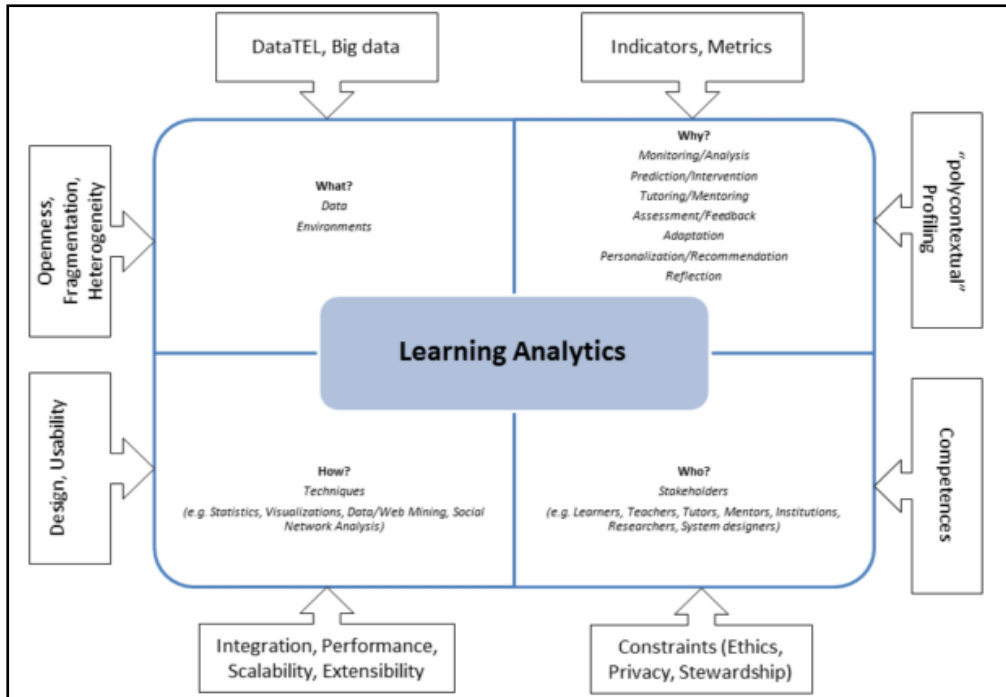


Figure [II-2]: LA reference model, source: (Chatti et al. 2012)

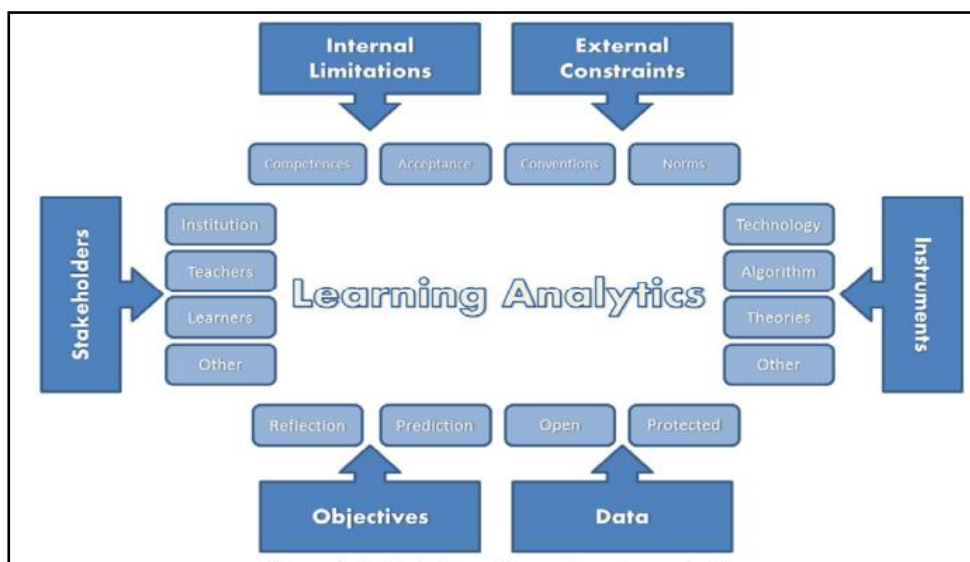


Fig.[II-3]: Critical dimensions of learning analytics, source: (Greller & Drachsler 2012)

In the literature, there is focusing in analytics of virtual learning environments (VLEs) e.g. Blackboard and Moodle, like the case study in (Bogarín et al. 2018) that use the log file delivered by LMS, fewer of them validate their app in real cases, due to ethical barriers, that should be considered prior the implementation (Jantti & Heath 2016). Most of LA applications are deployed in an online/blended environment rather than traditional classes (Martin et al. 2016); (Aljohani et al. 2018) ; (Martin & Whitmer 2016); (Martin et al. 2016); (Anderson et al. 2014)generating VLE usage data, such as the number of clicks, number of words in blogs, content usage, the number of blogs, .. etc. (Rienties et al. 2016). Most findings in literature, are correlated between students’ usage of learning resources and academic performance (Jantti & Heath 2016), (Gašević et al. 2016); (Aljohani et al. 2018).

LA can make use of big learners' data for investigating and understanding their requirements, improve the learning process, satisfaction, retention, inform stakeholders [fig 2.3], and advise quality assurance processes ([table 2.1], illustrate analytics capabilities for assessment one instance in QA processes).

	→ Analytical Complexity →		
Analytics categories	Descriptive Analytics	Predictive Analytics	Prescriptive Analytics
Generic Analytical Capability	Measure/monitor performance	Project, Analyse relationships	Model decisions, Optimise
Instance: Assessment Strategy Review	Overview of assessment activity across entire programme	Examination of relationship between assessment events	Determine modules that have most and least effect on programme award
Analytics Tool (e.g.)	Programme schedule report	Correlation and regression analysis tools	Statistical modelling tools enabling user modification of parameters

Table [2.1]: Analytics capabilities for assessment strategy evaluation (Murnion & Helfert 2013)

Using LA, models produced, can predict future processes (Murnion 2014); (Ferguson 2012); (Abdul Aziz et al. 2014); (Bienkowski et al. 2012); (Papamitsiou & Economides 2014); (Atkinson 2015), (Martin 2016).

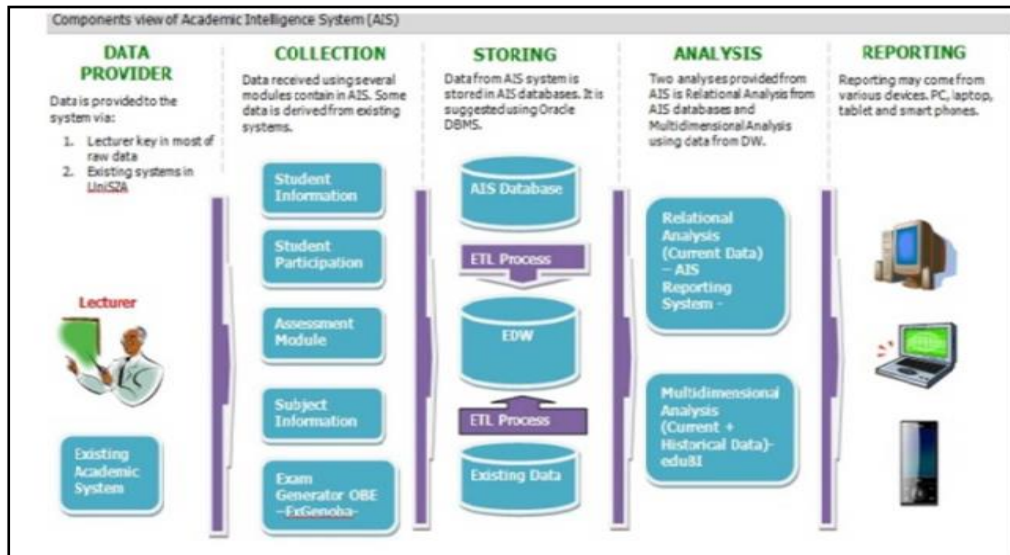


Figure [II-4]: An educational intelligence framework, source: (Abdul Aziz et al. 2014)

An international community and events such as SoLAR (the Society for Learning Analytics Research) has been developed (Ferguson et al. 2015), since the emergence of LA in North American, Europe and Australia, with smaller pockets of motion developing in other regions (Ferguson et al. 2015).

The effective LA challenge is how to use big datasets and analytics to care about students; refining learning outcomes (Elias 2011), knowledge, inform decisions, satisfaction, enjoyment, confidence, meeting career needs and promptly rising as a significant area of TEL (Technology-Enhanced Learning) research (Ferguson 2012).

The "big data" that daily increases due to growth in the use of online learning in VLE or LMS including Blackboard and Moodle is the main challenge in LA (Murnion & Helfert

2013); (Klašnja-Milićević et al. 2017), and business engagement analytics to cutting value from such datasets (Ferguson 2012); (Klašnja-Milićević et al. 2017).

Fig.2.5 shows the LA continuous improvement three-phase cycle through which a high-quality data is produced to improve learning processes and students’ satisfaction.

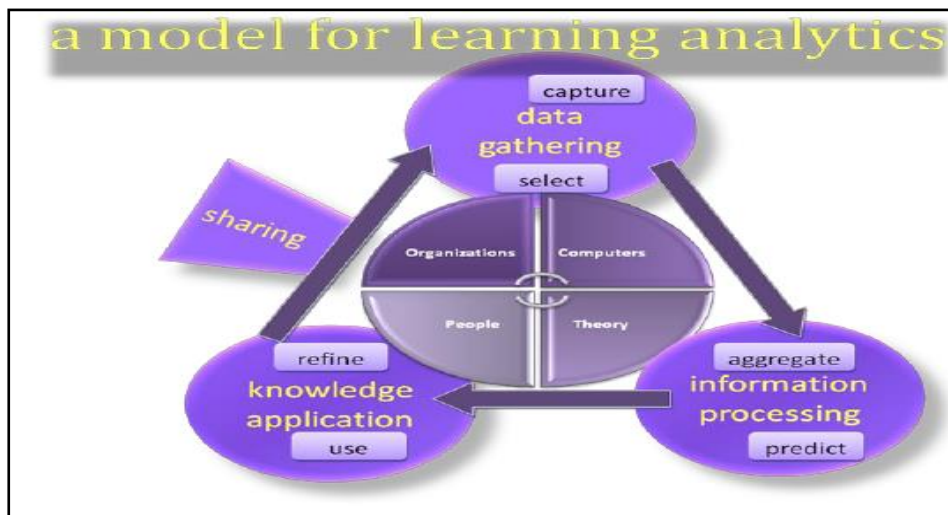
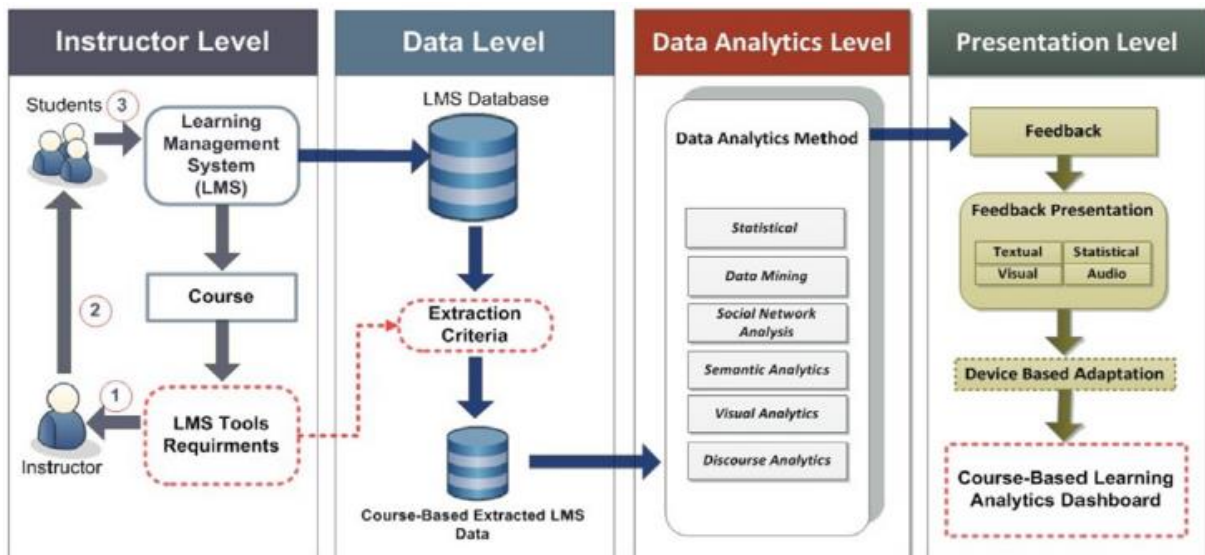


Figure [II-5]: LA continuous improvement cycle, Source: (Elias 2011)



Figure[II-6] : Course adapted student learning analytics framework , source (Aljohani et al. 2018)

Fig. 2.6 shows, one of the largest “course adapted student learning analytics” frameworks the framework has four different levels, Instructor, data, data analytics and presentation level. The framework is based and verified in a blended learning environment which is LMS, using dataset of 1200 students extracted from blackboard (Aljohani et al. 2018). Eventually most types of data used in LA are automated online dialog and/or survey data extracted from school ecosystem (Nistor & García 2018).

2.5 Universities’ BI initiatives

AS BI is increasingly being, one of the top priorities in HEIs, Some universities conducted an investigation experience in BI creativities for making significant and evidenced decisions with the use of IT systems, although very few universities of those has BI initiatives are formally documented their methods (Aljawarneh 2016).

Indian universities (IU) starting this experience since 2009 for supporting Decision Making resources and dimensions that assessed by IBM which confirmed the problems and describe a general method to solve them **however**, their approach did not provide accommodations executive structure and practices of the university and its essential campuses that are insecurely joined (Initiative 2015).And the data is not in its most functional setup as required for DSS and for encounter various needs throughout university (Initiative 2015).

Another limitation is lack of future resources requirements in addition; the general proposed model is dedicated for IU to overall activities including finance and administrations functions (i.e. not concentrated in the rise of learning-focused perspectives and its environment).

According to (Mutanga 2014), most of South African HEIs has no unified data structure (DW) that act as a foundation for employing analytic and BI systems initiatives. Data sources are reverse each other, in raw format and useless for Decision making process.

The paper (Mutanga 2014), contribution is to provide a context-aware frame work for BI initiatives for HEIs in South Africa, that collect context data and adjust the behavior of the system accordingly. However, the context-aware business intelligence framework (CABIF) is still a concept that not yet verified for its agreement and use in the South African higher education. In addition, the model is suitable for HEIs educational context in South Africa and worked with its MIS datasets fig. [II-7].

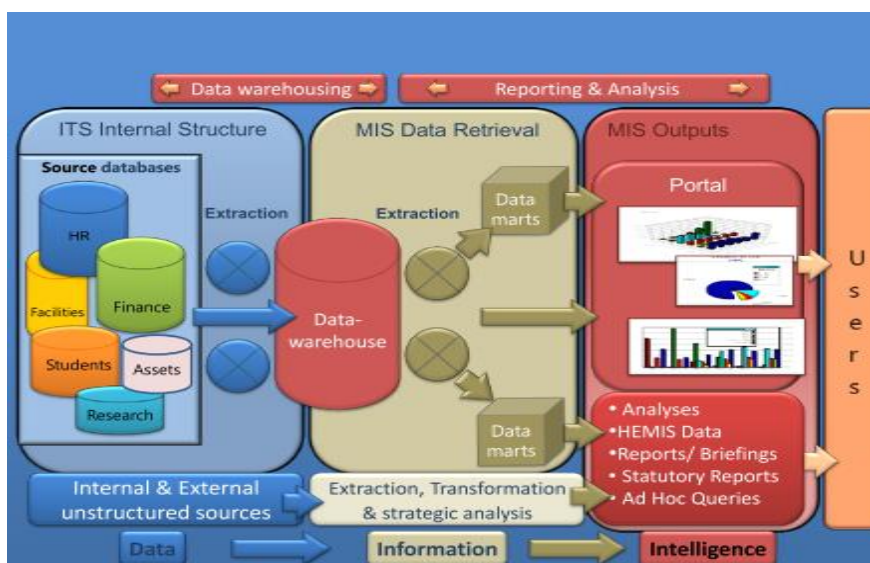


Figure [0-7] : Context aware BI framework for South Africa, source: (Mutanga 2014)

(Chen 2012) “Applying Business Intelligence In Higher Education Sector: Conceptual Model and Users Acceptance”, is a master research Thesis, conducted in university of Bedfordshire. The thesis combine technologies, tools, and technique with people (targeted groups and other stakeholders) to gain profound understanding that helps improve teaching-learning process, where (EDW) is the main component to support EI concept. To maintain the cost of deployment challenge, the researcher suggested some technologies that is combination of “open sources” tools and trademarked software. However, the model need further refining to accommodate evolution of ICT, and the vast amount of data that growing exponentially, considering essential changes in LMS.

(Abdul Aziz et al. 2014) “A Framework for Educational Data Warehouse (EDW) Architecture Using Business Intelligence (BI) Technologies”, is a paper introduce how to build EDW using “Congo’s” BI reporting. To further increase of students’ success and retention, they do reports for students’ result by subject, geographic information, time dimension and personalized students’ achievement taking Unassay (university of Sultan Zain Aladdin) as an example. However, need more of inclusive analyses of students’ data that can be done by accommodating more sets of students’ data.

Another study in University, (Aziz et al. 2012), certify that BI technology is applicable to educational data. In addition, that DM is used in business area rather than educational area. The big challenge was the “big, diversity and dynamic data” in educational field, therefore, this research only contributes on personalizing students’ academic behaviors. However, findings are based on the results for each semester, and several selected factors in the determination of students’ successes.

Researchers at the University of Florida (Baepler & Murdoch, 2010), use Moodle CMS data logs to see its impact of a student’s sense of community. Scores were compared with each student’s cumulative user log. The researchers concluded that the total number of log entries or user events was a valid predictor of a sense of community within the course. Such information, should help instructors construct a more accurate representation of, and tailored content for, their online students. The experiment suggests that it may be possible to measure some affective attributes among students with simple data logs. This development could enlarge data from student surveys or reduce the need to administer so many questionnaires at a time when survey collapse has become apprehension. However there were several significant limitations to the study according to depending only on students’ logs.

2.5 “Big Data”

One of the big challenges in educational field, is the “big, diversity and dynamic data” (Aziz et al. 2012), that is growing exponentially due to the fast evolution in ICT. The “big data” concept is an umbrella term (Hughes & Dobbins 2014), refers to data that is either too large or too unstructured and needs other new technologies (such as ubiquitous sensors or Hadoop framework) to be managed and analyzed, that is why it becomes one of most exciting issues in analytics, (Davenport, 2013).

According to Gartner, current data will grow up to 800% by 2020, and 80% of the data is still unstructured. These data are collected of emails, audio, images. As IBM argued, this data is the most complicated raw material in the IT domain. In this consequence, traditional capability is not enough to produce all the data and make the best decision.

IN spite of its important, researchers gave different definitions to “big data”, however they agreed in that it couldn’t be interpreted, perceived, process or managed using traditional IT or software and hardware tools in a tolerance time, and its 4Vs of (volume, variety, velocity and value), (Chen et al. 2014).

Some researches value the role of understanding and get most benefits of "big data" , (Klašnja-Milićević et al. 2017), or ocean amount of data in HEIs that is generated by users as a result of modern business, automation and new technologies.

(Daniel, 2014), describes challenges and opportunities and how to discourse some of this using "big data". The paper also describe how can HEIs apply "big data" information for helping to increase performance of learning outcomes. However, the proposed conceptual model is describing utilization of "big data" in general.

(BOLOHAN & CIOBANU, 2013) Argued that, no need to do effort of collecting big data unless it is meaningful, and a useful and timely information could be extracted, shared and easily accessed (i.e. properly analyzed). Also the paper showed what you should keep from the massive sets of data that grow exponentially and how to best manage and oversee it using analytics and technologies that emphasize the possibility of analyzing useful data, suggesting a number of recent technology advancements that facilitate things one never thought before (e.g. Hadoop framework & SAS technologies) (BOLOHAN & CIOBANU, 2013). Paper contribute also to the importance of analytic and DM and that big data has become as important as these tools.

However, the paper show some examples of models for big data management and analytic without illustration, which of them is the best model to use, and without showing how to improve an existent one, i.e. the models are not validated.

(Chen et al. 2012) Conduct structured L.R to confirm on the limitation and needy of relevant academic research and new visions to keep up with the revolution of ICT and growing of dynamic “big data”, with the importance of exciting capabilities of BI&A to mine unstructured “big data” in the past several years. Although it is still maturity, paper show the exceptional intelligence on gaining new business opportunities.

However, the Paper introduce a historical survey of special issue papers within BI&A research framework, without naming an open issues opportunities.

(Bichsel 2012), announce the Significance role of analytic in higher education, maturity level of adoption and limited researches, and the big revolution that will perform in the next twenty years in the systems of higher education as the data grown up with time. However, the paper provide summary of respondent to survey about analytic to some institutions’ members without demonstrating the results or showing personal opinion.

(Brown 2015), Contribute to confirming on the idea that “analyzing big data is the same as the process of eating an elephant; you do it one bite at a time”, the author decides to discourse the challenging of analyzing big diversity data by, starting with small manageable sample data

(Yeoh et al. 2008) to explore and determine values, with one eye to (legal) requirements of selections, then repeat this over and over, otherwise it will be very expensive and time consuming.

2.6 Open Issues

Very few universities of those has BI initiatives are formally documented their methods, often without a guidance of a research base.

Most of use cases are made in E-learning or blended VLE and rarely used a real active students' dataset due to ethical barriers, so adopting privacy and ethical requirement will increase the need for Ethical Models to guide students' data use and associated accountabilities that remain an open issue.

The link between BI maturity level, institutional success, quality performance and the impact of BI initiatives is not quite clear in the literature.

Concentration in literature is on BI maturity level but rarely addressed LA challenge within the maturity models described, nor considered the learners' opinions which will be essential in meeting their needs.

Summary

This review, offered the current state of the bulk of knowledge in the field of LA. A mixture of literature on action research, literature addressing the implementation of LA in some modern universities, as well as critical design and development LA models was illustrated. Additionally, growing "big data" development research as a big challenge and big opportunity in HEIs was introduced. And before the end, there are the open issues from current literature. Chapter 3 describes the methodology of design and development of the BI model to enhance LA in HEIs, used in this study as the main contribution in greater detail.

CHAPTER III

METHODOLOGY

3.1 Overview

Composite methodology was used for the purpose of this research, that integrates BI software tools, predictive analytics, LA, the latest DM technique in education arena, and student performance, to find answers to the research questions and to address the research problem, which is lack of evidenced-based, practical and step by step BI model to address extra-turbulent issues of LA in HEIs.

The main question: How to join BI systems, LA and students' performance to investigate a framework, helping HEIs in analyzing their students' learning experience for proper predictive analytics? , addressed by the practical implementing of the developed BIELA framework, using design and development research method (see Fig. 1.3). BIELA construction started by empirical study in LR serve as the basis, studying BI initiatives in some modern universities, desktop research, state of the art in learning analytics modeling, study universities' standard documents in QA measures, teaching learning standards and KPI, surveying and interviewing target groups and experts, and by using design and development methods (CRISP- data mining method, Monkey survey and Corel Draw).

Proper data analytics, is the vital requirement for addressing the second question: How to integrate BI solutions, learning analytics and students performance to raise learning effective and decision support? To reflect realistic reports and customizable dashboards to inform decision-making. Predicting and presenting useful data for enrollment and program review

planning, determining the end users' perceived adoption and acceptance of the implemented technology, all this will raise learning process and decision support.

As there is growing amount of data available in HEIs, that can be structured/unstructured and in various formats, the doubt has to be eliminated by cleaning inconsistency, transforming and completing data , to address the third question: How to populate students' data and ensure data quality? By joins BI application (Tableau) preprocessing phase (Tableau Prep), to ensure data quality which represents the foundation of the predictive visions and allow for appropriate decisions and better suggestions.

Individual student performance details, such as his personal profile and his results in his complete educational lifecycle, could give a clear vision to realize that the student is improving his scores semester over semester or going down, this process will be effective in picking at-risk students before being dropout by consulting and withholding them, which address the fourth question: How can Data about students improve the prediction of individual performance?. The most important research question is the fifth one: Is the existing vast amount of data in HEIs useful to produce information that is really interesting? , this question is addressed after scanning existing data to extract requisite variables, and investigating requirements specifications, analyzing and deriving reports.

3.2 Model Construction

The solution to the research problem, that is lack of evidenced-based framework to enhance LA in HEIs, is refers to the process of integrating BI technology, LA and students' performance for analysis of university students' data assets available/collected from heterogeneous resources, builds the foundation of a profound understanding of the students' learning processes, leading to construction of a novel, but practical model that will fill the gap between the institution's BI maturity level towards implementation of LA and the desired one.

A mixed quantitative hybrid methods approach used in developing the BIELA university-business model. This approach is based on, understanding the user ethical requirements for the predefined target groups (administrations, staff members, students, head departments and managers for academic and quality affairs) and the services that are dedicated to learners (main stakeholders that should be engaged in helping the University to feed and update their data to support withholding and consulting them). Researcher used CRISP-DM methodology phases for exploring main phases of the model discovery (see Fig. III.1).

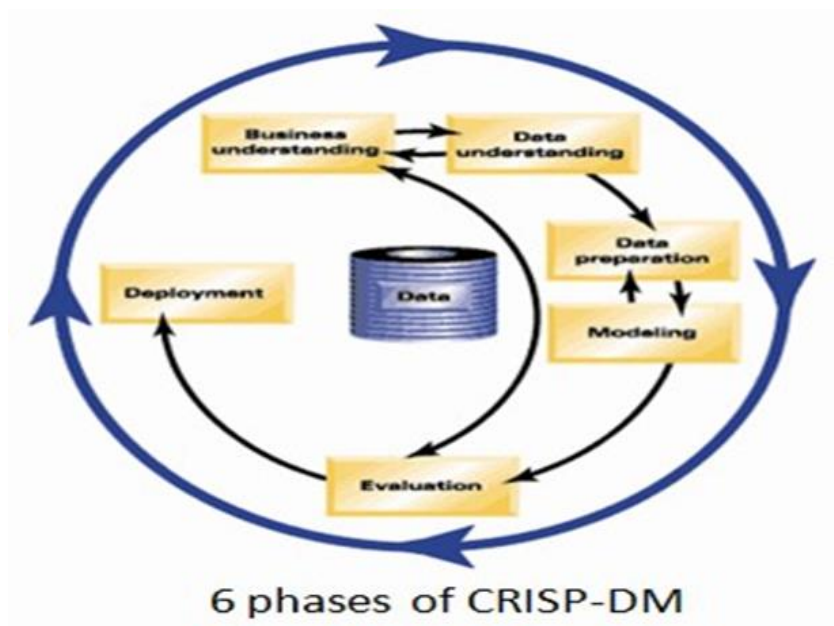


Figure [III-1]: CRISP-DM phases source: (Piatetsky 2015)

In spite of developing new processes in DM recently, but most of it are slightly different from each other, in overall structure, e.g. SEMMA focuses mainly on the modeling tasks of data mining projects, leaving commercial aspects (contrasting, for example, CRISP-DM and its domain understanding phase). Moreover, SEMMA is designed to help users from the Enterprise SAS Prospecting Agent program. Therefore, applying it outside the enterprise prospecting is indefinite. Moreover, the most commonly used methodology, in knowledge discovery is CRISP-DM (Giraud-Carrier & Povel 2003); (La Red Martínez & Podestá Gomez 2014); (Liu & Huang 2017); (see Table. [3.2]).

What main methodology are you using for your analytics, data mining, or data science projects? [2007 votes total]	
	2014 poll 2007 poll
CRISP-DM (86)	43% 42%
My own (55)	27.5% 19%
SEMMA (17)	8.5% 13%
Other, not domain-specific (16)	8% 4%
KDD Process (15)	7.5% 7.3%
My organizations' (7)	3.5% 5.3%
A domain-specific methodology (4)	2% 4.7%
None (0)	0% 4.7%

Table [3.1], main methodology using for analytics Source: (Piatetsky 2015)

The CRISP-DM (Cross-Industry Standard Process for Data Mining) methodology is systematized in six steps (see Figure [III-2]), including: domain understanding, data preparation, modeling, evaluation and deployment (Liu & Huang 2017). CRISP-DM methodology used to develop a process model, for the purpose of achieving goals in this research, to construct the main phases of BIELA, together with other instruments and software tools.

Starting by domain understanding, the first phase in CRISP-DM, researcher exploring the state of the art in LA maturity level of some modern universities, BI initiatives and action research in some other universities, modeling and design perspective and big data that growing exponentially in HEIs as a big challenge, the deliverable of this was the problem identification

and void in literature (see Figure [III-2]). In the same context, to enlarge the domain knowledge researcher also conducted a student satisfaction survey.

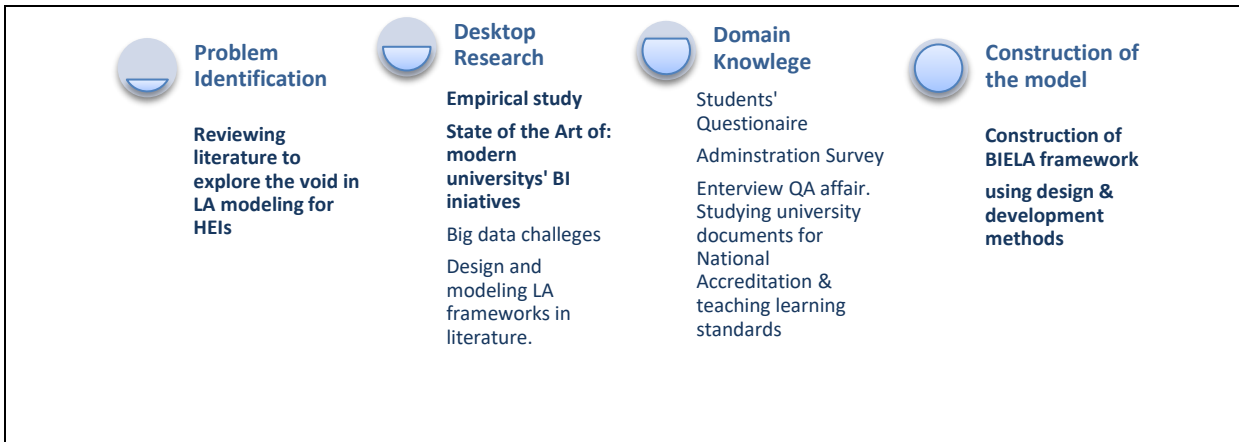


Figure [III-2]: Model development procedure (source: Author)

Student satisfaction survey via a questionnaire is conducted, to capture student requirements in general, understanding their needs, trends, individual learning characteristics and considering their opinion into account, as a main stakeholder, the first survey was for a group of (29) students from different universities. Here by some of the survey results (Appendix A): <https://www.surveymonkey.com/results/SM-WTCFL5C58/>. Results showed that, students were feeling stressed (see Fig. [III.4]), they complained of unstable curriculum, no social counselling, and no timely ongoing feedback about progress toward academic goals, staff availability and teaching effectiveness. Student were happy about future career opportunities and academic reputation, and were somewhat satisfied with counseling services, responding to individual needs of students.

Stress	7/16/2016 4:18 PM	View respondent's answers
stress	7/16/2016 2:58 PM	View respondent's answers
Had an undiagnosable disease that the administration didn't recognize as legitimate	7/16/2016 1:39 PM	View respondent's answers
There is no social counselling	7/16/2016 12:04 PM	View respondent's answers
The only serious problem was poor management and planning, affecting the curriculum	7/16/2016 12:04 PM	View respondent's answers
Unstable curriculum	7/16/2016 10:44 AM	View respondent's answers
Some stupid university rules that can cost a student a lot	7/16/2016 9:59 AM	View respondent's answers

Figure [III-3] : View of some respondent’s answers to satisfaction survey (source: Author)

The investigating of the individual learning characteristics and educational needs, followed through comprehensive surveys, questionnaires, studying university’s documents, brainstorm sessions and face-to-face interviews, to provide significant information and joined strategy formulation for various stakeholders, to support higher quality decision making, tailor educational opportunities to specific students’ prerequisites, future planning and efficiency improvement in the teaching-learning process, addressing LA challenges and enhance utilization of the dynamic and diversity ocean amount of data that available/collected in HEIs building EDW to be a solid foundation for mining knowledge and well understanding of the Students’ learning experience and investigating user requirements of target groups in academic background.

BIELA (see Figure[0-4]), is arises from empirical study, reviewing BI initiatives in some modern universities, desktop research, learning analytics modeling perspectives to fill the void in LR, study universities’ Documents in QA measures, teaching learning standards and KPI, surveying and interviewing target groups and experts, and by using design and development methods. The BI technology will then be appropriately applied for performance supervision.

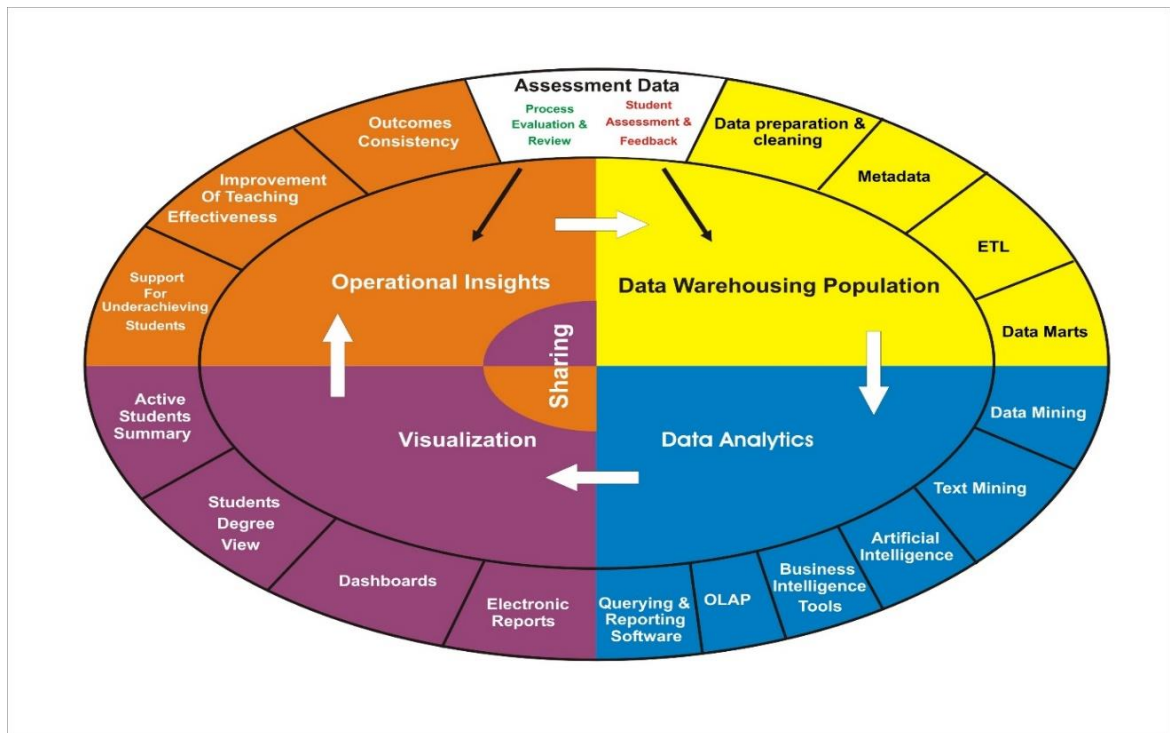


Figure [III-4]: Business Intelligence Enhance Learning Analytics (BIELA) framework (source: Author)

3.2.1 Data preparation (Phase I)

Data preparation, is the step concerns populating, manipulating and transforming the raw data gathered into appropriate format that should meet the specific criteria of the quality requirements for visualization, using BI tools.

To better oversee the nature of the data, it also includes checking data redundancy, consistency, completeness, missing values, the credibility of attribute values. Contextual knowledge can be used to lead these instructions.

In addition, for inform knowledge, privacy, ethical consideration and ensuring the quality of data by enforcing constrains and correcting wrong entries, typical examples of manipulation include converting data from manual entry work sheet format to attributes in database format, moreover, academic numbers which is the key field, are converted to encrypted/fake numbers using specific code, to anonymize students' personal information for ethical considerations.

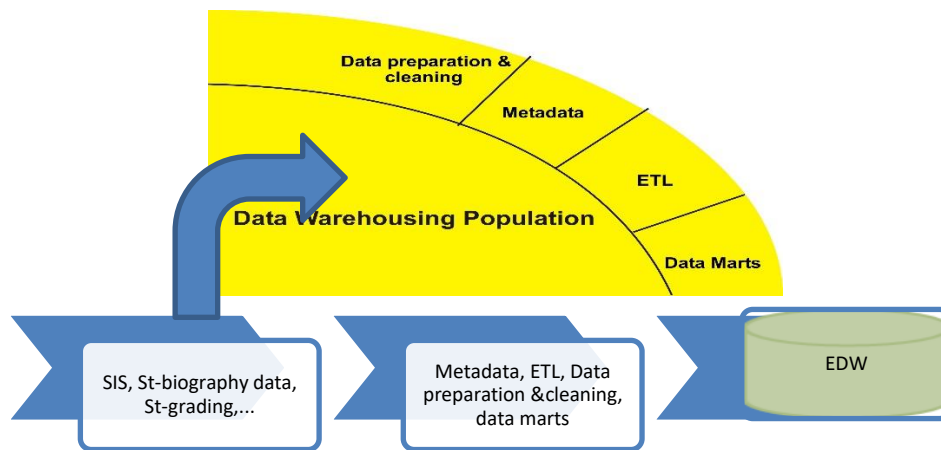


Figure [III-5] : 1st phase in BIELA (source: Author)

Preparation also involves metadata, schema, running correlation and significance queries that help understanding data and clearing views, and data cleaning which includes eliminating doubts and transforming missing and unknown values. Intelligent attributes selections used, from the cleaned data to visualized really valued knowledge, in the later phases for actionable insights.

Data preparation step is indeed, the most challengeable and time-consuming part of the Data management process (Liu & Huang 2017), since the raw data used, is from different resources (students' data , students' results and student biography information, with different/heterogeneous format and mostly inconsistent.

In our case, academic record and biography information are considered personal and not allowed, unless under ethical requirements and guarantees, which have yet to be explored for big data (Swenson 2018), so the researcher take precautions, to be vigilant, made several actions to anonymize the origins of the data, like converted academic numbers which is the key field, to fake/encrypted numbers using specific code, “ to achieve the goals”, that leads to support and withhold students’ learning experience by improving learning outcomes and get actionable insights of student achievement for students and society.

Data is captured from more than one resource, in different format, for the purpose of this research, the most challengeable phase is the preparation of the data to meet the goals and to extract real valued knowledge.

3.2.2 Analyzing knowledge (Phase II)

After data preparation, will be the most important pillar, which is analyzing data for extracting useful knowledge. BI software tools, used to extract useful knowledge from preprocessed data. BI is the umbrella of fast growing powerful technologies (e.g. DM, OLAP, AI,.. etc.), that can collect spread and dissimilar data in an intelligent way that will be suitable for decision support and strategic organization, this usually comprises the standardization of the factors to the optimal values.

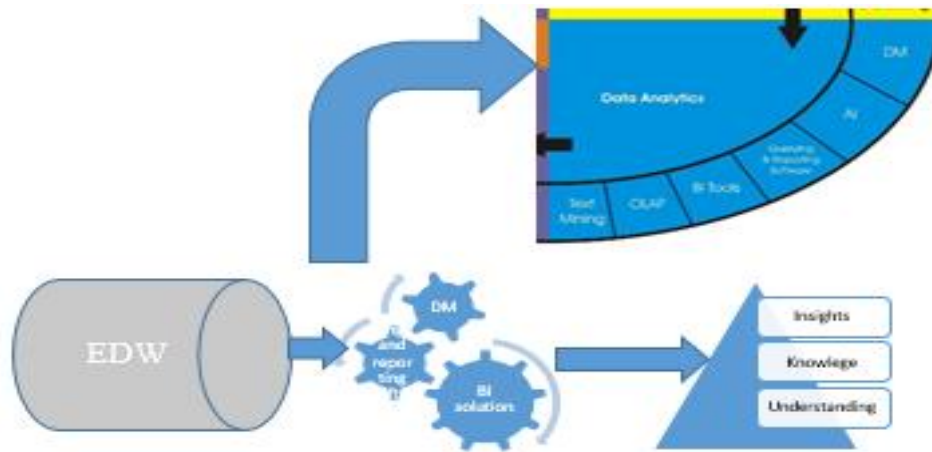


Figure [III-6] : 2nd phase in BIELA framework (source: Author)

The deliverable of this step is some visual model bounds or design capturing predictabilities and increasing understanding, knowledge and insights in the higher level of the pyramid (see Fig. [III.6]).

3.2.3 Visualization (Phase III)

Visualization are vital tools of the communication, sharing and customizing of information which provide users with the information required to monitor and controlling deliverable outcomes to make intelligent, real-time decisions, that's why it should be prepared very carefully. The well designed dashboards let managers make well-informed and suitable decisions that help achieve institutional goals, therefore managers can avoid making decisions only on intuition, and the result is more actual operations, which increase improvement of learning outcomes and QA.

The ideal visualizing system would tell managers all they want to know and only those things. Although no such ready-made system exists for every application. An effective dashboard system will lower risk and cost and reduce information excess, it creates a

communication channel to share information upward, downward and laterally, and transmit information in whatever direction needed. The dashboards can communicate in more than one direction at a time.

More accurate planning and foretelling is extremely important to running a progress meters, since amazing technological development, and strategic planning becomes difficult. The visualization system is timely evaluation and control, therefore managers may not necessarily have the detailed fact and figure needed for comparison and evaluations (see Fig. [3.7]).

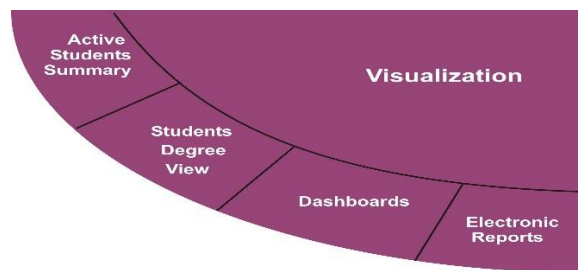


Figure [III-7] : Phase III in BIELA (source: author)

3.2.4 Operational Insights (Phase IV)

This final phase, that an important aspect of the overall effort consists of predicting how and where to put the final discovered knowledge into realistic activities and decisions. The fundamental elements of this phase are derived from awareness and the lessons learned from all the previous processes.

A management plan can be produced by simply documenting the achievement principles being used to improvement of teaching effectiveness, withholding and supporting underachieving students before being dropout exploring their educational lifecycle, helping academic advise catching them early. Outcomes consistency is the result of continuous improvement with the approved changes to reach insights serves students' success and satisfaction.

These visualizations can deliver decisions' makers with knowledge about progress indicators, including students' performance, and abilities. The discovered knowledge is then finally positioned in this phase.



Figure [III-8] : Phase IV in BIELA, (Source: Author)

3.2.5 Assessment Data

The evaluation stage serves to help ensure that the discovered knowledge meets the original research objectives and extracting real valued knowledge before moving further. The quality of courses must be checked regularly through suitable evaluation mechanisms and revised as required, with more extensive quality assessments conducted periodically.

Researcher used evaluation techniques like interviews, surveys and case study, with feedback from main stakeholder and decision makers. To further explain and validate the framework, we next conduct a case study, employing the framework in Computer Science and Information Technology College in SUST.

3.3 Case study

3.3.1 Validation method

After the model is constructed, researcher need to validate the model, by examining its usability, effectiveness, efficiency, and learnability. Once the model is constructed, then a continuous improvement was made to the design, according to feedback, validation method and researcher's experience. An internal deployment is established in one of the public universities in Sudan (SUST), using real students' dataset, with continuous feedback form stakeholders and experts (Figure [0-9]).

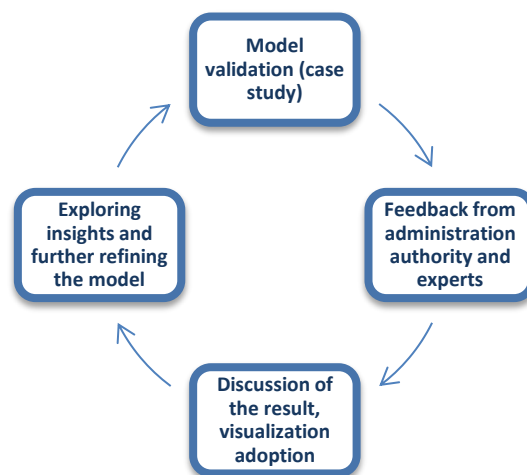


Figure 0[III-9] : Model validation procedure (source: Author)

3.3.1 Participants:

Researcher use data from real case study, of 6084 result records of undergraduate active students (2016-2017 academic year), result records are between (2013 – 2017) years, (students' mean

age 19.5, 65% females), studying for degree of computer science in Computer Science and Information Technology College in one public university in Sudan, Sudan University of science and technology (SUST).

University of Sudan Selected in 2002 among a number of universities in the Arab world for the United Nations Development Program (UNDP), qualitative performance development project, for upgrading the institutional planning at universities, where the program of computer science, faculty of science and its department upgraded to College of computer science and information technology. In 2009 the quality assurance council of Arabic universities Union, applied an institutional accreditation in SUST as the first Arab University within four other Arab universities in the Arab League, and awarded certificate of this in 2010. In the year 2017 University was selected from among Sudanese universities within the external accreditation program Association of African universities (AQRM).

3.3.2 Instruments:

The data was gathered from multiple heterogeneous resources by the following instruments:

- Extract the variables from heterogeneous resources (student information system (SIS)/ registration information and university academic information) where most data about students and their learning results are held, along with students biography information from students' interior center, to populate the EDW or the "one version of truth" as a good start.
- Survey and data analysis for university target groups (teachers, head departments (Appendix D), dean (Appendix C), academic adviser (Appendix I) and QA dean (Appendix J)), used for maximizing domain knowledge as the first phase in the CRISP-DM method.

- Exploring HEIs documents of teaching-learning standards (Appendix F), also, to consolidate the base of domain knowledge. Explore which variables are coming from LA, seeing what can serve the BI concept.
- Deriving implications for the Business Intelligence performance towards LA application area, identifying needs/user requirements.
- Use of BI software tools, for extracting hidden knowledge in the data at different levels of granularity, and for verification of hypothesis.
- Identifying challenges, barriers and opportunities for data-driven, visioning how to solve these problems and achieving the goals using framework serving those solutions.
- Investigating the validation of BIELA model, by deploying it in a HEI to assess the results, and further refining according to feedback from stakeholders.

3.3.3 Data Sources:

Students' study record held by SUST (active students at 2016-2017 academic year), summarized in eight attributes (see table2), and student personal data provided by them at registration, from registration office in SUST, summarized by four attributes (see table1), along with student biography that contains details like guardian work, sponsor, residence and health status, from student central interior, summarized by fifteen variables (see table 3), all data was in excel format, so it was very noisy and inconsistent especially for table3.

Table 1 Students Data	
Attribute	Description
Stnumber	The academic number of student (PK)
Sname	The name of student
State	The state where student come from
Province	The province where student come from

Table 3.2: Student basic information from registrar

Table 2 Students Result	
Attribute	Description
Stnumber	The academic number of student (PK)
Sname	The name of student
Yearno	The year number
Semno	The number of the semester (1 to 8/10) of the year
Sem GPA	Semester grade point average
GPA	Grade point average
Res Details	The result details
DEPT	The department name

Table 3.3: Students result records description

Table 3 Students biography information	
Attribute	Description
Stnumber	The academic number of student (PK)
Sname	The name of student

Gender	The gender of student
University	The university name
College	The name of the college which student admitted to
DEPT	The department name
Level	The level of the student
Admission	The admission year
St_telno	The telephone number of student
Residence	The residence where student live
State	The state where student come from
Province	The province where student come from
Guardname	The name of student' guard
Guardwork	The work of student' guard
Healthstate	The student' health state

Table 3.4: Students biography information

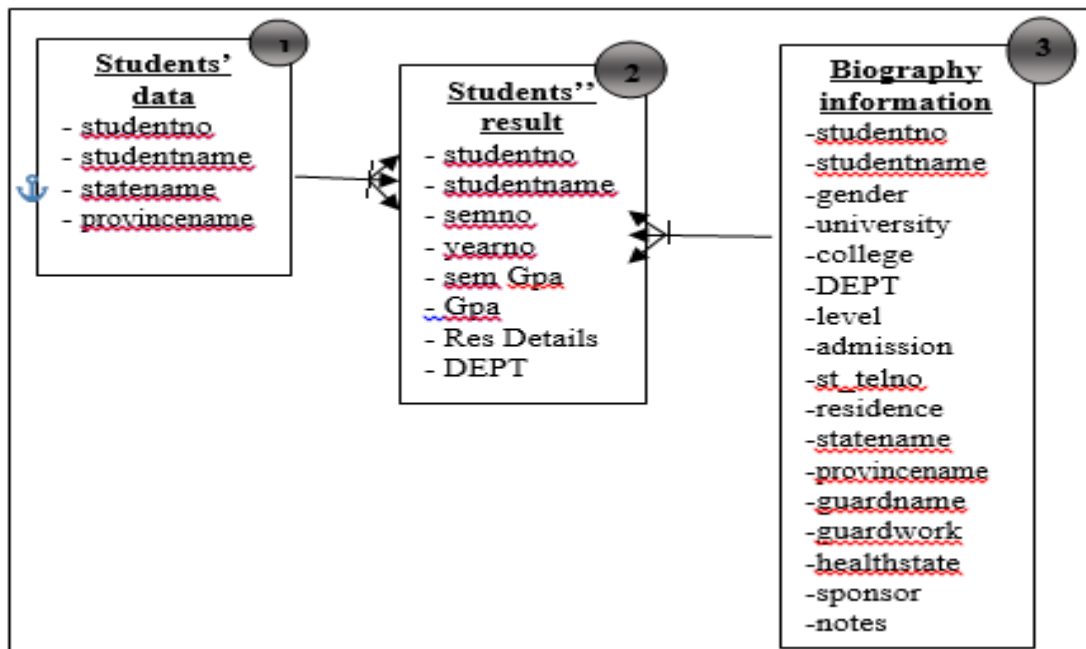


Figure 0[III-10] : ER Diagram (source: Author)

3.3.4 Data Collection

Collecting computer science students' datasets (College of Computer Science and Information Technology in SUST) from SIS database, Students' results and student' registration data, results' dates are from (2013 to 2017 academic years), from registration office, and other biography information from "Alshaheedain" students' interior center, that affiliated to the National Fund for student support in Sudan, where the enrollment's data of many universities in Sudan are grouped there.

The data was extra noisy and in an excel format. Student assessment and feedback Survey (second survey), is conducted (Appendix B), for the students only in the College of Computer Science and Information Technology (the sample that dataset of the research is taken from), to richen the domain knowledge and for understanding students' needs, trends, opinions as well as their individual learning characteristics. Questions in the questionnaire were seeking pressures, limitations as well as motivations, that the researcher need to maintain and resolve using third phase (visualization) and fourth phase (operational insights), in BIELA framework, coping with performance measures.

The responses of the students' questionnaire (63), have been analyzed and described from students' perspectives and taken into account, by considering them with information from data analysis. We can see that, females are nearly 65%, males 35%, GPA is normally distributed i.e. most students have 2.6 to 3.0 grades, more than 75% of the students are not satisfying with the learning outcomes specification/consistency with the needs of the labor market requirements, nor with the mechanism used to evaluate the learning outcomes. Most students are complaining of time management, teaching effectiveness, time tables' managements and lab preparations.

In analyzing students' individual learning characteristics, most of them prefer to learn using photos and videos, take detailed notes, need very specific examples and share the others' in their thoughts. About 50% of the students missing academic advisor and/or psychological help. Students (more than 70%) are agreed that, this college has great desire and good academic reputations.

These results were come in line with the data record analysis (discussed in chapter four with details), and with decision makers' survey, that agreed there was no system for academic advising helping to reach at-risk students before being drop out and there was a lack of staff retention, infrastructure, decision support systems and affordability.

Interviews were with dean of Computer Science and Information Technology College, quality assurance dean, academic and administrative staff members on behalf of many keys regions to understanding and capturing quality requirements.

Analyzing students' result records along with their registration and biography information for the purpose of mining knowledge and awareness about students' experience and performance, tackled in the next section in details.

Constraints which faced the researcher in data collection confined to: Privacy (students 'data considered personal and not allowable), due to ethical considerations. Also data pre-processing and ensuring of fitness and clearance of diversity nonhomogeneous datasets as a big challenge.

3.3.5 Data Analysis and visualizations:

Data analysis has six steps: Beginning with collecting students' records from all angles to assess the situation, Extract-Transform-Load, data preprocessing and cleaning noise, which is the most challengeable phase (described in the preprocessing phase Fig [III-6]), data analytics using BI software tools, Tableau, the dominant tools topping the Gartner lists for many years

(according to Gartner analysis as of Feb. 2017 (see Figure [0III-11])). Tableau has being used in data visualization and has great desire, fast and broad adoption in practice and in academic background (Mamonov et al. 2014). The author tried “RAPID MINER”, as one of BI tool that is completely free, but visualization was poor and redundant with limited flexibility.

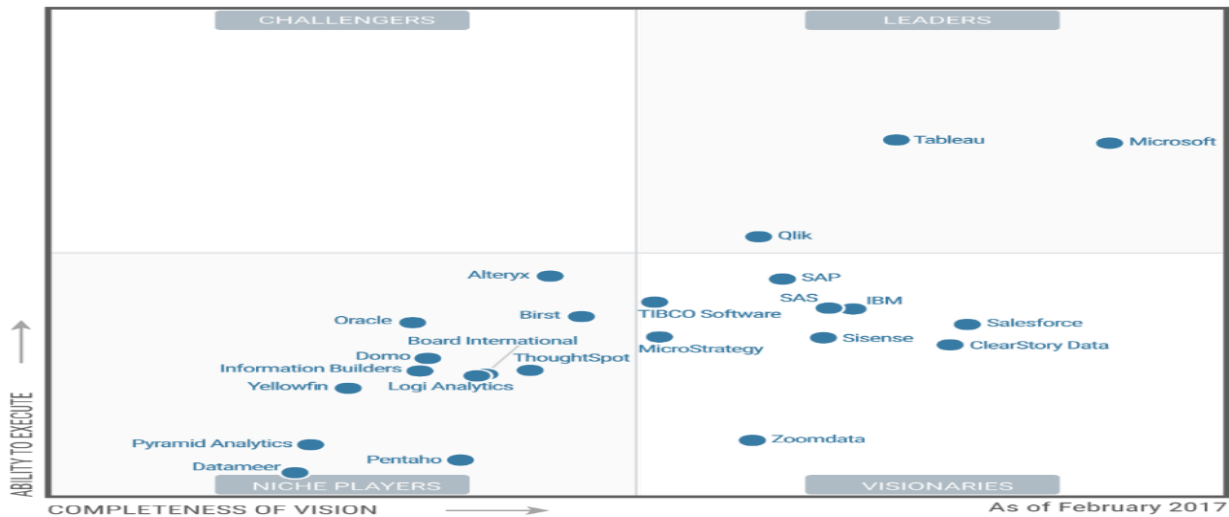


Figure [III-011] : Gartner MQ_analysis_and_BI_2017_HI_res source: Gartner (Feb. 2017)

Customizing visualization and dashboard detection, exploring which view is come on line with demands and really valued for the purpose of informing decisions and enlarging awareness of students’ learning experience, for decision making, predicting and presenting useful data for enrollment trends and program review planning, and finally determining the end-users’ perceived adoption and acceptance of the implemented technology for evaluation and interpretation.

Only approved models are retained for the next step, otherwise the process is revised to identify which data entry could be corrected to validate the results (e.g., writing wrong input name, getting different data). The researcher assessed the results carefully through case study and Expert Corporation and thus gain confidence as to whether or not they are qualified.

Researcher exploring documents of QA in teaching learning standards in HEIs and gather ideas about specific quality indicators to evaluate the effects of learning analytics technique.

The researcher encapsulate the results in figure [0-12] to figure [0-15]. The benchmarks deliver away to regulate the assessment of learning analytics tools. In addition, the academic context experts support interpreting the significant types of comparisons, results and checked whether the exposed knowledge is useful, clear, and effective.

CHAPTER 4

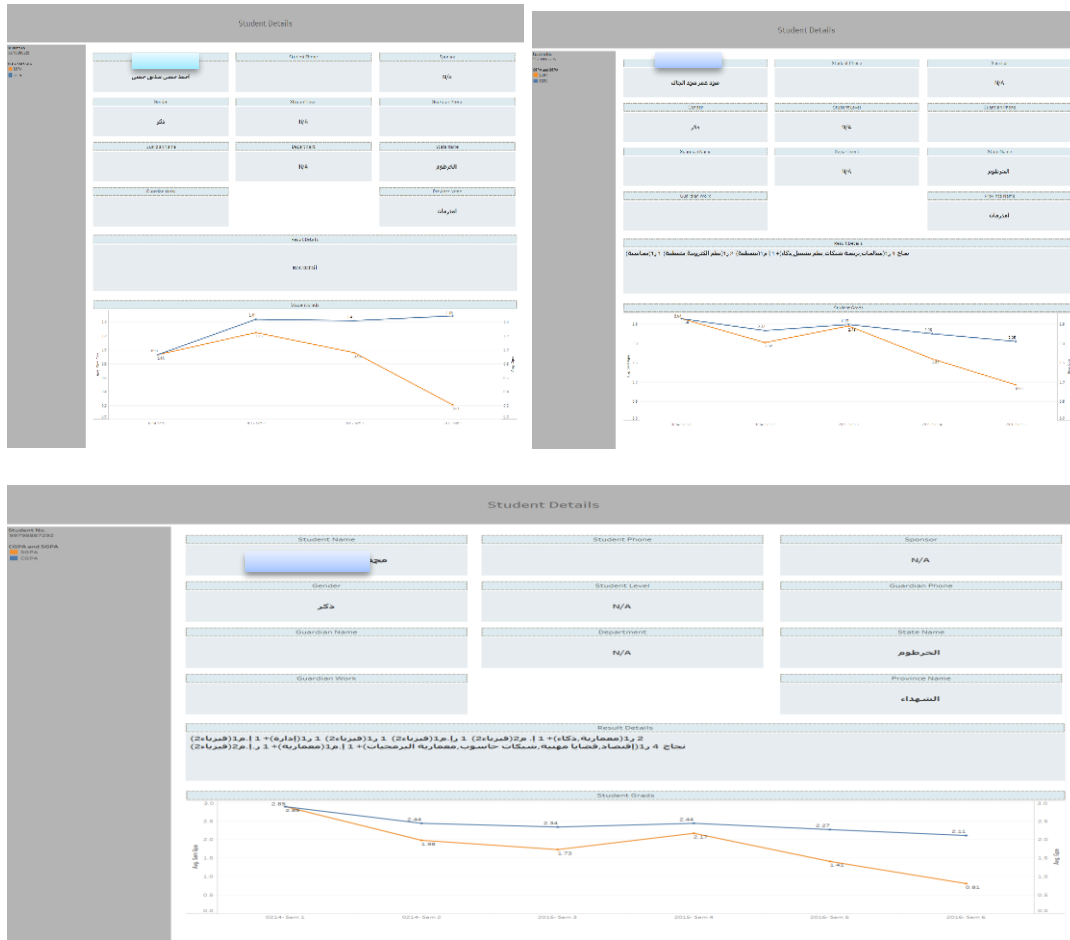
DISCUSSION OF RESULTS

Many aspects are presented in different granularities, using drilling down or roll up in the visual results and dashboards. In the investigation of the states and provinces, results showed that distribution of students is not identical, some state have very small number of students comparing to other ones see Fig [III -14].

Universities need to investigate the effect of number of students per college/department on average GPA, results in our case study showed that, the average GPA does not affected by the number of students, but could be affected by the curriculum i.e. tough courses in computer science & network departments led to a lower average, than other departments (see Fig [0-12]). Dashboards in the result, easily presented comparisons between different groups of colleges/departments/students per years/semester/gender/GPA at any level of granularity.

Number of students per college/department per semester and the average Semester GPA per college per semester to analyze the effect of curriculum, and number of students per college/departments on avg. semester GPA, semester over semester (see figure [III-12]).

Individual student details, such as his personal profile and his results in his complete educational lifecycle. To analyze that the student is improving his scores semester over semester or going down, this process will be effective in picking at risk students before being dropout by consulting and withholding them as early as possible, realizing a fall in student's performance level/GPA, before sufficient time figure [0III-14].



0Fig. [IV-1] : Three examples of at-risk students (source: Author)

Retention or sustaining needy ones, and will be a good tool for the academic and/or psychological advise, raising student success, retention and satisfaction for students and society by minimizing the risk of dropout (see Fig [IV-1]).

Individual student details clearly showed that semester six, is the most challengeable for most of student, also investigation and interviews of academic administrators and head departments showed that the most difficult courses are taught in this semester, so university need to review semester six courses and learning styles for utilization this challenge.

Main Contribution and Outcomes:

As any estimation or quality assurance process in HEIs, seeking progress indicators, require advancing on preparation to demonstrate on students' learning, and there is a growing need in universities for an evidenced-base LA model to employ big data for the benefit of their students, researcher build this novel but practical, step by step framework to fill the void in literature.

The novel practical Business Intelligence Enhance Learning Analytic Framework (BIELA), that represent meaningful guidance on effectiveness use of LA in HEIs, keeping up with the revolution of ICT and the dynamic “big data” growing exponentially, toward growth in HEIs, the extraordinary turbulent environment, is the main contribution of this research.

A simple and concise view that collects all students' information in proficient and secure way, prepared as a solid foundation for proper analysis.

High quality, informed, more timely and customizable fact-based reports and dashboards that support high quality LA suggestions, retention and decision making to enhance the learning processes and improve the HEIs' performance and efficiency, addressing the most challengeable issue in HEIs, which is students' success.

Contributions to knowledge: Theory and practice of integrated MIS (Management Information System) in HEIs.

Contributions to practice: Inspire a culture of evidence to resolve decision making processes in teaching-learning process of HEI, by minimizing decision time and minimizing the risk of dropout of the students as a big benefits to the organizational performance.

With steady interest in data and analytics in the education sector, it is important to have tools and techniques that go deeper than being assessed through tradition metrics such as blogs' long, time spent online, content usage and number of clicks.

- BIELA is from the result of empirical study in LR, presenting BI initiatives in some universities, desk top research (Fig. [IV-2]), and study universities documents in QA measures in teaching learning standard and KPI, surveying and interviewing target groups and experts, and by using design and development methods. And then validated in one of the public universities with real students' dataset, and feedback form stakeholders.
- Thus the importance of this model lies in its ability to provide a deep and accurate insight into students' learning experience and their environment. In this context, alternative and diversified assessment and evaluation techniques are necessary to improve the harmonization and articulation of technical, informational learning complexity that constitutes the core of education in the twenty-first century.
- Extra refining in the BIELA model after a continuous survey, considering opinions and feedback from experts and stakeholders as target groups.
- Publishing articles related to this field in valued academic journals.

CHAPTER V

CONCLUSION AND FURTHER WORK

BI is the process of increasing the competitive benefits of a company/institute by the smart use of available data in decision-making to solve complex issues, and certify the critical information availability since it emphasizes the practice of performance and analysis assessment in all levels of an educational landscape which is extraordinary turbulent, (Duan et al. 2013).

Today, most universities are actively gathering and storing students' data in large databases (SIS, LMS). Most of them have understood their potential value and taken the revolutionary approach of “FROM DATA TO PROFIT” by targeting competitive improvements applying BI toolkits, for making decisions to increase performance for strategic transformations in terms of teaching quality, student satisfaction, students’ retention, students' grades and preventing students’ failure/ dropping. The dramatically increasing demand for better timely decision knowledge about the user demands and performance measures, that increasing managers' satisfaction for Decision support.

The research was motivated by the lack of validated evidenced based, standard, practical step by step framework that enhance LA in HEIs. The main contribution is the novel, practical, and step by step Business Intelligence model (BIELA), that represent meaningful guidance on effectiveness use of LA in HEIs, validated and grounded in Sudan.

Researcher use data from real case study, of 1034 undergraduate active students (students’ mean age 19.5, 65% females), studying for degree of computer science in Computer

Science and Information Technology College in SUST. The data was gathered from multiple heterogeneous resources, and by survey and data analysis for the target groups.

BIELA is arises from empirical study, review LA construction and modeling in LR, studying BI initiatives in some universities, desktop research, , study universities' documents in QA measures, teaching learning standards and KPI, surveying and interviewing target groups and experts, and by using design and development methods (CRISP- data mining method, Monkey survey and Corel Draw).

BIELA framework, differs from previous models, in its fourth and fifth phases addition that is insightful, assessment data and feedback, BIELA framework also differ in fundamental elements that characterize the five Stages. BIELA framework is distinct because verified and proved its success and hypothesis using real dataset for more than one thousand university students, rather than the greatest of the research in the field of LA, which has been applied on the Online/blended/survey/eye tracking etc. (Nistor & García 2018).

This research has illustrated how BI and LA can be exploited to develop successful algorithms for extracting and analyzing constructions to produce an intelligent step by step revolution model, act as a practical framework that serves and guidance the process of teaching-learning by effectively dealing with the vast amount of data available and/or collected from various sectors in HEIs.

Moreover, how that constructions can take the form of statistical outlines, models, KPIs, insightful and interactive dashboards and relationships, offering a grand challenge for technology enhance learning (TEL).

Future work

- Broaden the system to include the result of students prior to university education (secondary certificate) and linkage with the university admissions system.
- Discovering different hypotheses by exchanging data models or predictive models using different variables/tools.
- Concentrating in the future will be on how the learning will be takes place adopting learners' needs.
- Challenge the complexity of BI applications due to multi-layer of DW & BI, perceived cost of acquisition, user acceptance and improper implementation.
- Adopting methods that integrate vast amount of dynamic and diverse datasets that growing exponentially and can be structured or unstructured into a single coherent framework, remain an open issue in the future.
- State of the art concentrated mostly on technology, information security and user acceptance. Therefore, the future work will concentrate on further work like addressing difficulty in creating dashboards and providing right reports at the right time to the right persons, beside a lack of usefulness, customization and sharing/communicating analyzed details records of results/information provided in dashboards for a wider user range what makes a critical dearth in decision making.
- How to access and extract real value from institutional captured data in terms of privacy and ethical framework.
- Automating the process of improving performance and collecting more data about students' behavior and their learning experience.

Opportunities for further research abound mostly as:

- The deployment of the envisaged BIELA model in further universities, national and/or international with active community partnership and industrial collaboration, will serve the broad need for big data exploration toward enhancing learning and educational processes in the Higher Educational domain. This can be achieved by, for example: - customizing the model to accommodate the partner requirements.
- More LA competences, intelligent security and increased reality are expected to gain more prominence for SRM (Student Relationship Management) users in near future.
- Increasing the number of monitoring devices/ sensors for collecting more students' engagement information and ensure an automated retrieval of institutional information from anywhere.
- Developing other BI toolkits for efficient managerial decisions.
- Developing real-time feedback and online analytics for evaluating performance.

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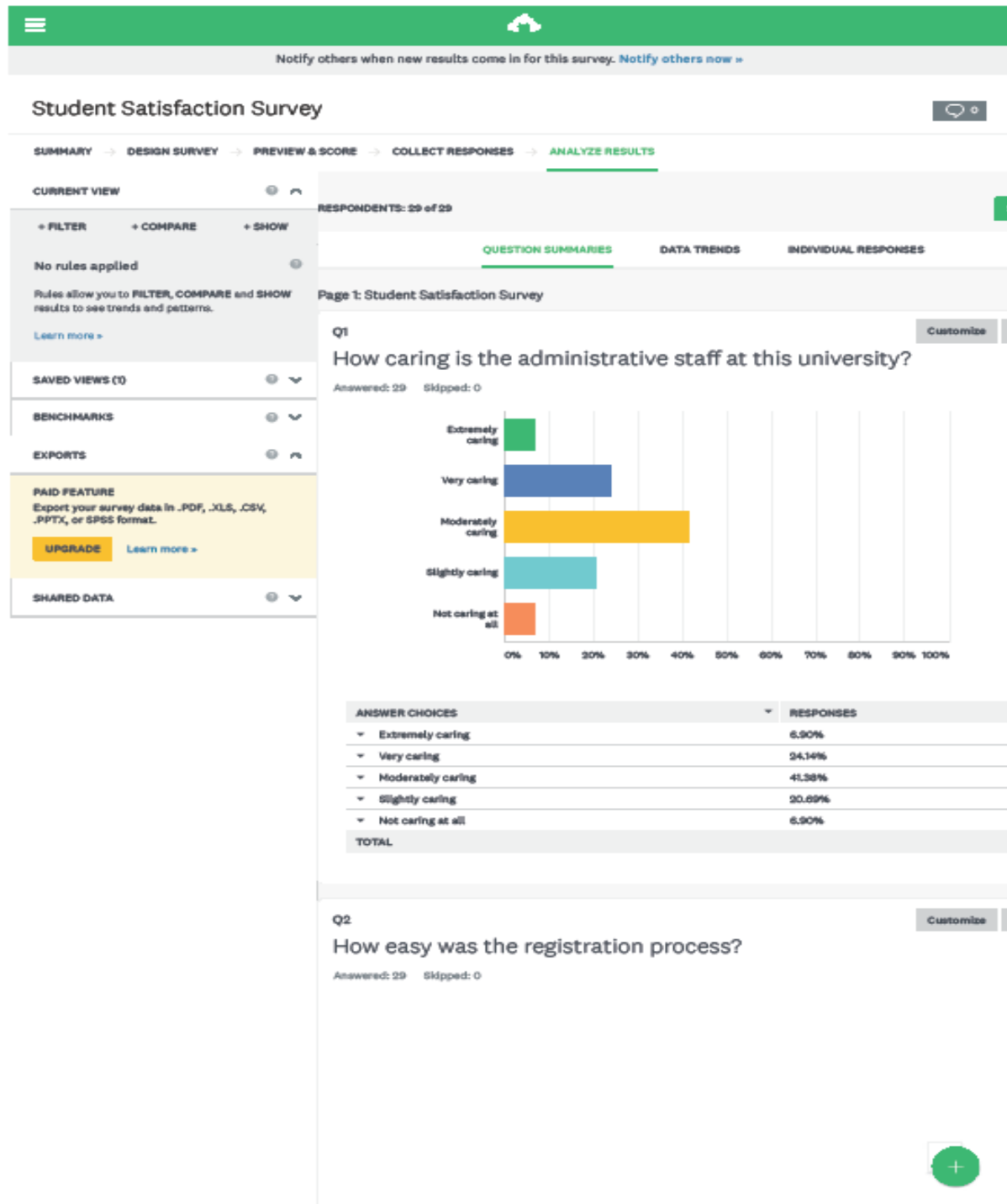
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Appendices

Appendix A: Student satisfaction survey results



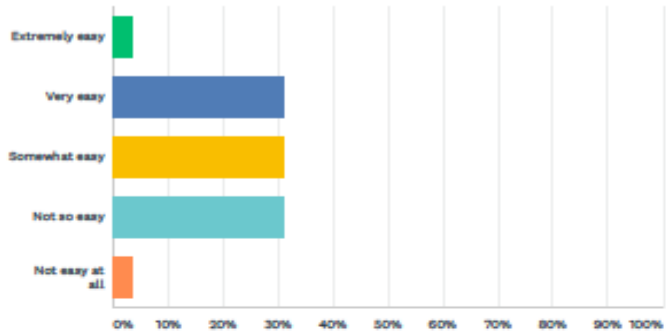


Notify others when new results come in for this survey. [Notify others now](#)

Student Satisfaction Survey



[SUMMARY](#) → [DESIGN SURVEY](#) → [PREVIEW & SCORE](#) → [COLLECT RESPONSES](#) → [ANALYZE RESULTS](#)



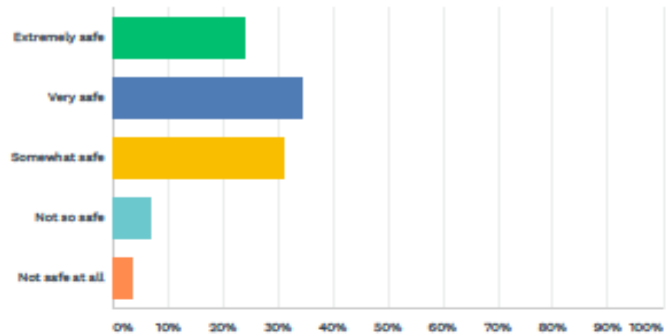
ANSWER CHOICES	RESPONSES
Extremely easy	3.45%
Very easy	31.03%
Somewhat easy	31.03%
Not so easy	31.03%
Not easy at all	3.45%
TOTAL	

Q3

[Customize](#)

How safe do you feel on campus?

Answered: 29 Skipped: 0



ANSWER CHOICES	RESPONSES
Extremely safe	24.34%
Very safe	34.48%
Somewhat safe	31.03%
Not so safe	6.90%
Not safe at all	3.45%
TOTAL	

Q4

[Customize](#)

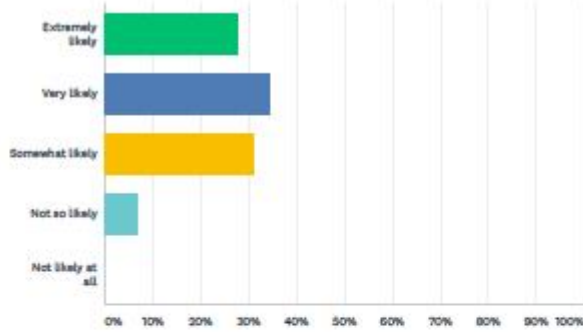
How likely are you to recommend this university to others?

Answered: 29 Skipped: 0





Notify others when new results come in for this survey. [Notify others now >](#)



ANSWER CHOICES	RESPONSES
Extremely likely	27.59%
Very likely	34.48%
Somewhat likely	31.03%
Not so likely	6.90%
Not likely at all	0.00%
TOTAL	

Q5

What was your major?

Answered: 29 Skipped: 0

RESPONSES (29) TEXT ANALYSE TAGS (0)

PAID FEATURE
Text Analysis lets you search and tag comments and see word clouds of frequent words and phrases. To get this feature, upgrade your plan.

[UPGRADE](#) [Learn more >](#)

Add Tags Filter by Tag

Showing 29 responses

Computer Science

8/2/2016 2:27 AM

[View respondent's](#)

Business administration

7/26/2016 1:05 AM

[View respondent's](#)

computer

7/25/2016 10:03 AM

[View respondent's](#)

Information system

7/25/2016 9:57 AM

[View respondent's](#)

Information technology

7/25/2016 9:41 AM

[View respondent's](#)

is

Q6

How happy are you with the contents of your major?



RESPONSES

[Customize](#)

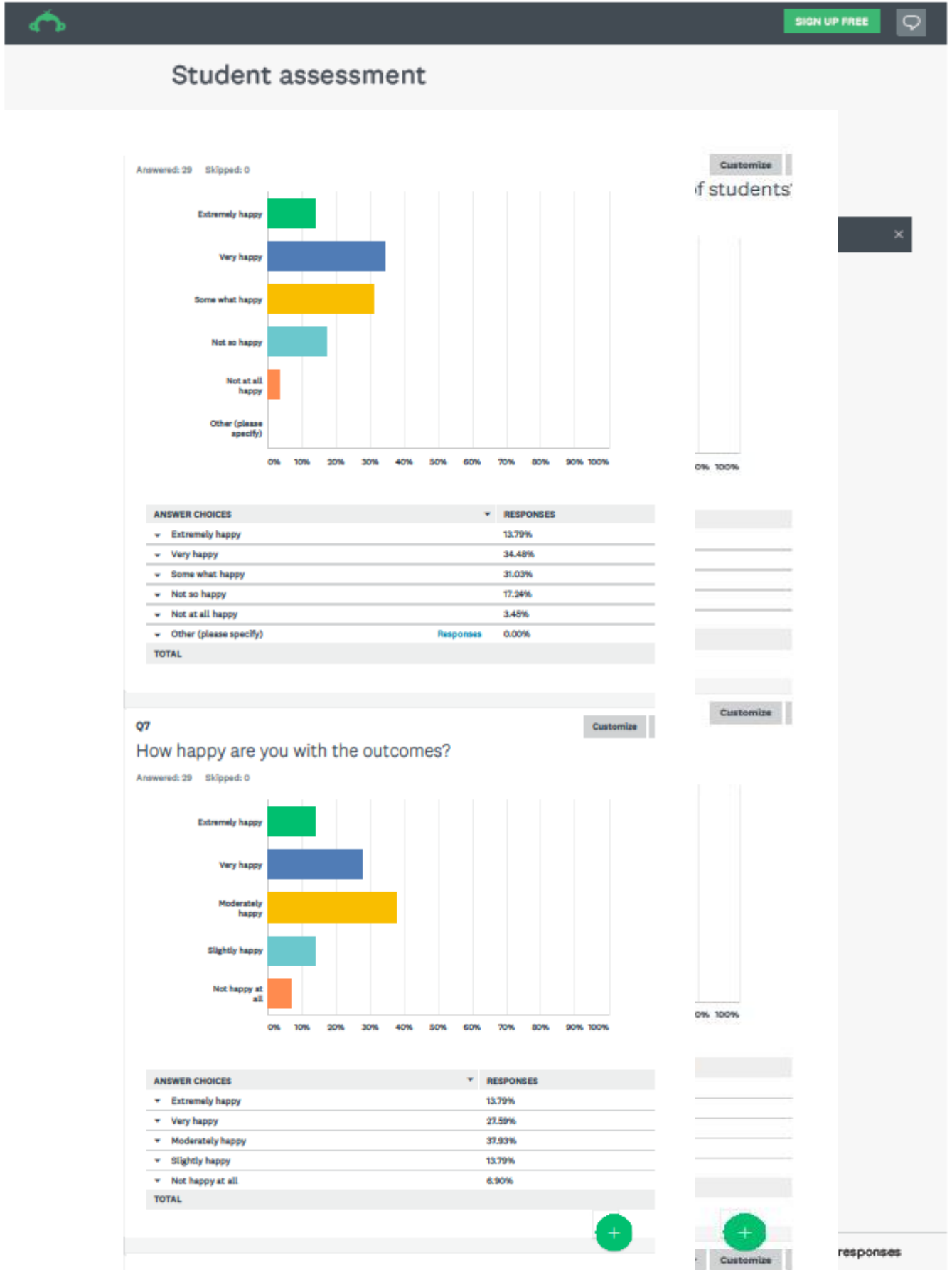
ty?

90% 100%

[Customize](#)



Appendix B: (SUST) student assessment and feedback survey results



Student Satisfaction Survey



SUMMARY → DESIGN SURVEY → PREVIEW & SCORE → COLLECT RESPONSES → **ANALYZE RESULTS**

CURRENT VIEW

RESPONDENTS: 29 of 29

+ FILTER + COMPARE + SHOW

QUESTION SUMMARIES DATA TRENDS INDIVIDUAL RESPONSES

No rules applied

Rules allow you to FILTER, COMPARE and SHOW results to see trends and patterns.

Page 1: Student Satisfaction Survey

[Learn more >](#)

SAVED VIEWS (1)

BENCHMARKS

EXPORTS

PAID FEATURE

Export your survey data in .PDF, .XLS, .CSV, .PPTX, or SPSS format.

[UPGRADE](#) [Learn more >](#)

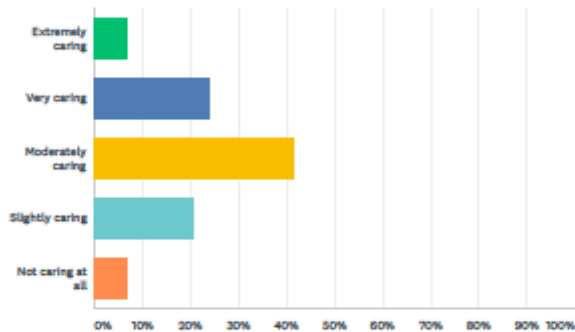
SHARED DATA

Q1

[Customize](#)

How caring is the administrative staff at this university?

Answered: 29 Skipped: 0



ANSWER CHOICES	RESPONSES
Extremely caring	6.90%
Very caring	24.14%
Moderately caring	41.38%
Slightly caring	20.69%
Not caring at all	6.90%
TOTAL	

Q2

[Customize](#)

How easy was the registration process?

Answered: 29 Skipped: 0

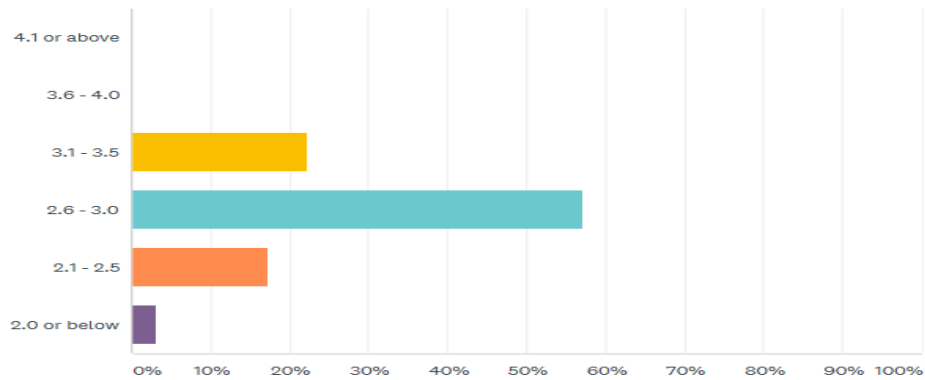


What is your gender?



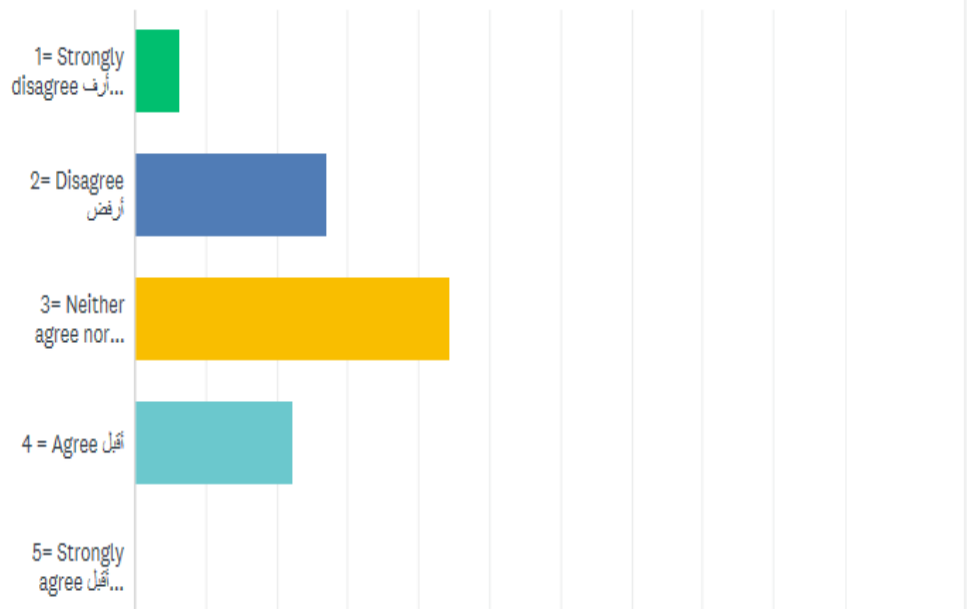
What is your GPA? كم هو معدلك التراكمي الاخير

Answered: 63 Skipped: 0



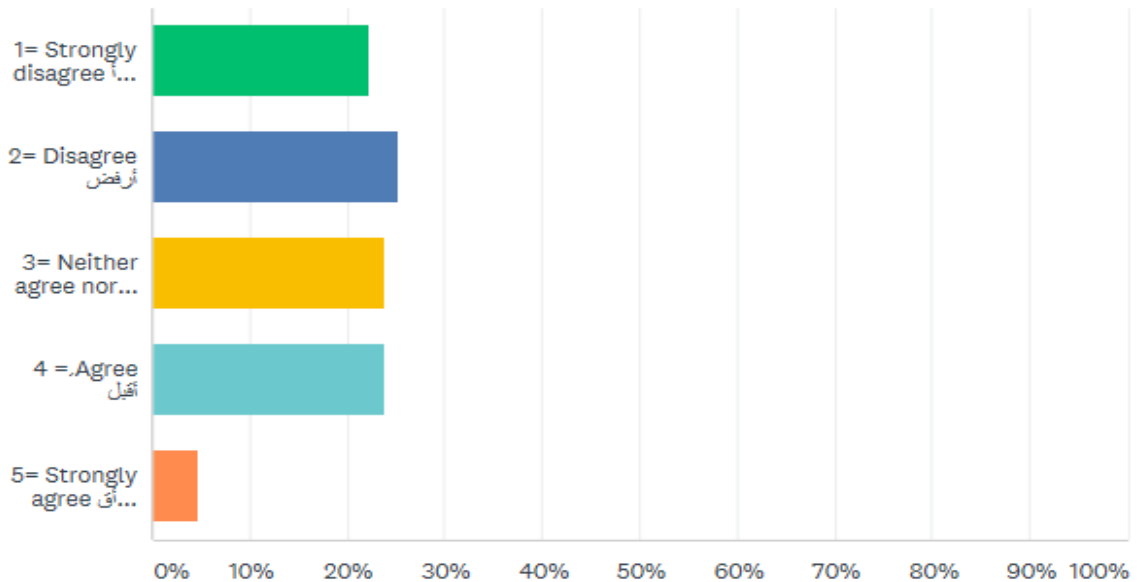
Student learning outcomes are clearly specified, and consistent with the needs of the labor market and requirements for employment ?
المخرجات التعليمية محددة ؟
بوضوح، ومتسقة مع حاجة سوق العمل ومتطلبات الممارسة المهنية في البرنامج الذي أدرسه

Answered: 63 Skipped: 0

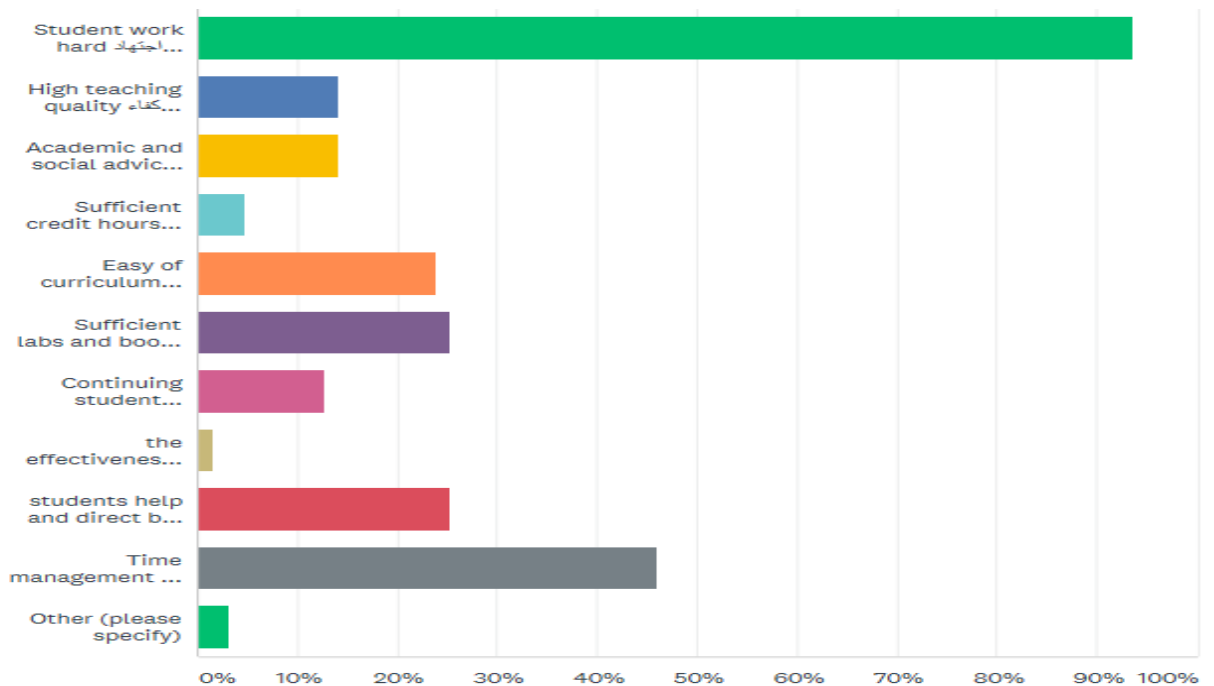


are appropriate and sufficient to the program I am studying ?
 آليات المستخدمة لتقييم الطلاب أكاديمياً تعتبر كافية و مناسبة و مناسبة
 للبرنامج الذي ادرسه

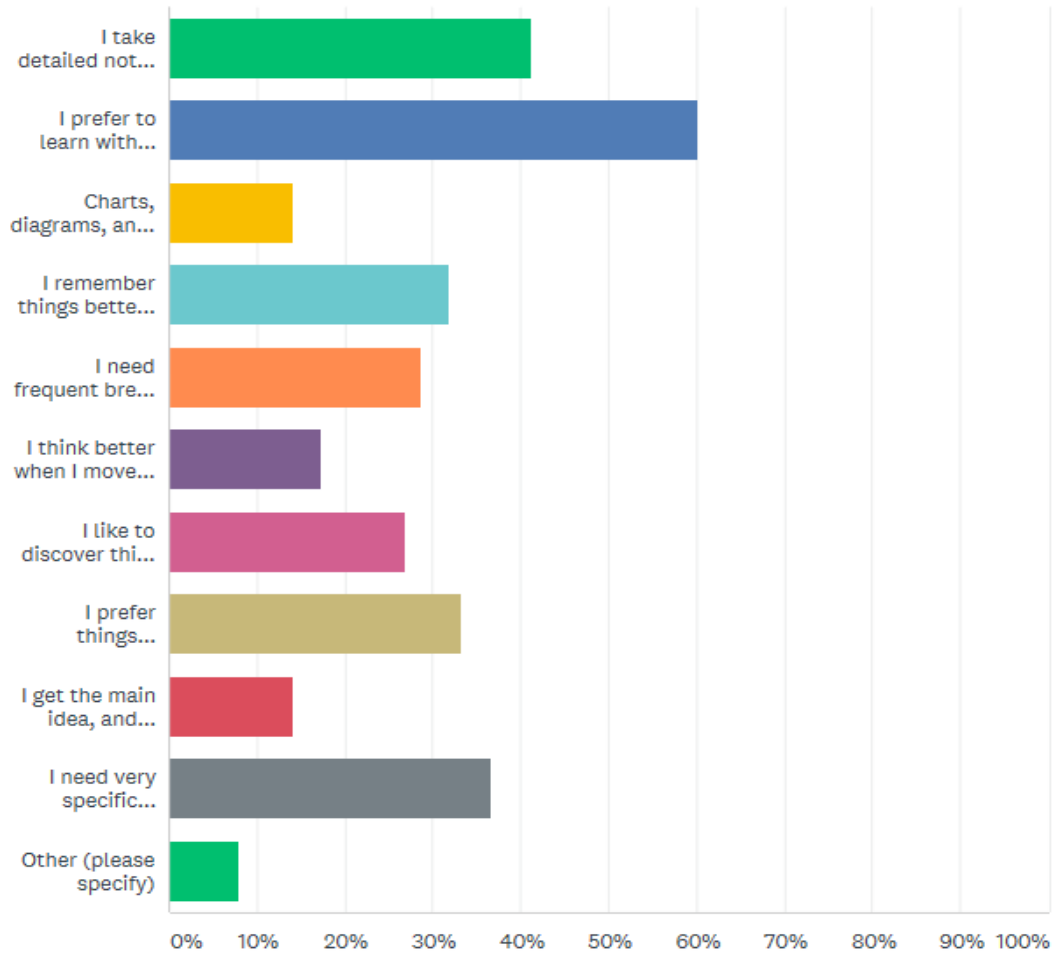
Answered: 63 Skipped: 0



what are the problems that can lead to a failure or a low student GPA?
 ما هي المشكلات التي من الممكن أن تؤدي الى رسوب أو تدنى معدل الطالب
 أو تدنى معدل الطالب "يمكن اختيار اكثر من إجابة"

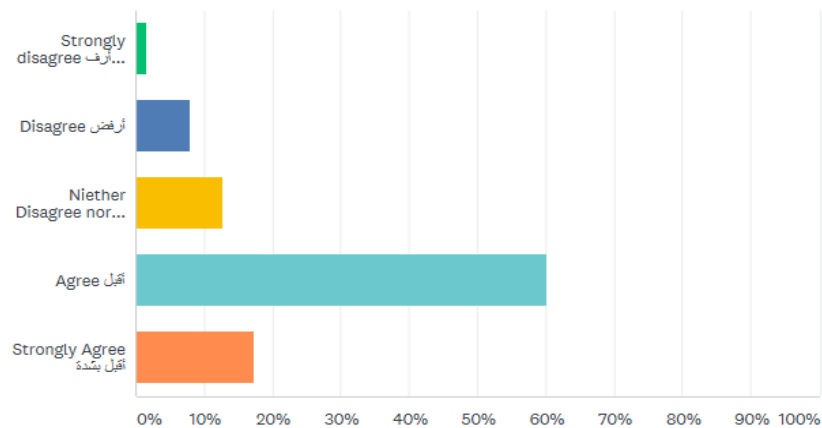


What is your learning style? "ما هو أسلوب التعلم الذي تفضله" يمكنك اختيار أكثر من إجابة



This college has a great desire and good academic reputation? من هذه الكلية من الكليات التي تحظى بنسب قبول عالية وفرص وظيفية

Answered: 63 Skipped: 0



Appendix C: The dean interview questions

THE DEAN OF COMPUTER SCIENCE AND INFORMATION TECHNOLOGY COLLEGE

–SUST -INTERVIEW

DEAN OFFICE 5.AUG. 2018

Time: ▪ email: ▪ college web site:

Goals, view and message of the college

-From website

Student and staff statistics?

Three doctors (male),

Number of trained and certified teacher by gender and by level of education

Education of staff (by gender)

(2) PhD males (three males, females)

(1) MSc male (-----)

(3) PhD females (-----)

(4) MSc females (-----)

Statistics (student enrolled, suspension, dropout and successfully graduated by gender), graduation rate (students those passed the final year successfully/ students those expected to graduate)?

Your opinion in BIELA framework, opportunities & recommendation?

Appendix D: Teachers & Decision maker survey

STAKEHOLDERS SURVEY

Students' Assessment & Feedback

What is your occupation?

Question Title

1. What is your occupation?

Decision maker

Dean

Staff member

Head of Department

Senior Staff

OTHER

SUST has a Datawarehouse for mining knowledge

Question Title

2. SUST has a Datawarehouse for mining knowledge

Strongly disagree

Disagree

Neither disagree nor agree

Agree

Strongly Agree

What is the most challengeable Class level, in your opinion?

Question Title

3. What is the most challengeable Class level, in your opinion?

L	L	L	L	L
evel 1-2	evel 3-4	evel 5-6	evel 7-8	evel 9-10
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Level 1-2	Level 3-4	Level 5-6	Level 7-8	Level 9-10

Student assessment process are appropriate for the intended learning outcomes and effectively and fairly administered with independent verification of standard achieve.

عمليات تقييم الطلاب تناسب تماما مخرجات التعلم المرجوة وتدار بفاعلية وانصاف مع التحقق بطريقة محايدة عن المعايير المتحققة

Question Title

4. Student assessment process are appropriate for the intended learning outcomes and effectively and fairly administered with independent verification of standard achieve.

عمليات تقييم الطلاب تناسب تماما مخرجات التعلم المرجوة وتدار بفاعلية وانصاف مع التحقق بطريقة محايدة عن المعايير المتحققة

Strongly Disagree

Disagree

Neither disagree nor agree

Agree

Strongly Agree

أخرى تذكر Other (please specify)

Student learning outcomes are clearly specified, and consistent with the needs of the labor market and requirements for employment? المخرجات التعليمية محددة بوضوح، ومتسقة مع حاجة سوق العمل ومتطلبات الممارسة المهنية

Question Title

5. Student learning outcomes are clearly specified, and consistent with the needs of the labor market and requirements for employment? المخرجات التعليمية محددة بوضوح، ومتسقة مع حاجة سوق العمل ومتطلبات الممارسة المهنية

1= strongly disagree أرفض بشدة

2= Disagree أرفض

3= neither agree nor disagree لا أرفض ولا أقبل

4 = Agree أقبل

5= strongly agree أقبل وبشدة

The mechanisms used to assess students academically are appropriate and sufficient to the program?

الآليات المستخدمة لتقييم الطلاب أكاديمياً تعتبر كافية و مناسبة للمنهج

6. The mechanisms used to assess students academically are appropriate and sufficient to the program?

الآليات المستخدمة لتقييم الطلاب أكاديمياً تعتبر كافية و مناسبة للمنهج

1= Strongly disagree أرفض بشدة

2= Disagree أرفض

3= Neither agree nor disagree لا أرفض ولا أقبل

4 =.Agree أقبل

5= Strongly agree أقبل بشدة

What are the problems that can lead to a failure or a low student GPA?

يمكن اختيار أكثر من إجابة " ما هي المشكلات التي من الممكن أن تؤدي الى رسوب أو تدني معدل الطالب "

7. What are the problems that can lead to a failure or a low student GPA?

يمكن اختيار أكثر من إجابة " ما هي المشكلات التي من الممكن أن تؤدي الى رسوب أو تدني معدل الطالب "

Time table is not proper (المحاضرات الصباحية) جيدا الجداول الدراسية غير منسقة جيداً

Low teaching quality تدني جودة التدريس

Insufficient credit hours عدد الساعات المعتمدة غير كافي

Lack of references قلة الكتب والمراجع

Lack of labs and preparations قلة المعامل والتجهيزات

Unsuitable curriculum المنهج الدراسي غير مناسب/قديم

Teaching staff are not available الأساتذة غير متفرغون

Test anxiety قلق الاختبار

Time Management إدارة الوقت

Other (please specify) أخرى تذكر

If student's GPA is high, that is as you think because of ...

يمكن اختيار أكثر من إجابة".... إذا كان معدل الطالب عالياً لفصل معين ،فهذا في رأيك يعود إلى"

8. If student's GPA is high, that is as you think because of ...

يمكن اختيار اكثر من إجابة".... اذا كان معدل الطالب عالياً لفصل معين ،فهذا في رأيك يعود إلى"

Student work hard اجتهد الطالب ورغبته

High teaching quality كفاءة المعلمين

Academic and social advice الإرشاد الاكاديمي والنفسي

Sufficient credit hours كفاية عدد الساعات المعتمدة

Easy of curriculum سهولة المنهج الدراسي ووضوحه

Sufficient labs and books توفر البيئة المناسبة من كتب ومعامل

Continuing student meetings and activities leads to encouraging them to

study

اللقاءات المستمرة والنشاطات تؤدي لتشجيع الطلاب على التحصيل

The effectiveness of the orientation week for new students

أسبوع تهيئة الطلاب الجدد

Students help and direct by their older colleagues

مساعدة الطلاب وتوجيههم من قبل زملائهم الاقدم في الكلية (السنابر)

Time management فن إدارة الوقت

Other (please specify)

What procedures are in place to ensure the quality of the program taught in college

ما هي الإجراءات التي يتم ممارستها للتأكد من جودة البرنامج المعتمد تدريسه في الكلية "يمكن اختيار اكثر من" إجابة?

9. What procedures are in place to ensure the quality of the program taught in college

ما هي الإجراءات التي يتم ممارستها للتأكد من جودة البرنامج المعتمد تدريسه في الكلية "يمكن اختيار اكثر من إجابة"

The program seek and obtain a relevant academic and professional advice in specifying intended learning outcomes for students
البرنامج مبني علي المشورة الاكاديميه والمهنية ذات الصلة في تحديد النتائج التعليمية المستهدفة للطلاب

There is evidences showing how intended learning outcomes are consistent with the Qualifications Framework
هناك ما يدل على اتساق نتائج التعلم المعتمدة مع اطار المؤهلات

Teaching staff are made familiar with and enabled to use the strategies included in the program and course specifications.
الاستراتيجيات المدرجة في توصيف البرنامج يتم تعريف هيئة التدريس وتمكينهم من استخدام

Texts and reference materials are updated for relevance and quality so that students in academic/professional field are adequately prepared.
لملاءمتها وجودتها بحيث يتم اعداد الطلاب في المجال الأكاديمي/المهني بشكل كاف

Teaching staff are available at sufficient scheduled times for consultation and advice to students, and in office hours
المدرسون متاحون في مواعيد كافيه للتشاور وتقديم المشورة للطلبة وفي الساعات المكتبية

Measures have been adopted to provide appropriate preparatory support and orientation to help students study in a higher education environment. وقد اتخذت تدابير لتوفير الدعم والتوجيه التحضيري المناسبين لمساعدة الطلاب علي الدراسة في بيئة التعليم العالي.

Measures are taken to see that students are given feedback on performance and results of assessments in a timely manner, and there is additional assistance provided where necessary. وتتخذ تدابير لمعرفة ما إذا كان الطلاب يحصلون علي تغذية مرتدة بشأن الأداء ونتائج التقييمات في الوقت المناسب ، وهناك مساعده اضافيه تقدم عندما يقتضي الأمر التدخل.

The content of course and program portfolios are described as it relates to changes made periodically. يتم توصيف المحتوى وملف المقرر ليسهل التغيير دورياً.

أخرى تذكر (Other please specify)

يمكنك اختيار أكثر من "ما هو أسلوب التدريس الذي تفضله

"إجابة

10. What is your teaching style? يمكنك اختيار أكثر من إجابة "ما هو أسلوب التدريس الذي تفضله

I take detailed notes during lectures أكتب ملاحظات تفصيلية أثناء المحاضرات

I prefer to teach with images, videos or other media أفضل التدريس باستخدام الفيديوهات

والصور او الوسائط عموماً

Charts, diagrams, and maps help me to illustrate المخططات والرسوم البيانية والخرائط

تساعدني على التوضيح او الشرح

I allow discussions and presentations by students أفضل أسلوب النقاش وشارك الطلاب

في تقديم العروض

I allow frequent breaks during lectures أسمح بالتوقف او الاستراحة أثناء المحاضرة

I move among my students during lecture اتحرك بين تلاميذي أثناء المحاضرة

I explain the main idea and leave the rest to the diligence of the student أكتفي بشرح الفكرة الأساسية واترك الباقي لفطنة وبحث الطالب

I prefer presented in a step-by-step way أنا أفضل الأشياء التي تعرض بطريقة خطوة بخطوة

I adopted specific examples in order to students' fully understanding أنا أعتد على أمثلة محددة

للمغاية من أجل الفهم التام

Other (please specify)

المرشد الاكاديمي موجود ويقوم بدوره تماماً

Academic advisor is available and helpful

Question Title

11. المرشد الاكاديمي موجود ويقوم بدوره تماماً

Academic advisor is available and helpful

Strongly disagree أرفض بشدة

Disagree أرفض

Neither Disagree nor agree لا أرفض ولا أقبل

Agree أقبل

Strongly agree أقبل بشدة

Other (please specify)



Strategies have been developed in university to help weak students to supporting/withholding them

وضعت استراتيجيات في الجامعة لمساعدة الطلاب الضعيفين اكااديمياً لدعمهم ومساندتهم

Question Title

12. Strategies have been developed in university to help weak students to supporting/withholding them

وضعت استراتيجيات في الجامعة لمساعدة الطلاب الضعيفين اكااديمياً لدعمهم ومساندتهم



Strongly disagree أرفض بشدة



Disagree أرفض



Neither agree nor disagree لا أرفض ولا أقبل



Agree أقبل



Strongly agree أقبل بشدة

How does your program use the following to provide evidence of the appropriateness of intended (planned) learning outcomes and the extent to which they are achieved
كيف يستخدم برنامجك ما يلي لتقديم دليل علي ملاءمة نتائج التعلم (المخططة) المقصودة ومدى تحقيقها?


Question Title

13. How does your program use the following to provide evidence of the appropriateness of intended (planned) learning outcomes and the extent to which they are achieved
كيف يستخدم برنامجك ما يلي لتقديم دليل علي ملاءمة نتائج التعلم (المخططة) المقصودة ومدى تحقيقها

- Graduating student surveys دراسات استقصائية أو استبيانات للطلبة المتخرجين
- Employment outcome data بيانات نتائج التوظيف
- Employer feedback تعليقات صاحب العمل
- Performance of graduates after graduation أداء الخريجين بعد التخرج
- Other (please specify)

Appendix E: ALL SURVEYS:

☰
🏠



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All Surveys
📁

TITLE	MODIFIED	RESPONSES	DESIGN	COLLECT	ANALYZE	SHARE	MORE
<p>Teachers & Decision maker survey Created 02/14/2018</p>	06/26/2018	6	📄	📡	📊	🔗	⋮
<p>Student assessment Created 02/24/2017</p>	01/26/2018	111	📄	📡	📊	🔗	⋮
<p>Student Satisfaction Survey Created 05/13/2016</p>	08/01/2018	29	📄	📡	📊	🔗	⋮


+ CREATE SURVEY

All Surveys: 3 of 3



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Appendix F: National Academic Accreditation

بسم الله الرحمن الرحيم

السلطة القومية لتقويم واعتماد التعليم العالي

المعايير القياسية لتقويم واعتماد مؤسسات التعليم العالي

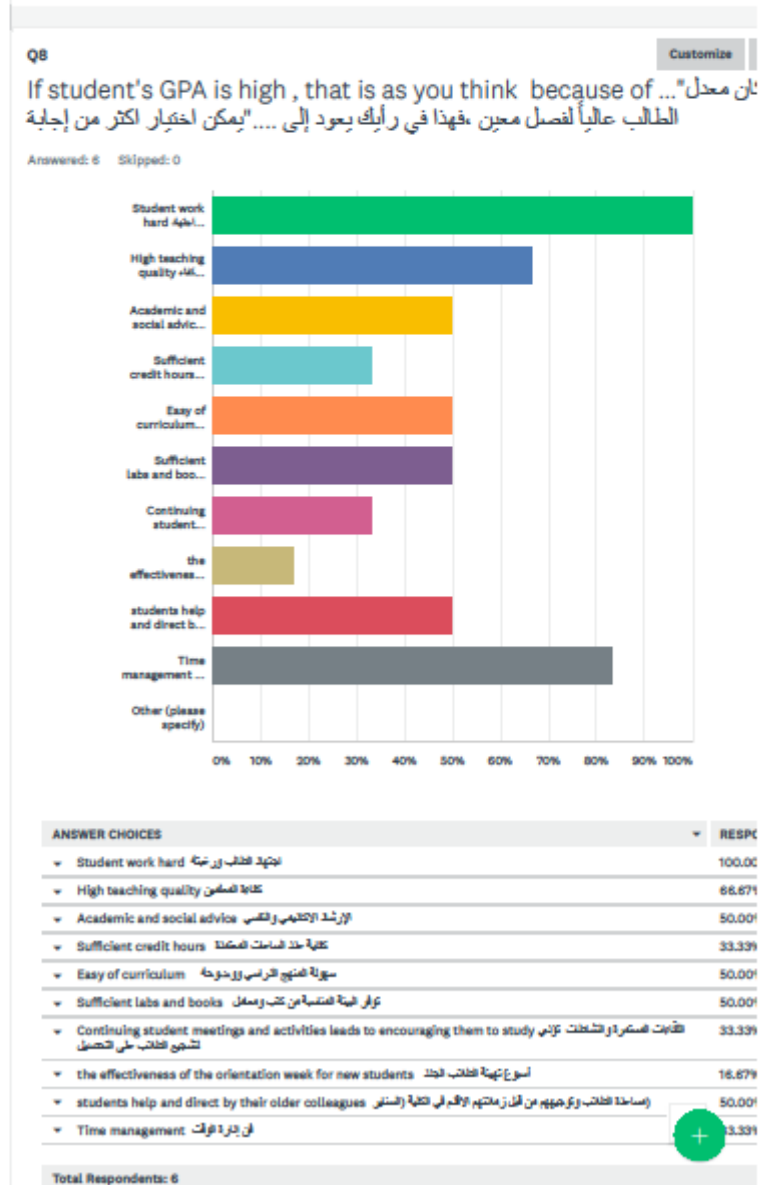
أبريل 2016

Appendix G: Teachers and decision makers summary:

ANSWER CHOICES	RESPONSES
Time table is not proper (الجدول الدراسي غير منسق جدا (المحذرات الصباحية)	83.33%
Low teaching quality (تدريس جودة التدریس)	66.67%
Insufficient credit hours (حدا الساعات المسجلة غير كافي)	16.67%
Lack of references (قلة كتب والمراجع)	16.67%
Lack of labs and preparations (قلة معامل والتجهيزات)	50.00%
unsuitable curriculum (منهج الدراسي غير مناسب)	16.67%
Teaching staff are not available (الإستةاذ غير متوفر)	100.00%
Test anxiety (قلق الاختبار)	100.00%
Time Management (إدارة الوقت)	100.00%

Total Respondents: 6

Comments (1)



Teachers & Decision maker survey

SUMMARY → DESIGN SURVEY → PREVIEW & SCORE → COLLECT RESPONSES → **ANALYZE RESULTS**

CURRENT VIEW

+ FILTER + COMPARE + SHOW

No rules applied

Rules allow you to FILTER, COMPARE and SHOW results to see trends and patterns.

[Learn more](#)

SAVED VIEWS (1)

EXPORTS

PAID FEATURE
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UPGRADE

[Learn more](#)

SHARED DATA (1)

RESPONDENTS: 6 of 6

QUESTION SUMMARIES DATA TRENDS INDIVIDUAL RESPONSES

All Pages

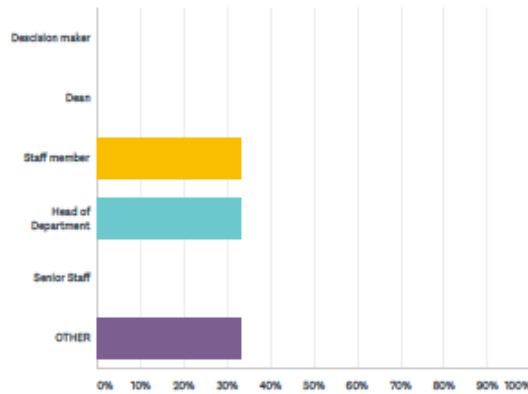
Page 1: STAKEHOLDERS SURVEY

Q1

Customize

What is your occupation?

Answered: 6 Skipped: 0



ANSWER CHOICES	RESPONSES
Decision maker	0.00%
Dean	0.00%
Staff member	33.33%
Head of Department	33.33%
Senior Staff	0.00%
OTHER	33.33%
TOTAL	

Q2

Customize

SUST has a datawarehouse for mining knowlege

Answered: 6 Skipped: 0



Appendix H: Graduation Rate case study

(done manually), from Registrar Office (2012/2013 – 2017/2018 academic

years) - قسم البرمجيات -

	35	عدد الطلاب النجاح في 4 سنوات
4	6	عدد الطلاب النجاح في 5 سنوات
	1	عدد الطلاب النجاح في 6 سنوات
	0	عدد الطلاب النجاح في 7 سنوات
	0	عدد الطلاب النجاح في 8 سنوات
	45	العدد الكلي للطلاب
	3	الطلاب المتسربين
	93.33%	الكفاءة الدخلية

Network Dep.:

	35	عدد الطلاب النجاح في 4 سنوات
	3	عدد الطلاب النجاح في 5 سنوات
	1	عدد الطلاب النجاح في 6 سنوات
	0	عدد الطلاب النجاح في 7 سنوات
	0	عدد الطلاب النجاح في 8 سنوات
	45	العدد الكلي للطلاب
	6	الطلاب المتسربين
	86.67%	الكفاءة الدخلية

Computer Science Dep.

	27	عدد الطلاب النجاح في 4 سنوات
	1	عدد الطلاب النجاح في 5 سنوات
	2	عدد الطلاب النجاح في 6 سنوات
	0	عدد الطلاب النجاح في 7 سنوات
	0	عدد الطلاب النجاح في 8 سنوات
	43	العدد الكلي للطلاب
	13	الطلاب المتسربين
	69.77%	الكفاءة الدخلية

IT Dep.:

28	عدد الطلاب النجاح في 4 سنوات
3	عدد الطلاب النجاح في 5 سنوات
0	عدد الطلاب النجاح في 6 سنوات
0	عدد الطلاب النجاح في 7 سنوات
0	عدد الطلاب النجاح في 8 سنوات
36	العدد الكلي للطلاب
5	الطلاب المتسربين
86.11%	الكفاءة الدخلية

Appendix I : Quality assurance dean interview

8/5/2018

fawzia awad elhassan
Prepared by:

Supervised by

Personal Information

اسم المسئول:

الوظيفة:

الزمان:

المكان:

1. ما هي مهام ودور ادارة الجودة ومدى تأثيرها على العملية التعليمية؟
2. ما هو الإطار العام أو الإجراءات المتبعة في ادارتكم لدعم اتخاذ القرارات؟
3. ما هي المدة الزمنية المتبعة لمراجعة البرامج التعليمية وكيفية تطويرها أو تغييرها ، وهل هذه البرامج معتمدة برامجياً وأكاديمياً ؟
4. ما هي مؤشرات الأداء التي تعتمد عليها ادارة الجودة لديكم ؟
5. ما هو تقييم الطلاب بصورة عامة علي جودة المناهج والكورسات الدراسية؟
6. ما هو معدل إكمال الطلاب للبرامج الدراسية (البكلوريوس) بصورة عامة وكلية علوم الحاسوب وتقنية المعلومات بصورة خاصة؟ و نسبة الطلاب الذين أكملوا في الوقت المحدد ؟
7. نسبة الطلاب الملتحقين ببرامج الدراسات العليا الذين يكملون هذه البرامج في الوقت المحدد ؟
8. ما هي قائمه مواطن القوه والتوصيات ؟

Percentage of students entering programs who successfully complete final year
Course completion rates for Full time students in computer science and technology college
Apparent completion rate for undergraduate programs for full time students
Proportion of students entering post graduate programs who complete those programs in specified time
list strengths and recommendations

Any quality management papers and performance indicators can be attached

Prepared by:

Supervised by

8/5/2018

Fawzia Awad
Quality Affairs Survey document

Personal Information

اسم المستوف: د. لبنى براهيم عبد الباقى

الوظيفة: عميد

الزمان: ٢٠١٨ ١٨١٦

المكان: جامعة بنها - كلية التربية

1. ما هي مهام ودور ادارة الجودة ومدى تأثيرها على العملية التعليمية؟
هناك اهمية

2. ما هو الإطار العام أو الإجراءات المتبعة في ادارتكم لدعم اتخاذ القرارات؟
تقديم الخيارات و برامج مستشارية وادارية
اليه

3. ما هي المدة الزمنية المتبعة لمراجعة البرامج التعليمية وكيفية تطويرها أو تغييرها : وهل هذه البرامج معتمدة برامجا و أكاديميا ؟

المدة المقررة لمراجعة البرامج هي سنوية حسب خطة العمل السنوية
تصنف البرامج التي تم تحديثها جيداً ورائداً

4. ما هي مؤشرات الأداء التي تعتمد عليها ادارة الجودة لديكم ؟
منه لاجراءات لاجراءات الجودة
مؤشرات لتقييم البرامج

5. ما هو تقييم الطلاب بصورة عامة على جودة المناهج والكورسات الدراسية؟
التقييم جيداً

6. ما هو معدل اكمال الطلاب للبرامج الدراسية (البكالوريوس) بصورة عامة وكلية علوم الحاسوب وتكنولوجيا المعلومات بصورة خاصة؟ و نسبة الطلاب الذين اكملوا في الوقت المحدد ؟

تقريباً ٧٩٠

Appendix J: Academic adviser report

Republic of the Sudan

Sudan University of Science and Technology

College of Computer Science and
Information Technology



جمهورية السودان

جامعة السودان للعلوم والتكنولوجيا

كلية علوم الحاسوب وتقانة المعلومات

مكتب الاشراف الطلابي

التمرد: ج. س. ع. ت. ك. ع. ح. ت. / أ. ش. ط. / 2

التاريخ: 2018/7/19 م

السيد/ عميد شؤون الطلاب

حفظه الله

السلام عليكم ورحمة الله وبركاته

الموضوع: تقرير عن الدعوات في الفترة من شهر يناير 2017 الى شهر يوليو 2018 م

الرقم	الاحداثيات	جهة الدعم	العدد	المبلغ الاجمالي
1	الفصول المتقدمة الطلاب المعسرين المعسرين السنة اولى	عمادة شؤون الطلاب عمادة شؤون الطلاب	25 13	9.466 6.880
2	حالات الوفاة احدى الوالدين	عمادة شؤون الطلاب	10	750 لكل طالب
3	دعم طلاب السنة اولى دعم طلاب السنة اولى	فاعل خير فاعل خير	11 6	3.000 2500
4	استقبال الطلاب الجدد وتكريم المتفوقين 2017 م	كلية علوم الحاسوب	63	8.000
5	يوم ثقافي عن الطواهر السلبية	عمادة شؤون الطلاب		3.000
6	زيارة طلاب جامعة زالنجي	كلية علوم الحاسوب	99	500
7	زيارة طلاب ام عشر الصف الثامن	كلية علوم الحاسوب	53	500
8	زيارة جامعة القران الكريم برفاعة	كلية علوم الحاسوب	45	750
9	زيارة مدرسة العمارات النموذجية بنات	كلية علوم الحاسوب	70	100
10	المنحة الكورية	د. محمد عز الدين عبد الرحمن	15	100 دولار لكل طالب
11	الطلاب المحرمين من الامتحان في الفصل الدراسي الاول	فاعل خير	6	4.000
12	الكتابة السنة اولى	انصتوق القومى لرعاية الطلاب	49	100
13	الذين قدموا للكتابة لم يحصلوا عليها من الفصول المتقدمة 2017 م	انصتوق القومى لرعاية الطلاب	30	

نوال صديقي عثمان - مشرف طلاب بالكلية

14 رسالة الخاصة لعميد الكلية

4

15 تم تكريم ابيه حارة
مع المتفوقين