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**UDC 37.022
JEL I-20, I-21**

IMPROVING EDUCATIONAL AND TRAINING PROGRAMMES THROUGH LEARNING ANALYTICS AND VISUALISATION OF EDUCATIONAL DATA

Abstract

This paper provides a step-by-step approach on how institutions can use their information for improving educational provision and subsequently becoming more competitive in the higher education sector. The paper focuses on three scenarios in explaining how the visualisation of data that are available in higher education institutions can become a key element for gaining competitive advantage.

Introduction

This position paper provides an overview of how data analytics and in particular the analysis of educational information can be used from institutions as the means for improving their competitiveness. The report first discusses different views on how learning analytics and their visualisation can be used for a number of areas to improve institutional effectiveness. The paper continues with a discussion on a number of scenarios where learning analytics could be used, with detailed guidelines on how data visualisations can assist decision-making. It is important to note that learning analytics can be used in two main ways in order to improve educational and training programmes. On one hand analytics can be used as predictive tools focusing on forecasting what will happen next based on patterns of what has happened before. For example how applications may increase following trends of the past few years. On the other hand analytics can be used as prescriptive tools focusing on determining recommendations for decisions and actions based on the institution's assumptions on what is

believed that it will happen. For example identifying the necessary resources to support the delivery of a programme based on the assumption of a set number of applicants to be registered for the programme in the coming year.

The Role of Analytics in Higher Education

The emerging field of analytics in higher education has been widely discussed over the past few years. Emphasis is given on understanding the role of analytics in higher education, as well as determining the impact of analytics on academic programmes. In this section we will briefly discuss the main concerns associated with the use of analytics in higher education. According to an article published by McKinsey & Company [3] there are a few challenges associated with the effective use of analytics in higher education including (i) being overly focused on external compliance (meaning that emphasis is given more on meeting benchmarks and standards for producing reports and visualisations rather than focusing on understanding the institution's own data), (ii) isolating the analytics program in an existing department (meaning that analytics are commissioned by specific units, failing to offer an institution-wide resource based on the integration of various analytics reports and merging of different data sources), (iii) failing to establish a culture of data sharing and hygiene (meaning the reluctance for integrating institutional data and allowing information sharing between different organisational units) and (iv) lacking the appropriate talent (meaning the ability of universities to employ skilled individuals who can properly analyse data sets and offer meaningful visualisations). The report concludes to five actions steps for academic institutions [3] as follows:

- Articulating an analytics mandate that goes beyond compliance – in other words universities must integrate analytics in their core strategy, making sure that they gain insights from their own data.

- Establishing a central analytics team with direct reporting lines to executive leaders – universities must ensure that sufficient human resource are available with specific line management and reporting responsibilities to the institution's board of governors.

- Winning analytics buy-in from the front line and create a culture of data-driven decision making – it is suggested that in order to gain true benefits from analytics universities must ensure there is strong support and commitment from senior management, as well as a transformation of the corporate culture towards effective use of institutional data.

- Strengthening in-house analytical capabilities – it is important for institutional analytics to be operated by full time staff members, able to understand the true value of the data being analysed.

- Not letting great be the enemy of good – university executives must understand that analytics do not always produce amazing results and that it is necessary to gradually immerse into the seamless use of analytics as part of the institution's self-assessment and decision-making processes.

The Center for Digital Education identifies a number of ways smart universities use data and analytics [2]. First, institutions can use analytics to improve recruitment, y attracting students with better chances for retention and progression based on careful profiling of

applicants. The admissions process can be also enhanced and lead to improved Return on Investment (ROI) after analysing several criteria such as demographics, academic prospects and historical data. Student progression can be also improved with strategic use of analytics, based on maintaining individual profiles with academics performance, personal tutorial information and student profiling. A very straightforward way to benefit from analytics is through evaluation of motivation, which can be done with the use of attendance monitoring. Emerging patterns can help institutions identify whether there is an issue for specific programmes and perhaps determine the reasons for increased absenteeism. Analytics have been historically used for curriculum evaluation, usually in the form of student surveys or other means for gaining feedback and student views. Analytics can be also used for designing lean, efficient operations. Cost and time gains can be the result of analytics for the way certain academic operations perform. There are quite a few benefits from the use of analytics in higher education including [1]:

- Optimising academic programmes in such a way that they are more aligned to learners' needs.
- Improving programme delivery through scheduling according to room availability, student preferences and available resources.
- Assessing profitability and ROI of academic programmes against a number of factors including enrolment forecasts, budgets, computing resources, parking, and more.
- Determining issues relating to retention and progression and assessing individual learners according to certain benchmarks that flag cases in need for attention.

According to Deloitte [5] the types of data generated in academic institutions that can be used for effective analytics include the following: (I) timetables, (II) administrative data, (III) application and admissions data, (IV) research data, (V) financial data, (VI) planned work, (VII) maps, estates and facilities data, (VIII) student and performance data, (IX) staff data, (X) course data, (XI) environmental data and (XII) alumni and historical data. In the UK, there are certain data collection institutions that serve the education sector as follows [5]:

- HESA – collecting and holding information on the composition of the student body, degree results, and destinations of leavers after graduation.
- UCAS – holding data on the prior qualifications of successful and unsuccessful university applicants.
- SLC – holding data about applicants for student support, the rate at which they repay their student loans after graduation, and the accumulation of debt and the total loan outlay.
- UKVI – holding data on international students, including attendance data.

Recommendations for using Learning Analytics

We could identify a number of motivating factors for deploying analytics in a Higher Education Institution (HEI). These can be as follows:

- Improving the institution's student retention results.
- Providing better feedback to students based on their performance.
- Assessing attendance patterns across cohorts and programmes.
- Enhancing the learning experience of students.
- Evaluating teaching and assessment practices.

According to the report of a ten-month inquiry co-chaired by Lord Norton and Sarah Porter for the UK Higher Education Commission, a set of recommendations were produced –

that emphasise the importance of a strategy for data and analytics that needs to be put in place, and kept up-to-date, by each university [5]. We will attempt to adapt these recommendations into the following table, to provide suggested actions that can be implemented by institutions that wish to consider the deployment of learning analytics.

Table 1.

Recommended actions for the deployment of learning analytics in higher education institutions

| Recommendation | Description |
|---------------------------|---|
| Recommendation 1. | Having in place a sector-wide strategy for excellent and innovative data management. |
| Recommendation 2. | Rationalising the data collection process across the sector. |
| Recommendation 3. | Introducing an appropriate learning analytics system to improve student support / performance at each institution. |
| Recommendation 4. | Putting in place clear ethical policies and codes of practices that govern the use of student data in analytics and other digital systems I each institution. |
| Recommendation 5. | Seeking fully informed consent from students to the use of their personal and learning data in analytics before introducing learning analytics to na institution. |
| Recommendation 6. | Driving learning analytics by improvement of learning and teaching processes and student engagement. |
| Recommendation 7. | Reviewing institutions' internal data management approaches and put in place action to ensure that institutional data is fit for purpose. |
| Recommendation 8. | Ensuring that digital literacy, capability and good data management strategies are an integral part of each institution's strategic plans. |
| Recommendation 9. | Ensuring that the digital agenda is being led at an appropriate level within each institution. |
| Recommendation 10. | Providing teaching and administrative staff with appropriate training and support to improve their digital capability and data management skills. |
| Recommendation 11. | Ensuring that institutions are not exempt from the Freedom of Information Act. |
| Recommendation 12. | Encouraging institutions to use the information from learning analytics systems to identify and foster excellent teaching. |

However, it is important to ensure that institutions use learning analytics, with the understanding that one size does not fits all. According to research studies [7] it is imperative for learning analytics research to account for the diverse ways technology is adopted and applied in course-specific contexts. We mentioned earlier the role of analytics as predictive tools for universities. Alternatives to predictive models can be provided in the form of (i) social network analysis aiming to increase the effectiveness of student engagement in real-time and (ii) personalisation of learning, and guiding the student along a learning pathway that meets their specific needs, are other uses for learning analytics.

Another important aspect relates to institutional responsibility when using analytics. According to JISC's Code of Practice for Learning Analytics [8] universities should allocate specific responsibility for a number of areas including:

- The collection of data to be used for learning analytics.
- The anonymisation of the data where appropriate.

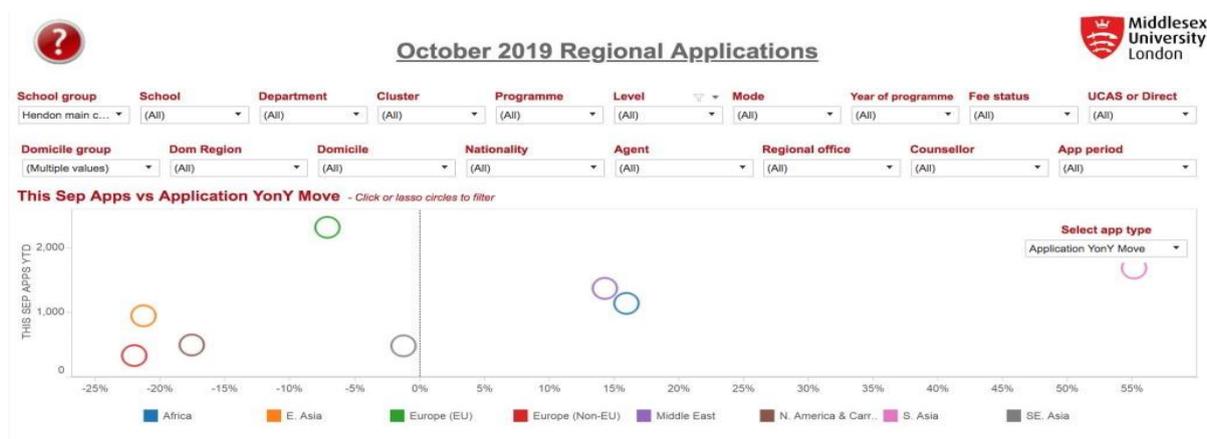
- The analytics processes to be performed on the data, and their purposes.
- The interventions to be carried out.
- The retention and stewardship of data used for and generated by learning analytics.

Cases of Learning Analytics

In this section we briefly discuss some examples of how analytics can help academic institutions to improve the effectiveness of their operations. Figure 1 shows regional application to the Middlesex University programmes, allowing identifying trends with previous years and attractiveness of programmes to certain regions.

Figure 1.

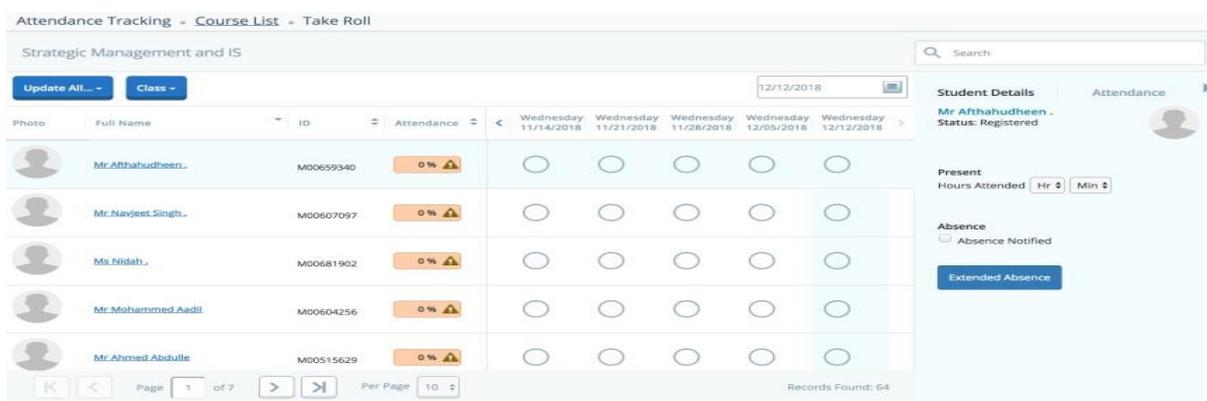
Regional applications



The next figure shows the interface used for attendance monitoring. As a result the attendance for specific modules can be viewed in different formats and analysed on a weekly basis.

Figure 2.

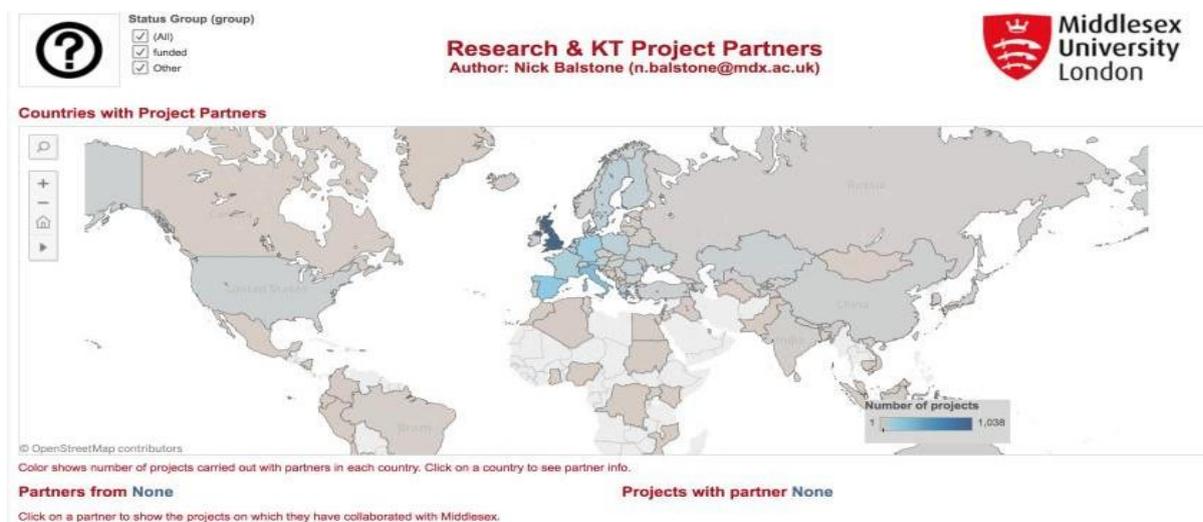
Attendance monitoring



The next figure shows the geographic dispersion of project partners in externally funded projects. This dashboard helps to determine potential partners for future research projects.

Figure 3.

Research and knowledge transfer partners



Finally the following two figures help the institution to assess the trends with respect to the grade analysis with respect to the final grades of modules (see figure 4) and the progression and achievement results at programme level, analysed per year (see figure 5).

Figure 4.

Grade analysis trends

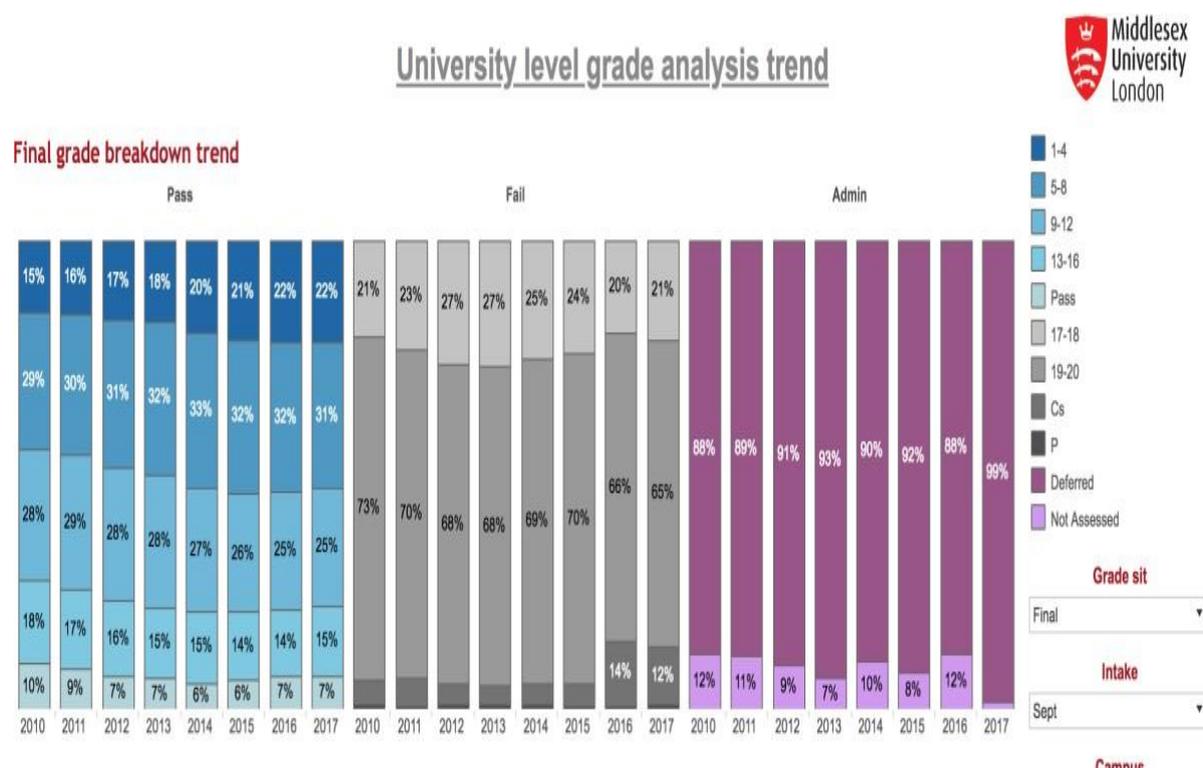


Figure 5.

Progression and achievement results



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*Məqalə redaksiyaya daxil
olmuşdur: 28.02.2020
Təkrar işləməyə göndərilmişdir: 12.03.2020
Çapa qəbul olunmuşdur: 30.03.2020*

*Дата поступления статьи в
редакцию: 28.02.2020
Отправлено на повторную
обработку: 12.03.2020
Принято к печати: 30.03.2020*

*The date of the admission of the article to the
editorial office: 28.02.2020
Send for reprocessing: 12.03.2020
Accepted for publication: 30.03.2020*