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- Introduction
- Deloitte
- SAP & itelligence
Student Analytics Services Deloitte
Cornerstone for tailored student counselling

Montevideo, 2014
Determine which eggs have a big chance of breaking and which do not...
We use a sophisticated visual segmentation technique to zoom in on different types of students: the **Self Organizing Map**

Imagine all faculty students standing next to each other on the pitch of the Amsterdam Arena...

**The assignment:**

*Stand next to the persons who you resemble the most in terms of:*

- study results in the first semester
- secondary school grades and prior education
- information received
- motivation to study

The students discuss into the small hours of the night and more and more groups start to form.

Coloured flags are distributed late in the morning, a helicopter takes off, and a question is asked:

*What was the grade of your first exam?*
The Deloitte Student Analytics Service offers insight into the chance of study success and the underlying reasons:

1) Quick dropouts
Low grades at 1st exam (#1.821)

2) Slow, no-info people
Needed no information for their study choice and obtained only some 10 study points in the first semester (#1.310)

3) Hardworking late bloomers
High grades, but obtained few points and chance of dropping out (#824)

4) Contract students
Study as hobby, contract students (#299)

5) The average students
No high grades, but generally no dropouts (#2.742)

6) Country folk
Moving from the countryside to the city with high grades (#764)

7) HBO non-Dutch
HBO-prior education, non-Dutch (#1.671)

8) Narrow marginers
Low grades secondary school, chance of dropping out and study delay (#901)

9) Bad starters
Somewhat older students who are likely to drop out, more often from low income municipalities (#753)

10) Good VWO students
Good and excellent students (#3.803)

11) HBO propaedeuticals
HBO propaedeutic exam with chance of a bad start (#1.117)

12) Staplers
Spent a long time in secondary school (#676)

Special anti-dropout policy  Potential for differentiation in favour of higher results
Dropouts are grouped at the left side of the chart in segments 1, 9 and part of 8 and 3

- (1,3,8,9) Dropouts can be found in several areas; it shows the reasons for dropping out differ.

- (Ditto) Dropouts and delays in years following the first year strongly resemble the first year dropouts.
We can aggregate the SOM statistics to segment level as well

- The good VWO students (10) and the average students (5) comprise **39% of the population**.
- The HBO segments (7 and 11) add up to **17%**.
- **25% of the dropouts** are classified in the quick dropouts segment.

**Percentage of students per segment**

- 1) Quick dropouts: 11
- 2) Slow, no-info people: 8
- 3) Hardworking late bloomers: 5
- 4) Contract students: 2
- 5) The average students: 16
- 6) Country folk: 5
- 7) HBO non-Dutch: 10
- 8) Narrow margeners: 5
- 9) Bad starters: 5
- 10) Good VWO students: 23
- 11) HBO propedeuticals: 7
- 12) Staplers: 4

**Percentage of dropouts per segment**

- 1) Quick dropouts: 68
- 2) Slow, no-info people: 26
- 3) Hardworking late bloomers: 37
- 4) Contract students: 32
- 5) The average students: 22
- 6) Country folk: 11
- 7) HBO non-Dutch: 19
- 8) Narrow margeners: 40
- 9) Bad starters: 63
- 10) Good VWO students: 15
- 11) HBO propedeuticals: 30
- 12) Staplers: 17
Age during final exam and at start of study

- (12) Staplers or repeaters in secondary school have a lower chance of dropping out.
- (4) The students include a group of "disguised" contract students, who mostly study for a hobby.
A logistic regression with five variables shows desired characteristics for predicting dropout rates

- Where the algorithm predicts a student will not drop out, the chance of dropping out is only 14.1%.
- When the algorithm indicates a student to fall in the dropout category, the chance of dropping out is 73.3%.
- Thus, this approach is stronger than each separate variable.
- New students can be designated a chance of dropping out based on this.
- The coefficient shows which variables (together) positively and negatively influence dropout rate.

### Coefficients of the comparison per variable

- Bachelor simultaneous: 1.71
- Pass rate: -1.04
- Number of results achieved: -0.38
- Age grade compared with cohort: -0.73
- Department x: 0.70

### Prediction

<table>
<thead>
<tr>
<th></th>
<th>Dropout rates</th>
<th>Not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dropout rates</td>
<td>9.2%</td>
<td>14.1%</td>
</tr>
<tr>
<td>Not</td>
<td>3.3%</td>
<td>73.3%</td>
</tr>
</tbody>
</table>
A number of schools with high dropout rate rates have a shorter study term. A number of schools with low dropout rate rates have a longer study term.
Table of Contents

- SAP & itelligence
  - The Situation
  - The Opportunity
  - The Proof-of-Concept
  - The Lessons learned
  - The Next Steps
The Situation & The Market (trends)

**Big Data**
Other saying for student & learning analytics?
- Vast amounts of data kept in different systems like CRM, SIS, LMS, external data sources, etc
- Students leave behind major trails of “data—something” information that’s ripe for mining and analysis

**Increase**
Online Learning Environments
- Blended and cyber learning continue to gain a stronghold
- Increasing usage of online learning tools deliver millions of data week-by-week

**Informed decision making**
Student Retention & Engagement
- Enabling management and staff to more effectively manage student engagement & student retention
- Support advisors track student engagement & manage retention

“Advancements in big data and learning analytics are furthering the development of visually explicit streams of information about any group of students or individuals, in real-time”

The Situation & the **hot topic** of student & learning analytics

“… is the use of data and models to predict student progress and performance, and the ability to act on that information.”

**Trending topic**

Learning Analytics only recently gained wide-spread support among data scientists and education professionals.

**Student & Learning analytics can provide valuable insight in:**

- Students’ learning behavior
- The quality of instruction material
- The use of digital learning management systems
- The quality of assessment and testing
- Individual student performance & progression
- Reasons for early, late, etc drop-out
The Situation & SAP solutions

SAP HANA

Turn Real-time Insight into Big-time Results with SAP HANA as database ‘big data’ engine

Predictive modelling

Predictive analytics with SAP (HANA) solutions allows you to achieve real-time insights that increase understanding of student behavior

Real-time reporting & analysis on live data

Usage of virtual data model with SAP HANA Live delivered via for example Lumira, Business Objects, etc
The Situation & why SAP HANA

To report or not to report ...

**Limited** standard *reporting*, no analytical SLcM reporting in SAP SLcM

**Performance**

No *load* on transactional Db tables (SAP HANA tables)

**Harder, Better, Faster, Stronger**

Reporting on (granular) **mass of data**

**Artificial intelligence**

Predictive analysis *library* (eg. KNN model)
The Opportunity
The window of opportunity to lead your way
*Real-time Operational Intelligence is the new frontier*

- Big Data
- New Signals
- Real-Time Empowerment
- Consumerization of IT
- In-memory
- Cloud
- Mobile
- Social

- Sensing and Responding
- Personalized Insights
- Sentiment Intelligence
- Predictive Analytics
- Real-Time Analysis
Student & Learning Analytics Use Cases

- Basis for setup of proof of concept
- Use cases are result of first brainstorm
- We took the SAP Student Lifecycle processes as the first basis
- Use cases are divided in different focus areas:
  - Operational reports
  - Management reports
  - ‘Predictive’ analytical reports
Student & Learning analytics Use Cases (1/5)

- **Recruitment & Admission**
  - Predict which prospects (enquiries) are likely to become applicants
  - Predict which applicants are likely to graduate. Build a predictive model based upon students success trends.
    - **Focus area**: operational predictive analytics
  - Capture Social media (Facebook, Linkedin, etc) data analyse where applicants are most active and where a CRM campaign could be most effective
    - **Focus area**: operational predictive analytics
  - Applicant ranking after Admission application audit. Include extra student data/private/social media data etc. Optimise student retention/graduation.
    - **Focus area**: operational predictive analytics
Student & Learning analytics Use Cases (2/5)

- **Recruitment & Admission**
  - Real-time admission dashboard; Number of applicants, # rejections, # withdrawals, # approvals. Incl. historical view, ‘The pipeline report”: where were we last year on this day?
  - **Focus area**: operational & management analytics.
  - Sentiment analysis to determine what applicants and students like, not like on campus (life)
    - **Focus area**: operational & management analytics.

**Student Financials**
- Analytics on fee collection data; to determine early late payers also based on historical data
  - **Focus area**: operational predictive reports
Student & Learning analytics Use Cases (3/5)

- **Equivalency determination**
  - Report on the equivalency determination agreements and how they are used (in detail with the courses used) and how many times applied, etc etc
  - **Focus area**: operational & management analytics.

- **Event planning/Scheduling & Course registration**
  - Use predictive analytics during course registrations to help students select the most applicable (course suggestion) course based parameters eg. program registration, specialization registration, remaining capacity, predicted grade, academic standing, etc.
  - Use scheduling information to support facility management & real-estate planning
  - **Focus area**: operational predictive reports
Student & Learning analytics Use Cases (4/5)

- **Exams & Grading (& attendance tracking)**
  - Analytical reports showing trends of courses and their grades.
  - Analytics of what is the relation between actual attendance and the grade outcome.
    - **Focus area**: operational predictive reports

- **Academic Advising/Student Retention**
  - Use predictive analytics during academic advising as an early alert system based on parameters eg. Academic standing, number of student logons in key systems like student portal, LMS (Blackboard), Course evaluation, etc.
    - **Focus area**: operational predictive reports
Student & Learning analytics Use Cases (5/5)

- **Progression & degree audit**
  - Use predictive analytics during registration/academic advising to monitor and alert the graduation time (nr. of years)
  - **Focus area**: operational predictive reports

- **Graduation**
  - Relation to degree audit/course registration. Notify student that they are close to graduation should book courses that will help them graduate soon(sooner).
  - **Focus area**: operational predictive reports
Student & Learning analytics Main thread in use cases

- Informed decision making
- Direct management information
- **Early Alert reporting** (e.g. Academic advising, Student retention)
- Applicant & Student **success prediction**
- **Student retention prediction**
- Direct information to optimize processes/student success
- **Identify & Support** specific student groups
SAP HANA scenario’s

**SAP HANA Analytics (via Analytics Foundation)**

**SAP HANA Accelerators**

**BW on SAP HANA**

**Apps on SAP HANA** (Next Generation & Strategic Investments)

**Business Suite/SLcM on SAP HANA**

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**Side-by-side scenarios**

More Insight: Exploring data loaded from Business Suite on any level of detail

In seconds: Accelerating existing transactions of the Business Suite

Supercharged BW: Fasten up your BW without disruption

Innovation: Functional applications natively built on SAP HANA, with & without Business Suite integration

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**Integrated scenario**

All in One – Ultimate: Business Suite/SLcM/third party data on HANA to deliver lighting speed (predictive) operational analytics
SAP HANA (Live) & consumption layer

Dashboards and Reporting

Semantic Layer - Universes

SAP Predictive Analysis
Incl. Statistical R Algorithms

SAP SLcM

BLACKBOARD

Early Identifiers
- Motivation
- Process Decision
- Nationality
The proof-of-concept
SAP HANA Student Learning analytics POC: Goals

Co-Development

- **Innovation** area
- Build a proof-of-concept which delivers **operational and predictive reporting** on student & learning data
- Create student & learning **data model**
- Build **consumption reports** (UI)
- SAP HANA for (Higher) Education POC: **Test and Validate**

Why HANA? Why Operational (predictive) reporting? Why student & learning data?

- SAP Student Lifecycle Management has only **few standard operational reports**
- **Student & learning data** is a university's core data
- Get the most out of **SOH** (SLcM) and leverage **in-memory** reporting
- Support customers with an existing SAP HANA **roadmap**
- Improve reporting **UI experiences** with new UI’s
The “SAP HANA Student Learning analytics – POC” outlines an opportunity to develop a new solution for use in the SAP (Higher) Education market.

Focus:
- The focus of the concept is on (operational) reporting, academic advising and student retention.

The following elements are build so far

- **HANA Virtual data model** based on:
  - SIS data (SAP Student Lifecycle Management)
  - LMS data (Blackboard)
- 4 ‘consumption’ reports based on Business Objects reporting tools:
  - 2 operational descriptive reports via BO Web Intelligence
  - 1 operational descriptive report via BO Dashboard Design
  - 1 predictive report via ‘R’
- Documentation
- Final report
SAP HANA Student Learning analytics POC: Main project steps

Focus:

- SAP SLcM as primary student data source (e.g. admission, course registration, grades, etc)
- Learning LMS data (e.g. activity data around LMS activities, e-learning, etc).
- Optional: CRM data (e.g. student prospect data, etc), scheduling data, etc.

Project steps:

- **Market survey**: Desk research on student analytics in Higher Education. How can learning analytics support informed decision making in key areas like recruitment, admission, retention, etc.

- **Customer workshop**: Roll-in workshop with 2 customers that have an existing HANA roadmap

- Based upon the concrete outcomes from 1 and 2 ➔ Setup, design & develop a **proof-of-concept**.

- Transform proof-of-concept into a **product & service**
SAP HANA Student Learning analytics POC: Planning

Kick off & High Level ‘design’ Use Cases

Market survey

Review use cases (customer workshop)

Setup POC system

Validate POC (customer workshop)

HERUG presentation

The Proof-of-Concept
The DETAILS on the proof-of-concept
SAP HANA System Details: SAP HANA Enterprise Cloud (HEC)
**SAP HANA System Details**

The HANA-Server has 256 Gig RAM and 4 processors (Xeon(R) CPU E5-2670 0 @ 2.60GHz ) with respectively 8 cores = 32 physical CPU cores. Central Instance and database are installed on the same server.
SAP HANA Student Retention Dashboard: Predictive Analysis

Predictive Analysis for Academic Advisors
Student Retention

- Predictive Analytics for Academic Advisors
- Academic Advisors need a list of students which are categorized as “presumable non-retention”.
- Used to initiate dialog with the student about his study progression
SAP HANA Student Retention Dashboard: Predictive Analysis

Predictive Analysis for Academic Advisors

Student Retention

- **Predictive Analytics** for Academic Advisors

- **Academic Advisors** need a list of students which are categorized as “presumable non-retention”.

- Used to initiate **dialog** with the student about his study progression
SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO TABLES
SLcM Data

- Student Lifecycle Management (SLcM) data fully integrated in SAP HANA tables.
- Example of an SLcM data table in HANA with HRP1702 attributes.
- Import external data via dataservices (eg. “BlackBoard”)
SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE TABLES
Student Retention

- Predictive modelling
- **Data table:** (un)Successfully graduated students and their past results
- **Class data table:** Students we want to evaluate
- **Results table:** Output after running the KNN algorithm: which student will drop out, who will succeed
SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE TABLES

Class data

- **Class data table**
  - **X1**: student motivation factor
  - **X2**: process study selection (well considered decision on study selection)
  - **X3**: Health condition from student (disability)

- **Data input** via CRM, specific questions during admission, student survey, app, etc.

- Generated data for POC
SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE TABLES

Student data table

- **Student data set:**
  List of students (un-) successfully graduated with all factors x1,2,3
  - X1: student motivation
  - X2: study selection
  - X3: disability

- **Reference data set**
SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE TABLES

Results table

- **Results from KNN run:**
  List of students (un-) succesfuly graduated with all factors x1,2,3

- **Type 2:** will succeed (prediction)

- **Type 0:** will not succeed (prediction)
SAP HANA Student Learning analytics POC: Data flow (for dummies)

HANA STUDIO PREDICTIVE ANALYTICS FUNCTIONS

KNN function

```
SET SCHEMA ITELL_NL;
DROP TYPE PAL_KNN_DATA_T;
CREATE TYPE PAL_KNN_DATA_T AS TABLE( "ID" INT,"TYPE" INT,"X1" DOUBLE,
"X2" DOUBLE, "X3" DOUBLE);
DROP TYPE PAL_KNN_CLASSDATA_T;
CREATE TYPE PAL_KNN_CLASSDATA_T AS TABLE(ID INT,WEIGHT DOUBLE,SIZE DOUBLE);

DROP TYPE PAL_K;
CREATE TYPE PAL "doubleArgs" DOU;
DROP table PAL_K;
CREATE column t "DIRECTION" VAR;
insert into PAL_KN
insert into PAL_KN
insert into PAL_KN
insert into PAL_KN;

GRANT SELECT ON
call SYSTEM.afl_w
call SYSTEM.afl_r
PAL_KNN_PDATA_T;

DROP TABLE #PAL
CREATE LOCAL TEMPORARY TABLE #PAL
("intArgs" INT, "doubleArgs"
INSERT INTO #PAL
INSERT INTO #PAL
INSERT INTO #PAL
INSERT INTO #PAL;

DROP TABLE PAL_
CREATE COLUMN
CALL _SYS_AFL.PA
"#PAL CONTROL.TI
SELECT * FROM #PAL;
```

- **KNN**: Predictive Analytics functions in use to calculate the relative weight of the student-retention parameters
- **KNN**: is a machine learning algorithm used for classification
  - the input consists of the $k$ closest training examples
  - the output is a class membership
- **SAP HANA** Predictive analysis library
SAP HANA - Operational Reporting Course Registration Details

- Operational reporting
- Web intelligence report
- BusinessObjects
- Input controls:
  - Faculty
  - Academic term
  - Course
  - Student
Lessons Learned
Lessons Learned ... so far

Team
- Bundling expertise: educational, technical, statistical, pedagogical, ...

Analytics
- What is Student Learning analytics?
- The data used and the questions asked define a certain Predictive Model
- HANA Studio provides big advantages in terms of agility and flexibility to define data model and predictive models

Data
- Which data can be seen as relevant learning data?
- Quality of the data! Great analysis on wrong data ...
- Privacy? Legal restrictions?
5 key points to take home

- SAP HANA allows for faster and smarter (reporting) solutions
- With HANA Live you can build data models that provide real-time insight into your business
- Customer can perform real-time reporting on (big) student & learning data
- The POC already proven the power of the SOH concept for SLcM in relation to (predictive) operational reporting
April 30, 2014 | Newsbyte | by SAP News

SAP Announces Plans for First Big Data Innovation Center and Innovation Lab With Universities

WALDDORF — SAP AG today announced the planned launch of its first Big Data innovation center in cooperation between the SAP University Alliances program and the University Competence Center (UCC) location at Otto-von-Guericke University in Magdeburg, Germany. As part of this relationship, the company also announced the anticipated opening of the first SAP University Alliances Innovation Lab with the Institute of Enterprise Systems (InES) at the University of Mannheim. Additional Big Data innovation centers at UCC locations and innovation labs at universities worldwide are planned.

“SAP already offers the SAP HANA platform for teaching purposes at universities,” said Dr. Bernd Welz, executive vice president, global head of Solution and Knowledge Packaging SAP. “With Big Data innovation centers at UCC locations, the company is planning to enable academics worldwide to leverage SAP HANA to re-invent business processes based on new Big Data applications. The lab would also be used for Big Data-driven research across a wide range of applications such as genetics, geology or physics.”

The Big Data innovation center will be hosted at the Otto-von-Guericke University, which has a long-term relationship and hosting experience with SAP. The center in Magdeburg is intended to closely cooperate as an interdisciplinary research hub with the new innovation lab at the University of Mannheim, a top university in Europe. The SAP University Alliances Innovation Lab at the InES is planned to offer a platform for scientists, practitioners and startups to explore, design and evaluate data-driven process excellence in enterprises and business networks in areas such as smart logistics, Internet of Things, process intelligence, predictive maintenance and others. It also aims to help identify and verify new use cases based on a solid Big Data technology platform and can be utilized by data scientists, mathematicians or economists for a variety of industry sectors, including automotive, manufacturing, banking, utilities, retail and public sector.
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