



Tableau Big Data Visualization Tool in the Higher Education Institutions for Sustainable Development Goals

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***Abstract—** The purpose of this paper is to use of Tableau in HEIs to achieve the Sustainable Development Goals (SDGs). Tableau can use large data sets to analyse, visualize and share knowledge, such as: whole Egypt, HEIs, governorate, university, college, program, course, faculty members, and students to determine the demography and performance. It provides a variety of graphs, chart forms and dashboards that can assist to have a better tool in HEIs for sustainability. An analysis based on a literature review of visualization tools such as Tableau and sustainable development goals. This paper suggests that most 17 SDGs and ESDGs can be analysed, visualized and shared knowledge using Tableau. Tableau tool can be used to study the extent to which higher education institutions can be used to contribute to the achievement of sustainable development both internal and external EHEIs geographical boundaries. This paper emphasizes the application of a relevant practical underpinning to support Sustainable Development Goals (SDGs).*

***Keywords—** Big Data, Visualization Tools, Tableau; HEIs, SDGs.*

I. INTRODUCTION

Headings Tableau is one of the tools of knowledge management systems for the third generation of the Internet with live connection. In higher education, Tableau is unlocking the power of data to improve learning, fundraising, planning, and research. Hundreds of leading institutions use Tableau to analyze student enrolment, achievement, and demographics. Educational institutions are developing better alumni relations and streamlining educational reporting. In the classroom and in the lab, Tableau enriches the learning experience with analytics anyone can use and understand [1].

The role of HEIs in achieving sustainable development (SD) was highlighted for the first time in the 1972 Stockholm Declaration on the Human Environment [2]. Since then, HEIs and their stakeholders have increasingly engaged in a number of global initiatives and expressed their commitment to SD in a variety of national and international declarations and charters [3]. Recent examples include the United Nations Higher Education Sustainability Initiative (UN HESI) and the UN Higher Education and Research for Sustainable Development (HESD) platform. Both initiatives foster the implementation of the Sustainable Development Goals (SDGs), as part of a globally agreed policy agenda for SD, in higher education [4] and [5].

Education for sustainable development (ESD) is expected both to make people more aware and better qualified to take part in shaping future developments responsibly, and to raise their awareness of the problems

related to sustainable development and bring forth innovative contributions to all economic, social, environmental and cultural issues [6].

Universities play an important role for fostering ESD ‘by addressing sustainability through their major functions of education, research and outreach’ [7].

At the Millennium Summit of the United Nations in 2000, all UN members agreed to the eight international development goals called the Millennium Development Goals (MDGs) of 2000-2015. To continue and to complete what the MDGs did not achieve, the General Assembly of United Nations on 25 September 2015 adopted a resolution titled “Transforming Our World: the 2030 Agenda for Sustainable Development”, a plan of action for people, planet, and prosperity. They seek to balance the three dimensions of sustainable development: the economic, social and environmental [8]. The resolution called all countries and all stakeholders of governments, private sectors, academic communities, as well as civil societies to act in collaborative partnership to implement all of 17 SDGs. [9].

II. BIG DATA VISUALIZATION TOOLS USED IN THE HEIS AND COMPARISON

The following are five big data visualization tools [12]:

A. QlikView

QlikView is a solution that focuses on the user as the receiver of data. It allows users to explore and discover data in a workflow similar to the way developers work when processing data. To sustain flexibility in its approach to data exploration and visualization, this software strives to maintain the association between data. It’s flexible. It allows setting and weak every little aspect of each object and customizes the look and feel of any visualizations and dashboards. With such great deal of flexibility, there also comes an incorporated ETL (Extract, Transform, and Load) Engine that enables you to conduct the ordinary data cleansing operations. However, it may turn out to be costly. It has many unique features like patented technology and has in-memory data processing, which executes the result very fast to the end users and stores the data in the report itself.

B. Klipfolio

Klipfolio is a BI solution that resides 100% in the cloud (no desktop application is required) providing an insightful tool for data visualization and dashboard composition. It supports connectivity to a variety of data sources, both online and offline. The online sources integrate a range of cloud-hosted storages including Google Sheets, Relational DBs, and other services that provide data in all kinds of forms. It supports a great variety of offline service types: MS Excel, CSV, XML, JSON, and others. It applies the principle of responsiveness to facilitate the discovery of dashboards with the use of diverse technological platforms, from smartphones and tablets, to desktop computers and smart TVs.

C. Tableau

Tableau provides facility to connect to a variety of data sources with many systematic types, such as data systems organized in file formats (CSV, JSON, XML, MS Excel, etc.), relational and nonrelational data systems (PostgreSQL, MySQL, SQL Server, MongoDB, etc.), cloud systems (AWS, Oracle Cloud, Google BigQuery, Microsoft Azure). The core distinction from competitors is that Tableau has a special feature of Data Blending. Another unique feature is the ability for collaboration in real time that makes it a valuable investment for commercial and non-commercial organizations alike. There are several ways to share the reports in Tableau: by publishing them to a Tableau server; via email Tableau Reader capability; by publishing Tableau workbook openly and giving access to anyone who has a link. This magnitude of options enables great flexibility and removes many restrictions. Tableau Public is a free software that connects any data source be it corporate Data Warehouse, Microsoft Excel or web-based data, and creates data visualizations, maps, dashboards etc. with real-time updates presenting on web. They can also be shared through social media or with the client.

D. Power BI

Power BI is the software solution, developed and supported by Microsoft, for business intelligence and analytics needs. At the core of Power BI is an online service with various options for interaction, also featuring several outlets for connection to data provided by third party software and services. In addition, it provides a simple web-based interface with a plenitude of useful features varying from customizable visualization to certainly limited controls of data sources. The desktop application expands the available functionality to an even larger extent with the addition of tools for data cleansing and normalization. Also, it has connections to some other software from the Microsoft’s toolbox but goes much farther than that by utilizing a whole suite of novel business analytics tools. Thus, Power BI is not just related to other products; it is tightly integrated with the main Microsoft tools including MS Excel, Azure Cloud Service, and SQL Server.

E. Google Data Studio

The youngest tool on our list is a part of Google's analytics solutions—Google Data Studio. Being relatively new to the field, it strives to take its position among many competitors via ease of usage, simple yet beautiful design, innovative problem-solving, and straightforward, habitual ways to share dashboards (just as you usually share documents). While still being in Beta, Google Data Studio gives an interesting insight into how it can process the data. It is a fully web-based solution, and there is no desktop version (unlike other BI solutions). The tool had a pretty decent start, but time will show whether it will perform well in the long run.

III. TABLEAU BENEFITS

The following are some of the benefits of Tableau [13]:

A. Ease of use

According to Gartner's Magic Quadrant, more than 70 percent of Tableau's customers selected the product based on its ease of use for the business user. Tableau basics can be understood in a few hours.

B. Advanced Analytics

Tableau's client references ranked it in the bottom third of all Magic Quadrant vendors for complexity of analysis.

C. Data Preparation

Despite efforts to improve its data preparation capabilities in version 9, Tableau still has weaknesses in the area of data integration across data sources. Tableau supports a diverse range of data connectivity options but offers little support when it comes to integrating combinations of these sources in preparation for analysis.

D. Security

With Tableau you can establish "row level" security at the data level. In order to set up row level security in Tableau, the user must have a database user account. The increased numbers of database accounts mean increased opportunities for hackers.

E. Cost

Tableau costs less upfront than Qlikview. Not only does Tableau have a reputation as being less expensive to purchase, it requires less developer involvement to implement, maintain and use making its total cost of ownership over its lifetime less than Qlikview's.

IV. TABLEAU PRODUCTS

Tableau has five products which together form a product platform to enable users to create Tableau files. These five products are: Tableau desktop, Tableau online, Tableau Server, Tableau Public, and Tableau reader. [14].

A. Tableau Desktop

Tableau Desktop is a data visualization tool designed to create data visualization, report and dashboard in a fast and intelligent way. To be more specific, users can connect to multiple data sources, carry out multi-dimensional data analysis, create dashboards or report, modify metadata and publish a complete workbook to Tableau server if needed.

B. Tableau Online

Tableau Online is a hosted version of Tableau Server. It is the business analytics platform where people can share dashboards, interact with report and gain insights. It is hosted in the cloud so that there is no hardware, no set-up time needed.

C. Tableau Server

Tableau Server is a data governance platform and can be either browser based or mobile based. It enables users to publish dashboards on Tableau Server so that everyone in the organization can share, collaborate and interact with them. It facilitates the integration of data in the organization.

D. Tableau Public

Tableau is a free tool that anyone can use to connect to data, create interactive data visualizations and publish them on the web. Since everyone has access to published data, user should be careful not to put the proprietary data on Tableau Public.

E. *Tableau Reader*

Tableau Reader is a free desktop application that users can open and interact with data visualizations which are created with Tableau Desktop.

V. **TABLEAU ARCHITECTURE**

Tableau has highly scalable and it has n-tier client-server based architecture that serves the mobile clients, web clients, and desktop installed software [15] and [16].

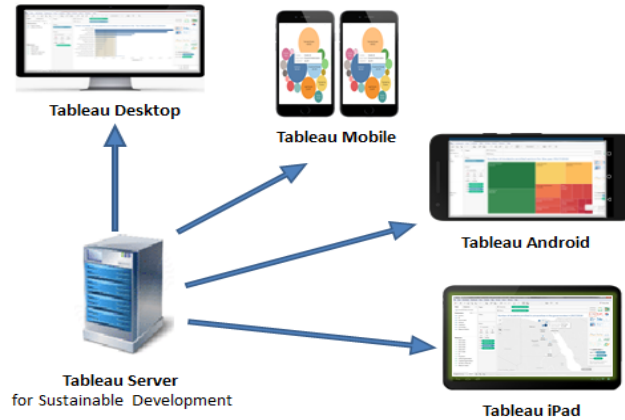


Figure 1: Tableau Architecture for Sustainable Development

Tableau server is an enterprise business class platform it can set up hundreds of thousands of users. It offers powerful mobile and web-based analytic works with companies existing data and security protocol.

- Scales up: Is multi-threaded
- Scales out: Is multi-process enabled
- Provides integrated clustering
- Supports High Availability
- Is secure
- Runs on both physical and Virtual Machines

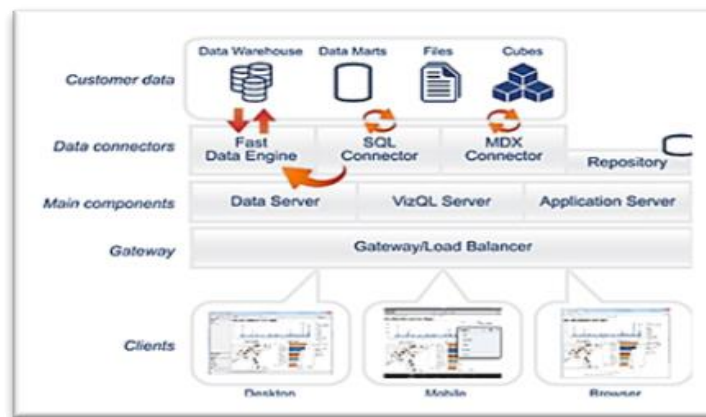


Figure 2: Tableau Server Architecture [15]

- **Data Layer:** The basic characteristic of tableau that supports your choice of data architecture. Tableau does not require any restrictions for the database like data to be stored in any single system. Most of the organizations have a heterogeneous environment. Tableau can work with all these simultaneously.
- **Data Connectors:** Tableau includes a number of optimized data connectors for databases such as Microsoft Excel, SQL Server, Oracle, Teradata, Vertica, Cloudera Hadoop, and much more. There is also a generic ODBC connector for any systems without a native connector. Tableau provides two modes for interacting with data: Live connection or In-memory. Users can switch between a live and in-memory connection as they choose.

- **Live connection:** Tableau's data connectors leverage your existing data by sending dynamic SQL or MDX statements directly to the source database rather than importing all the data. It's the front-end analytics client to many of the largest databases in the world. Tableau has optimized each connector to take advantage of the unique characteristics of each data source.
- **In-memory:** Tableau offers a fast analytic performance due to in-memory data engine. Data engine will extract the data and bring it in memory in the tableau. Data engine utilized your entire system to get the fast query response one million of rows of data. Data engine can access the disk store as well as RAM and cache memory.
- **Application Server:** Application server provides the authorization and authentications from the database.
- **VIZ sql server:** VIZ sql server converts the sql queries into visualization.
- **Data Server:** data server centrally manage and store tableau data sources. It also maintains Metadata from tableau desktop such as calculations, definition, and groups.
- **Backgrounder:** The backgrounder refreshes scheduled extracts and manages other background tasks.
- **Gateway/ Load Balancer:** It is the primary Tableau Server which trails requests to other components. Requests which come in from the client firstly strike the gateway server and then routed to the appropriate procedures. If multiple procedures are configured for any component, the Gateway will work as a load balancer and share the requests to the procedures. In a single server configuration, every procedure sits on the Gateway, or primary server. When running in a distributed atmosphere, one physical machine is designated the primary server and the others are designated as worker servers which can run any number of other procedure. Tableau Server always uses only one machine as the primary server.
- **Clients (Web Browsers and Mobile Apps):** It offers interactive dashboards toward clients using zero-footprint HTML and JavaScript (AJAX) in a web browser, or natively through a mobile app. No plug-ins or helper applications are necessary. Tableau Server supports:
 - **Web browsers:** Internet Explorer, Firefox, Chrome and Safari.
 - **Mobile Safari:** Touch-optimized views are automatically served on mobile Safari.
 - **iPad app:** Native iPad application that provides touch-optimized views and content browsing.
 - **Android app:** Native Android application that provides touch-optimized views and content browsing.
 - **Android browser:** Touch-optimized views are automatically offered in the Android browser.
- **Clients (Tableau Desktop):** Tableau Desktop is the rapid-fire authoring environment used to generate and publish sights, reports and dashboards to Tableau Server. Using this, a report author can tie with multiple data sources, explore relationships, create dashboards, modify metadata, and finally issue a completed workbook or data source to Tableau Server.

VI.SDGs OF THE UNITED NATIONS

The 17 Sustainable Development Goals (SDGs) are the world's best plan to build a better world for people and our planet by 2030. Adopted by all United Nations Member States in 2015, the SDGs are a call for action by all countries - poor, rich and middle-income - to promote prosperity while protecting the environment. They recognize that ending poverty must go hand-in-hand with strategies that build economic growth and address a range of social needs including education, health, equality and job opportunities, while tackling climate change and working to preserve our ocean and forests. The Sustainable Development Goals (SDGs), otherwise known as the Global Goals, are a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity [17]. It is made up of 17 goals meant to be applied to every country, not just developing nations.

The sustainable development goals are [8]:

- **Goal 1.** End poverty in all its forms everywhere.
- **Goal 2.** End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- **Goal 3.** Ensure healthy lives and promote well-being for all at all ages.
- **Goal 4.** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- **Goal 5.** Achieve gender equality and empower all women and girls.
- **Goal 6.** Ensure availability and sustainable management of water and sanitation for all.
- **Goal 7.** Ensure access to affordable, reliable, sustainable and modern energy for all.
- **Goal 8.** Promote sustained, inclusive and sustainable economic growth, full and productive. employment and decent work for all.
- **Goal 9.** Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
- **Goal 10.** Reduce inequality within and among countries.
- **Goal 11.** Make cities and human settlements inclusive, safe, resilient and sustainable.

- **Goal 12.** Ensure sustainable consumption and production patterns.
- **Goal 13.** Take urgent action to combat climate change and its impacts.
- **Goal 14.** Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
- **Goal 15.** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably. manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
- **Goal 16.** Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
- **Goal 17.** Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Where companies can choose just one SDG they wish to address in their operations. Similarly, The Higher Education Sustainability Initiative (HESI) asks colleges and universities to pick one of the SDG they wish to contribute towards [17].

Target 4.7 by 2030, ensure all learners acquire knowledge and skills needed to promote sustainable development, including among others through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development. SDG 4.7.1, Extent to which (i) global citizenship education and (ii) education for sustainable development, including gender equality and human rights, are mainstreamed at all levels in: (i) national education policies, (ii) curricula, (iii) teacher education and (iv) student assessment. [18].

VII. THE SUSTAINABLE DEVELOPMENT GOALS (SDGs) IN EGYPT

In line with the 2030 Agenda, the Egyptian Government has launched a working plan called Egypt's Vision 2030, also known as Sustainable Development Strategy (SDS), which encompasses the economic, social and environmental dimensions of development. SDS promotes economic flourishing based on justice, social integrity and participation. It is under the SDS that all development plans in Egypt are incorporated while at the same time being strongly guided by the SDGs. Additionally, in an effort to monitor the implementation and reporting on progress of the SDGs, the Primer Minister appointed the Ministry of Planning, Monitoring and Administrative Reform (MoPMAR) as its Rapporteur. The ministry is responsible for coordinating the steps towards integrating, institutionalizing and implementing the SDGs.

Key Messages of Egypt Voluntary National Review 2018

- Egypt is committed to progress towards achieving the Sustainable Development Goals (SDGs). Egypt's Sustainable Development Strategy, Egypt Vision 2030, is in line with SDGs. The national strategic plan's three dimensions (economic, social and environmental) are based on ten pillars covering broadly the SDGs. The plan provides programs, policies and measurable indicators in order to put Egypt on the right path toward sustainable development.
- Egypt embarked on a very comprehensive and home grown economic reform program that is supported by the international financial institutions starting November 2016. The Government of Egypt took very bold and timely measures as well as overdue reforms to put the economy on the path towards a more stable resilient economy. After a challenging year, economic fundamentals are stabilizing with reduction in fiscal deficit, curbing in the rate of inflation, waning in external deficit and increasing in the growth rate of output; all of these are met with increased confidence from domestic and international investors. The Government of Egypt is committed to pursuing its agenda of economic reforms to create an enabling environment for inclusive growth and sustainable development.
- Egypt is mindful of the vulnerable groups who are likely more adversely affected by stabilization and reform programs. In order not to leave anyone behind, the Government of Egypt has scaled up its social protection programs and has improved their target mechanisms. In addition, the Government of Egypt is allocating more resources to the more deprived areas to provide better quality of public services and infrastructure.
- Egypt is pursuing an ambitious plan to upgrade its infrastructure across all sectors and all regions within the country. The energy sector witnessed a substantial upgrade in its capacity to produce, transport and distribute electricity. Egypt increased its capacity to produce electricity by at least 15 Gigawatt of electricity using very advanced, sustainable and efficient technologies. Indeed, the energy strategy aims at increasing the share of the renewable energy to reach 42% by 2035. The government has also enacted major reforms in the legal framework of its electricity sector opening the door for increased participation of the private sector

and effective regulatory role of the state. All of these efforts in the energy sector are consistent with Egypt’s vision to become the energy hub of the Eastern Mediterranean.

- Egyptian network of highways witnessed major extensions and improvements. The national highway project is a much needed project to link distant parts of Egypt beyond the main cities and the Nile Valley in order to create economic opportunities and to expand beyond the narrow valley.
- The growing population consisting mainly of youth represents both a challenge and an opportunity. It is a challenge since the government needs to continuously scaling up the country’s infrastructure and housing units especially for low income groups. This explains Egypt’s heavy investment in infrastructure projects as well as social housing projects. On the other hand, this young sizeable population would be an asset if these young people obtain adequate quality education and training that prepare them for the fourth industrial revolution.
- Water scarcity within Egypt and regionally is a key challenge for the growing population; especially that the agricultural sector consumes almost two thirds of its supply of fresh water. Ensuring sustainable water resource management is a matter of high priority to the Government of Egypt.
- Egypt’s Vision 2030 and the 2030 Agenda are implemented by engaging all stakeholders. The role of the private sector and the civil society is key in the realization of these goals. The inclusivity and transformability aspects of the 2030 Agenda and its national counterpart necessitate active contribution of the private sector and the civil society in the achievement of all the goals. The Government of Egypt awareness this fact and is capitalizing on the positive synergies between the governmental efforts, private sector efforts and civil society efforts to achieve this ambitious agenda.

VIII. TABLEAU IN THE HEIS FOR THE SDGs

The Figure 4 is as shown in the Tableau in the HEIs for the SDGs

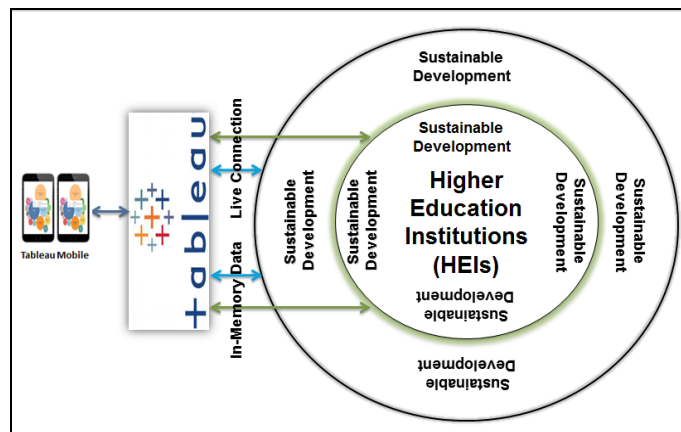


Figure 4: Tableau in the HEIs for the SDGs

An example of the charts is as shown in the Figure 5 in the Tableau. The different ratio of sectors can be observed.

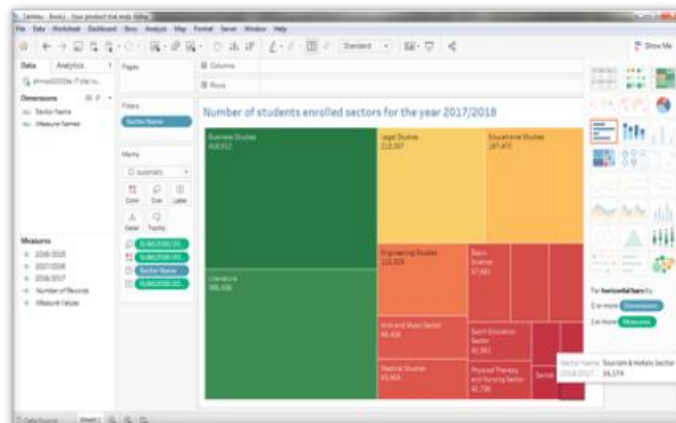


Figure 5: Number of students enrolled sectors for the year 2017/2018

IX. CONCLUSIONS

Tableau is one of the top powerful and fastest growing data visualization tool used in HEIs.

Higher education for sustainable development is not foregrounded precisely. The only SDG of higher education is SDG 4.7: “By 2030, ensure all learners acquire knowledge and skills needed to promote sustainable development, including among others through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture’s contribution to sustainable development”.

The task of higher education institutions is to graduate people in different sectors who are able to achieve the goals of different sustainable development.

The dimensions of sustainable development should not be limited to the three environmental, economic and social dimensions, but must include, in accordance with the environmental approach, other environments such as: higher education, politics, management, cultural, security, Industrial and tourism.

Using the Tableau data visualization tool should not be limited to analytics on target 4.7 but on all sectors.

The higher education sectors should include all aspects of the environmental approach...

REFERENCES

- [1] Tableau, (2019). Tableau for Higher Education. Retrieved from <https://www.tableau.com/solutions/education-higher-ed-analytics>
- [2] UN, (2018a). Declaration of the United Nations Conference on the Human Environment. Retrieved from <http://www.un-documents.net/unchedec.htm>
- [3] Lozano, R., Lukman, R., Lozano, F.J., Huisingh, D., Lambrechts, W., (2013). Declarations for Sustainability in Higher Education: Becoming Better Leaders, through Addressing the University System. *J. Clean. Prod.* 48, 10–19.
- [4] UN, (2018b). Higher Education and Research for Sustainable Development (Hesd). Retrieved from <https://sustainabledevelopment.un.org/partnership/?p=11748>
- [5] UN, (2018c). Higher Education Sustainability Initiative (Hesi). Retrieved from <https://sustainabledevelopment.un.org/sdinaction/hesi>
- [6] Barth, M., Rieckmann, M. (2016). State of the art in research on higher education for sustainable development, in: Barth. *Routledge Handbook of Higher Education for Sustainable Development*, London, 100 – 113. Retrieved from http://www.academia.edu/17998746/State_of_the_Art_in_Research_on_Higher_Education_for_Sustainable_Development
- [7] Fadeeva, Z.; Mochizuki, Y. (2010). Higher education for today and tomorrow: university appraisal for diversity innovation and change towards sustainable development. In: *Sustainability Science* 5 (2), 249–256. Retrieved from <https://link.springer.com/content/pdf/10.1007%2Fs11625-010-0106-0.pdf>
- [8] UN, (2015). Transforming our world: the 2030 Agenda for Sustainable Development. Retrieved from <https://sustainabledevelopment.un.org/post2015/transformingourworld>
- [9] Ridho, T. K., Vinichenko, M., & Makushkin, S. (2018). Participation of Companies in Emerging Markets to the Sustainable Development Goals (SDGs). Paper presented at the 741-752. Retrieved from <https://search.proquest.com/docview/2139001802?accountid=30906>
- [10] Clugston, R. M., & Calder, W. (1999). Critical dimensions of sustainability in higher education. In W. L. Filho (Ed.), *Sustainability and university life* (pp. 31-46). New York: Peter Lang. Retrieved from https://redcampussustainable.cl/wp-content/uploads/2018/03/3-Critical_dimensions_SHE.pdf
- [11] SDSEGYPT2030, (2016). Sustainable Development Strategy: Egypt’s Vision 2030. Retrieved from <http://sdsegypt2030.com/wp-content/uploads/2016/08/English-Booklet-2030.compressed.pdf>
- [12] Bobriakov, I. (2018). A Comparative Analysis of Top 6 BI and Data Visualization Tools in 2018. Retrieved from <https://medium.com/activewizards-machine-learning-company/a-comparative-analysis-of-top-6-bi-and-data-visualization-tools-in-2018-658490665973>
- [13] Akscellenceinfo, (2017). Market for BI & Data Analytics. Retrieved from <http://www.akscellenceinfo.com/media/1090/market-for-bi-data-analytics.pdf>
- [14] Machairidou, S. (2018). Big Data and Tableau. Retrieved from <https://ikee.lib.auth.gr/record/297918/files/GRI-2018-21585.pdf>
- [15] Intellipaat, (2019). Tableau Architecture. Retrieved from <https://intellipaat.com/tutorial/tableau-tutorial/tableau-architecture/>
- [16] ABC Learn, (2018). Tableau Architecture. Retrieved from <https://www.abclearn.com/courses/tableau/tableau-basics/tableau-architecture/>
- [17] UN, (2017). Sustainable Development Knowledge Platform. Retrieved from <https://sustainabledevelopment.un.org/content/documents/3949ola.pdf>
- [18] UNESCO Institute for Statistics, (2018). Quick Guide to Education Indicators for SDG 4. Retrieved from <http://uis.unesco.org/sites/default/files/documents/quick-guide-education-indicators-sdg4-2018-en.pdf>