A »flight recorder« for better learning

»Learning analytics«: Making digital data usable for greater educational success

By Anja Störiko

So far, personal feedback in the case of lectures with hundreds of students still seems utopic – even after the digitalization boom in times of the coronavirus. Tools from the research field of »learning analytics« could in future give students feedback and at the same time provide their supervisors with clues about where help is still needed.

For large courses such as the »Introduction to Computer Science« with 600 students, Professor Hendrik Drachsler from the »Educational Technologies« research unit sees digital room for improvement: »With one professor and eight tutors, the supervision ratio doesn't allow any personal feedback to students – we can improve this situation by means of technology.«

For digital feedback on the learning process, his »Learning Analytics« (LA) research team uses the process data which students leave behind each time they access a computer system. These log files are like footprints in the background which contain important and evaluable information. These also include – alongside activity, date and time – details of contents, which can be analysed by means of suitable software. A comparable example for such data analysis is the flight recorder which, when analysed after an accident, allows conclusions to be drawn about what happened in the cockpit.

Direct mapping of learning behaviour

»To date, questionnaires, interviews or specific tests to measure knowledge acquisition have been used to describe and understand learning processes – or subjective observers are deployed who log the learning situation of small groups and their actions,« says Drachsler. »Today, we can use process data from learning activities and exercises directly to evaluate the learning process and offer help.« This, in his view, allows more direct, more extensive and thus more conclusive analyses of learning behaviour. With the help of artificial intelligence, it is possible to identify and use behavioural patterns in order, for example, to test learning theories in terms of their practical feasibility.

If students are logged onto a platform and using it interactively, LA tools can evaluate their activity and provide corresponding feedback. »moodle«, for example, is a platform often used

in teaching. With each action – downloads, posts, questions or messages – school pupils or students leave behind their log data and with them evaluable information. »We're allowed to use these data, provided they are anonymous,« says Drachsler, explaining the background regarding data privacy. However, it often makes sense to ask for consent in order to facilitate a personal analysis as well and in this way be able to offer personalized assistance.

A survey conducted at Goethe University revealed that most students welcome appropriate feedback. It is precisely this personal feedback, which is often impossible due to high numbers of students, that many of them miss. »According to Germany's National Report on Education, 28 percent of students discontinue their bachelor's degree, among others because they feel inadequately supervised. With the aid of technology, we could help to offer prompt and personalized feedback here, with detailed individual solutions for each user,« explains Drachsler.

Only customized tools generate reliable statements

Data analysis which is as conclusive as possible necessitates complex, content-related, quantitative and qualitative evaluation. This means that each LA tool must be adapted to the context and cannot be »off the peg«. Drachsler's working group is planning a first research project in this direction: In the coming years, the DIFA lecture (Digital Formative Assessment) is to be supported by an LA system which,

IN A NUTSHELL

- Until now, lecturers have handed out material in tutorials, discussed it with the students and held a written exam at the end. They mostly remain unaware of what happens in between.

- From the data provided by the digital media increasingly in use, we can now deduce how the material is picked up and used for specific tasks. Via a tool, teaching staff can see how the group is working together, who replies to whom and which participants are less involved. Students then receive corresponding feedback.

- Especially for large-scale teaching formats with a large number of participants, learning analytics offers a completely new opportunity for individual feedback.

on the basis of process data, allows conclusions to be drawn about different prerequisites for learning, such as commitment, self-control and the ability to understand complex documents. Ideally, students (but lecturers too) will then be given an overview of the extent to which they have developed skills in these areas and who still needs help, why and where.

Learning activities play an important role in this context, that is, who is proactive and how often, for example, who uploads documents or posts messages in the forum. Keywords can help to identify and evaluate content as well. Language-processing systems already exist in English, for example for analysing essays, explains computer scientist Drachsler. They can, he says, even recognize and rate word usage and semantics (meaning).

The working group wants to make such applications publicly available as Open Source and Open Educational Resource. However, much of what is today found in the digital marketplace is already firmly in the hands of major US corporations such as Google, Apple, Amazon and Microsoft, which dominate the whole sector – such as in»the area of language recognition tools. »In this way, a lot of data from education migrates to private companies,« warns Drachsler and calls for controlled, EU-owned servers and the necessary funds for setting up independent European systems and platforms.

Learning of the future as feedback culture

Learning in ten or twenty years will require a change in thinking, of that Drachsler is convinced: »We must progress from an assessment culture, that is, thinking only of high performance, to a feedback culture.« This would make it possible to intervene much earlier and avoid frustration and directionless cramming. In his view, universities are predestined to take the lead here. In schools, by contrast, LA applications are problematic due to the sensitive nature of minors' data; but the different structures in the federalist education system in Germany also impede the use of such methods.

The Agora model school in the Netherlands provides a glimpse into the future. There, the students work in a very free manner on »challenges« with all manner of materials, often digital, as well as with role play and the internet. Learning progress is mapped individually in the process. »Learning analytics helps here in the acquisition of skills by each individual child,« explains Drachsler. At the same time, he warns: »Inequality of opportunity in the educational system must not be allowed to worsen as a result of different access to digital media.«

Drachsler reports that the new methods make teaching more attractive as well as motivating and fascinating the school students. Raising efficiency is also possible: For example, teachers today spend up to half their time on correcting tests – digital technology can accelerate this. »But it's no use simply making the biology textbook available as a PDF on a tablet – we need new didactic concepts in order to deploy new media expediently in teaching and, for example, facilitate new scenarios for joint learning.«

About Hendrik Drachsler

Hendrik Drachsler is both professor at Goethe University and Head of the Educational Technologies and Learning Analytics Unit at the Leibniz Institute for Research and Information in Education (DIPF). He is an elected member of the executive committee of the Society of Learning Analytics Research (SoLAR) and of the European Association of Technology-Enhanced Learning (EATEL). Drachsler has been scientific coordinator of various national and EU projects, regularly heads international scientific conferences and is co-editor of the IEEE Transactions on Learning Technologies (TLT) and of the Journal of Computer Assisted Learning (JCAL). He has written a number of often cited articles on technology-enhanced learning.

drachsler@em.uni-frankfurt.de

Practising presenting with the help of AI

Here, the next generation of learning technology is already in the starting blocks. Current research work by Drachsler's group shows that by using various data sources and systems, such as sensors, cameras and microphones, completely new types of learning systems can evolve. For example, the research group has developed a first presentation trainer based on an Xbox camera: It shows whether the presenter fiddles with his or her hands too much, is not active enough, needs to speak louder or more softly and a lot more besides. »Presenting is one of the skills of the 21st century, one of the most important abilities of our times that must be practised,« stresses Drachsler. With LA tools such as the presentation trainer, these skills can be practised individually and without stress or time pressure before facing a larger audience.

New learning systems are finding their way into the natural sciences, medicine and sport as well. As examples, Drachsler names training systems for cardiac massage and a salsa trainer that allows the user to practise the basic steps and the rhythm – with suitable feedback. Virtual representations (augmented reality) make learning easier. For example, a chemistry application brings the »dry« periodic table of the elements to life: It makes it possible to build molecules so that, for example, »visible« water is created from water and oxygen. Such effects support learning, since perception via several senses makes learning experiences more sustainable.

Over the last three years, collaboration between the Leibniz Institute for Research and Information in Education (DIPF) and Goethe University has been enhanced by the DELTA project (Towards Digital Education with modern Learning Technologies and Assessment approaches). It aims to provide a stimulus for establishing a nationwide and international centre of advanced educational technology in Frankfurt. To this purpose, students and teaching staff were asked about the success factors for digitalization, and from these the most important and achievable elements were deduced. For example, students expect more flexible and individualized studies as well as more support for independent learning – exactly what Drachsler targets in his research projects. The working group wants to draw up recommenda-

Transparent students? Much of what is found in the digital marketplace is already firmly in the hands of major US corporations.

tions for the DELTA project before the end of the year.

Ray of hope in mass intramural operations?

In keeping with this, Goethe University has set up a Digitalization Task Force, to which Drachsler also belongs. The university had already recognized before the Covid-19 pandemic that the increasing numbers of students, the strained supervision ratio and growing heterogeneity necessitate the use of digital structures. For example, the university's executive board announced in one of its publications last year: »Lecture theatres and individual offices will in future – at least partially – become collaboration spaces and experience centres.« It is therefore necessary, according to Drachsler, to support digital courses as well as examination and learning systems.

So that sufficient attention is also paid to data security, Drachsler's working group has coined the term »Trusted Learning Analytics«. »Trusted – that is, secure and reliable – means that we consistently bear in mind data privacy and ethical practices,« says Drachsler. Together with TU Darmstadt, the working group has compiled a code of conduct for universities. »It's very important for us that we don't play big brother here but instead support students.« Against the backdrop of more and more degree programmes and a rising percentage of students

who discontinue their studies, Drachsler feels that putting various LA tools into practice step by step and flanked by research makes sense and is necessary.

Examples from the Netherlands and the USA

A system already used at the University of Delft is the Learner Tracker. It supports self-regulated learning by visualizing students' time management and comparing it with previous cohorts. The Group Activity Widget (which is also Dutch) supports study groups by imaging initiative, productivity, presence, connectivity and reaction. »As we know, commitment is often unevenly distributed in group work – this can be demonstrably prevented with such systems; work is distributed more evenly and there are less conflicts,« says Drachsler, describing the system. The Student Explorer in use at the University of Michigan, USA, also identifies students with additional learning requirements in order to introduce support measures at an early stage.

Drachsler sees the possibilities and limits of digital media in his own three children: »Technology is, of course, enticing. That's why we limit screen time at home, for example.« And naturally parents need to talk about the risks – social media, stalking, bullying – and present alternatives in the shape of music, sports, reading, other recreational activities. »But it fascinates me how quickly children learn English today thanks to modern media or platforms for learning vocabulary or have fun acquiring skills at a high standard, for example, video production or the coordination of joint projects online.« These digital natives are conquering multimedia learning by themselves. LA research will fall on fertile ground here. ●

The author

Anja Störiko, 55, earned her doctoral degree in microbiology and has been working as a freelance journalist, authoress and editor for the »BIOspektrum« journal for many years. In an interview with Henning Drachsler, she recalls how, as a school student, she laboriously »hammered« Latin vocabulary into her head with the typewriter. She hopes that future generations of school students will be able to immerse themselves virtually and more easily in the world of the Romans or other fields of knowledge.

anja@stoeriko.de