How to start with learning analytics? Infrastructure and support.

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1. ABSTRACT

Better insight into the teaching process and targeted feedback to students, ultimately resulting in improved education: that is the idea behind learning analytics. Learning analytics makes it possible to follow students' digital footsteps. These footsteps can be recorded and analysed, leading to the creation of comprehensive data collections. With this data, it is possible to make predictions about, for example, the quality of the teaching materials used, how teachers and students interact with the material, how the digital learning and working environment is used, etc. Learning analytics offers a great many possibilities, but how can an institution use it successfully? This is the reason why SURFnet started the Learning Analytics Experiment for Dutch institutes for higher education to gain experience with learning analytics. With this experiment, SURFnet demonstrates the possibilities of learning analytics in education. In this paper we present the set-up of the Learning Analytics experiment, the learning analytics architecture and infrastructure used for this experiment as well as the preliminary results and further work.

2. INTRODUCTION

Learning analytics is often viewed as a complicated process by educational institutions. Frequently asked questions include: How do I use learning analytics? How can I use the data indirectly provided by students during online learning in order to provide targeted feedback? This raises other questions: Is learning analytics secure? What about the students' privacy?

In 2016 SURFnet started the Learning Analytics Experiment for Dutch institutes for higher education to gain hands-on experience with the above-mentioned aspects of learning analytics. With this experiment, SURFnet offers the institutes a learning analytics infrastructure which demonstrates the possibilities of learning analytics and shows how learning analytics can link to educational processes and provide insight into student activities. At this moment, a second round of experiments is running, including improvements based on the first round.

SURFnet is the Dutch NREN (National research and education network) representing all Dutch institutes for higher education and research. SURFnet's mission is to boost the quality of education and research through the support, innovation, development and operation of an advanced, reliable and interconnected ICT infrastructure, enabling the potential of ICT to be harnessed to its full extent. One of the innovation topics, which SURFnet is addressing, is Learning Analytics. This is done in a multi-year innovation program in which all institutes for higher education can participate. Main goal of the learning analytics project is to support institutions to gain insights in the way learning analytics can contribute information about the teaching process and targeted feedback to students, ultimately resulting in improved education.

In this paper we present the set-up of the Learning Analytics experiment, the learning analytics architecture and infrastructure used for this experiment as well as the preliminary results and further work.

3. SET-UP OF THE LEARNING ANALYTICS EXPERIMENT

Learning analytics offers the possibility of supporting students in their learning on the basis of educational data. It can provide teachers with real-time information about the quality of the learning material and the course curriculum. Learning analytics can also provide insight into online study behaviour both for students and teachers. In addition, it offers teachers and educational developers a new and practical source of information alongside their own observations and evaluations.

With the experiment, SURFnet aims to create a safe and secure environment for experimentation, by taking care of the infrastructure (including learning records store and visualisations), the process, privacy issues and hands-on support.

By carrying out this experiment, educational institutions can answer the following questions: Is learning analytics really so complicated? How does learning analytics fit into an educational infrastructure? How do you collect data? How do you visualise data? How do you obtain permission from students?

Furthermore, the process of collecting data becomes more transparent. The experiment will show which questions are used to obtain the data and how this data is analysed and visualised. In this way, institutions don't have to reinvent the wheel by themselves.

3.1. Approach

Within the experiment, SURFnet provides insight into student activities. It measures which online activities students actually perform. Educause (2007) defines five steps of analytics:

1) Capture: the process of extracting the data from the source and storage in a common location (mostly a learning records store).

2) Report: examine the information, and identify trends, patterns, and exceptions in the data and then visualize it.

3) Predict: to make predictions based on the reports.

4) Act: to act and make interventions based on the information

5) Refine: improvement of the analytics process and start again with 1).

SURFnets experiment focusses on the first two steps. Our focus is not on making predictions with data, but on making improvements to education. We measure and display the data, and educational institutions participating in the experiment can decide for themselves whether they will make any changes to aspects of education based on the displayed data.

The process of collection and visualization of the data consists of four steps:

Step 1: Formulate the questions to be answered:

It is important to first consider which data needs to be collected. In other words: Which questions can we answer with the data? Teachers and educational developers can determine these questions, potentially in collaboration with management.

SURFnet has formulated five questions for this experiment while working in collaboration with educational institutions:

- Which materials are frequently used?
- When does the student carry out learning activities?
- Has the student submitted the assignments and when were they submitted?
- How often does the student take interim tests during the course?
- Does the student monitor their own progress?

Step 2: Create Xapi recipe and collect the data in the LRS

xAPI recipes will be created for the educational questions listed above. This is the second step.

To be able to collect data, the xAPI recipes need to be linked to the applications used by students. When they are linked, data can be collected, analysed and organised. Data collection is performed in the Learning Record Store.

Step 3: Complete the dataset and analyse the data

After collecting the data in the Learning Record Store, the organisation and analysis of the data is carried out in the Learning Analytics Processor. Data is tailored for specific visualizations and data sets are placed in the context of a course, with start- and endtime and number of students. Also all relevant objects from the xAPI recipes are accounted for.

Step 4: Visualise the results

The data report will be shown on a webpage where the teacher and student can view and evaluate the visualisation for one of the educational questions. The teacher can then decide whether to give feedback to the students based on the visualisations. The process of providing feedback is not part of this experiment.

3.2. Learning analytics architecture & infrastructure

In order to facilitate the above described learning analytics process, SURFnet has developed a learning analytics architecture and built a learning analytics infrastructure. This infrastructure shows how the different layers within a learning analytics system – input, data storage, business and presentation – are connected.

The technical architecture (see figure below) of the infrastructure can be divided into four layers:

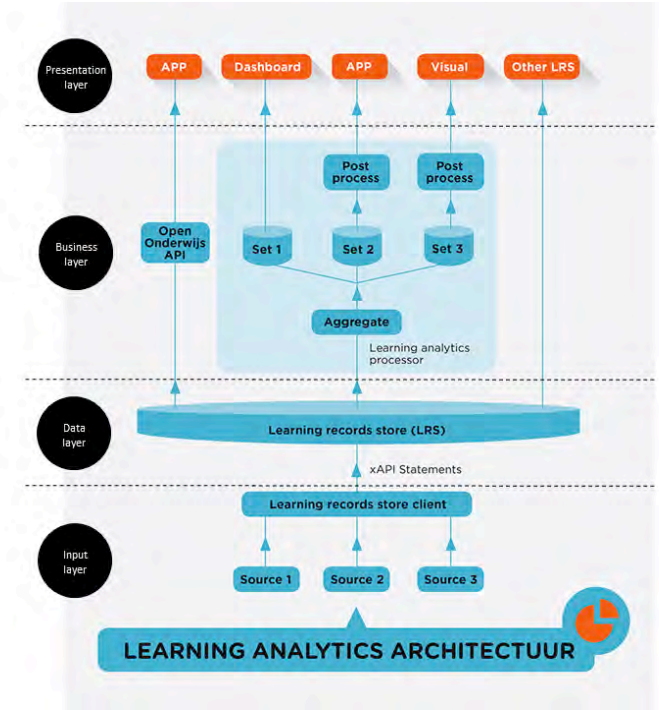

Figure 1: Technical architecture, with the four layers

1. The presentation layer, which provides the visualisation. The visualisations are visual presentations of the results of the Learning Analytics Experiment, which are intended to provide teachers and students insights into study behaviour. These visualisations are displayed on a dashboard.

2. The business layer, which provides the functionality for the experiment. This is the Learning Analytics Processor, which aggregates, organises, analyses and customises data from the Learning Record Store for different users in the presentation layer.

3. The data layer – the centre of the architecture. The most important component is the Learning Record Store, which is for storing student activities carried out in the various online learning environments used by students.

4. The input layer To which various sources (environments) are connected that provide the LRS with the activities.

This architecture brings two advantages. First, the components are based on open standards and therefore vendor independent. Second, the architecture is separate from the different kinds of digital learning environments and sources that are used within the institutions, so it is possible to collect data from various sources.

Regarding the capture process, the input layer ensures that data is collected in the LRS. Student activities originate from different sources and reach the LRS in a uniform manner through the LRS client developed by SURFnet.

The functionalities that are used in this process:

1. Tracking the student. Since student activities are distributed across various sources, it is important to clearly identify the student at each source.

2. It should be easy for the teacher to collect the student activities. This is achieved by removing the complexity of the xAPI from the source and monitoring the activities with simple javascript code via the LRS client.

3. The javascript code at the source is translated to xAPI statements used as input for the LRS. These xAPI statements record the type of student activity according to a defined xAPI recipe.

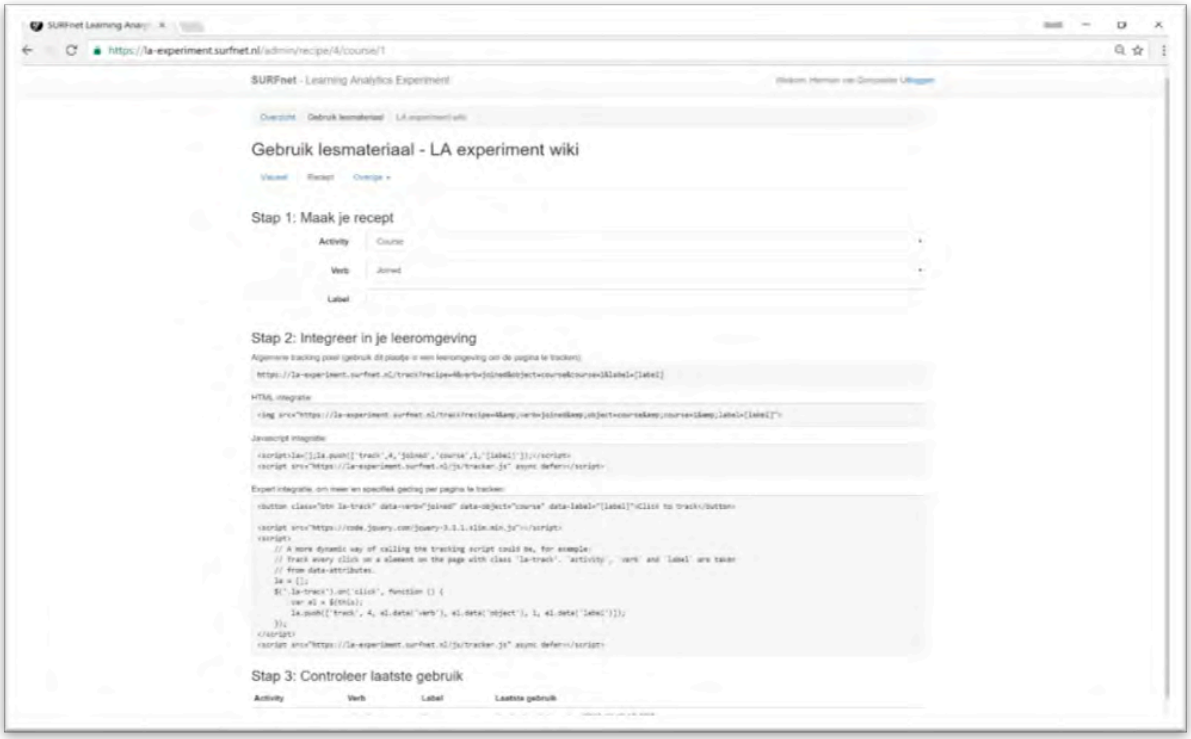

Figure 3: Creating xAPI recipes

The reporting process of generating datasets, post process data and visualizing is taken care of in the business and presentation layer:

Collecting data results in a huge amount of student activities in the LRS. In the Learning Analytics Processor, statements from a particular student are aggregated in a dataset, which then serves as input for the visualisation of the data. Different datasets are prepared for different visualisations. Datasets are stored in a uniform format, which allows post processing to occur in order to prepare data for visualisation. Simple visualisations require zero or very little post processing. For other visualisations, it may be necessary to interpret the data and organise it correctly prior to visualising it.
The Learning Analytics Experiment focuses on visualisations of the questions asked by teachers. Visualisations can be easily interpreted by teachers, so they can determine any steps that need to be taken.

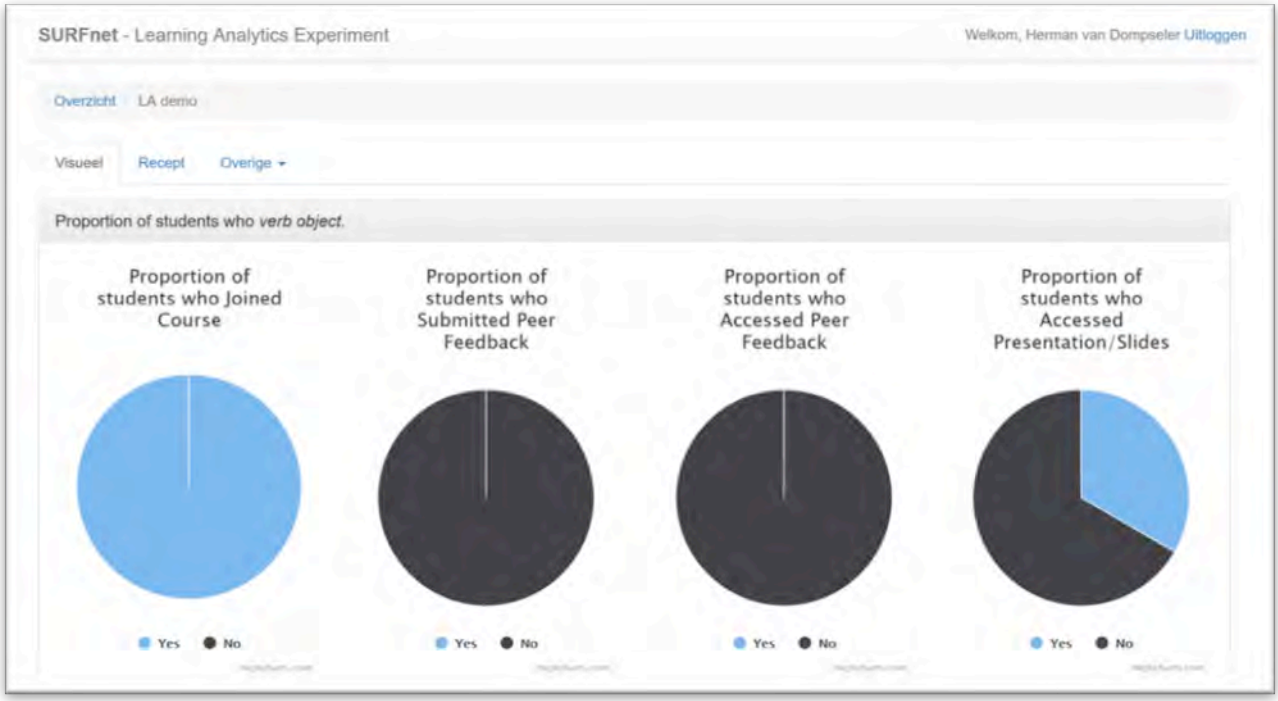

Figure 4: Example of visualisation

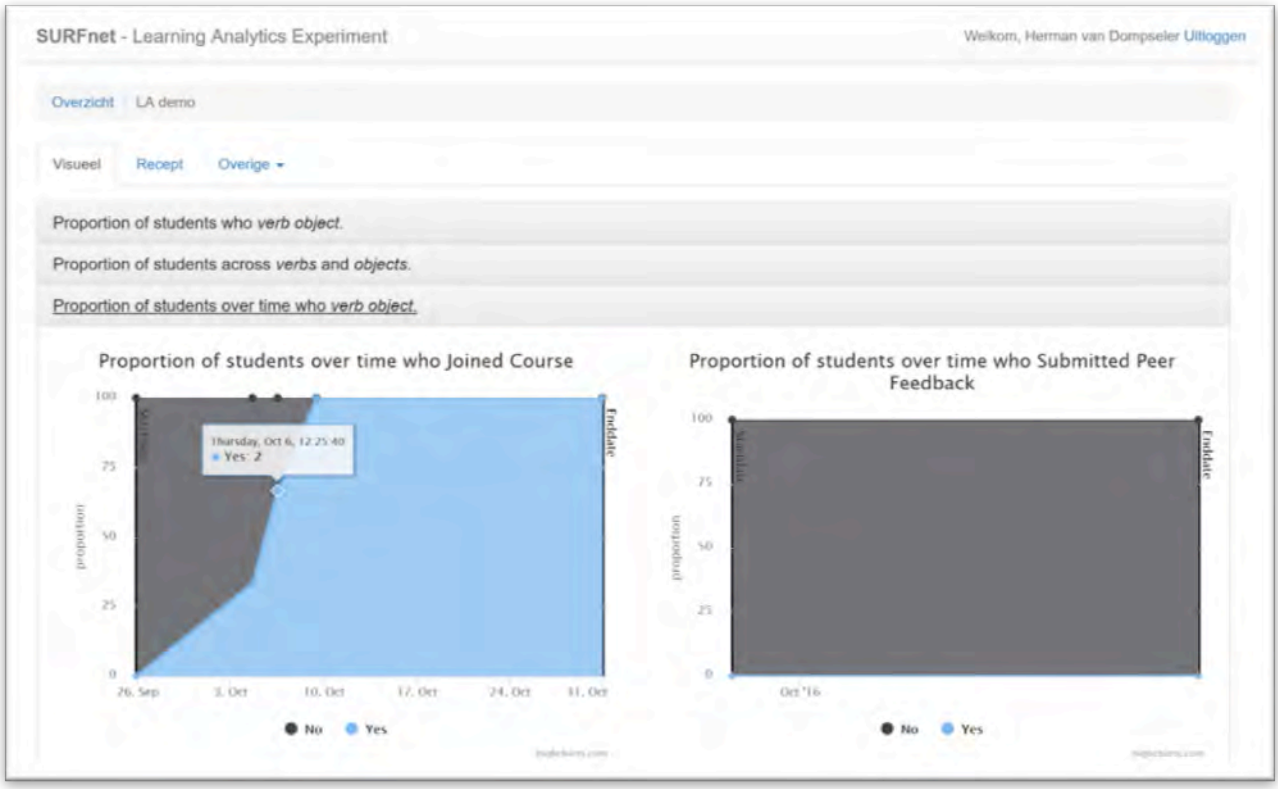

Figure 5: Example of visualization

3.3. Minimalizing privacy issues, hands-on support and documentation

3.4. Generic consent form

In the experiment, SURFnet aims to take care of as much constraints as possible for the institutions. This resulted in a generic consent form for the students participating in the experiment. Although this form has to be approved by the institution's privacy officer, most of the time the form is 100% adopted without any changes. Also because of the fact that SURFnet made clear rules and regulations of the use of the students' data.

3.5. Hands-on support

During the process, SURFnet offers hands-on support to teachers an IT staff. In practice, this means an intake with teachers and staff of an institution who are interested in participating in the learning analytics experiment. After the institution has decided which course will take part in the experiment, a meeting is planned with the teacher(s) involved. In this meeting, all ins and outs of the construction and implementation of the xAPI recipes are explained and brought into practice. Then, the course and thus the collection and visualization starts. We have contact on a regular basis and survey the experience with the experiment on both the teacher as well as the students. After the course, there is an evaluation and all lessons learned are collected. Lessons learned input for further development of the infrastructure and the process, and they are made available for other instiutions who aim to start with learning analytics.

3.6. Documentation

All documentation, like a user manual, interpretation and explanation of the visualisations and the xAPI recipes, is is available on a wiki. The source code of the experiment is available via Github (https://github.com/SURFnet/learning-analytics).

4. PRELIMINARY RESULTS

Despite the fact that the first round of experiments is finished two months ago and the second round just started, there are some preliminary results that can be shared in this paper.

Since the launch of the learning analytics experiment, 3 institutes of higher education participated in the experiment and used the learning infrastructure in daily educational practice. In the last couple of months over 500 students and 5 teachers worked with the learning analytics infrastructure. With this experiment, students and teachers are able to follow the learning process, near real-time. What's also interesting is that all the participating institutes use various learning management systems, such as Blackboard, N@tschool & Mentorix.

We learned that it was easy for teachers to get started with learning analytics. The infrastructure is running in the SURFnet Cloud, so there is no "burden" with IT implementations within the institution. Creation of the xAPI recipes was fairly easy for teachers by using our developed tool. It takes time to implement the recipes in the learning management system, but all teachers found it worth the effort.

Teachers think the learning analytics experiment is a useful tool to monitor students activities. At this moment, it is experienced as a promising project. In the future, it can be the basis of an effective educational intervention because 1) it provides real-time data so the intervention can be on time, 2) intervention can be done on personal level and 3) the goal is to identify students who are at risk of dropping out and to give targeted feedback.

The value of learning analytics for students can be found in the fact that students find it useful to have a better understanding of their study process.

All to all, what we have learned till now is, as long as you connect the use of learning analytics with the educational process, teachers and students are having a lot of advantage, by looking at the students' data on study activities. It seems that insight in actual learning activities provides valuable information which is not available in regular usage statistics.

For 2017 it is the ambition of SURFnet together with the Dutch institutes for higher education, to improve the learning analytics infrastructure and to offer more institutes, teachers and students the possibility to work with the infrastructure. We work together on creating evidence, guidelines and tools for effective use of learning analytics.

5. REFERENCES

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6. AUTHORS' BIOGRAPHIES

Marieke de Wit is community manager at SURFnet. She is responsible for the Learning Analytics and Digital learning environment projects, in which she brings IT in education professionals together in networks and collaborative projects in order to support institutions with their developments on IT in education. The last 7 years she was project manager of several innovation projects at SURFnet. Before SURFnet, Marieke worked at the Dutch ministry of economic affairs as policy advisor digital government. She holds masters degrees in business sciences (2002) and public information management (2007).
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Herman van Dompseler is a freelance software architect and software designer for internet applications. He is most interested in the innovation cycle of a software product, working from ideas to product to data according to the lean startup methodology. For SURFnet he worked on several innovation projects the last years, with the topics: Learning Analytics, Digital Learning Environments, Groups Management and Streaming Video Services.

Jocelyn Manderveld holds a master degree in educational psychology (1997). Since 2011, Jocelyn is working for SURFnet as a project manager, of various innovation projects as Learning Analytics, Research Support, Cloud Computing, Privacy & security. Besides her actvities for SURFnet she holds her own company (since 2007) where she works as a project manager and researcher for different (inter)national projects and organisations, she has a lot of expertise in the area of learning technology. She also worked at the Open University of the Netherlands (1998-2005) as an educationl technologist, where she managed, designed, developed, and implemented several innovation projects. More information https://www.linkedin.com/in/jocelynmanderveld/