How technology can support teachers best

Educational technologies are advancing rapidly; new solutions, apps, and online platforms appear every day. Mobile learning, learning on demand, and media rich curricula are recent buzz words describing the "techno-pedagogical" state of the art. And not least, the research and development community is encircled by the hovering spirit of "big data", "learning analytics", and "educational data mining". In educational practice, moreover, we can observe an increasing change towards a formative-centred evaluation and guidance/support of learners and a strong orientation towards competence development and individualisation. There is little doubt, that the pace and mode of learning must adapt to ever fast changing societal challenges.

Considering Europe's classroom reality, however, we can find a different situation: The most frequent situation in schools is that they are technology lean; there is little hardware and software, internet access is often not available, too slow, or restricted. Of course, there are few schools where the opposite is the case and technology is seen as an additional basic literacy. In the end, the use of (new) technologies is often dependent on the enthusiasm and skills of individual teachers and, even when teachers are using technologies; it still is difficult to give technology applications a deeper pedagogical value.

In conclusion, in all likelihood, there is no "big data" in schools and sometimes we do not even find "little data" in European school realities. Also, there is a lack of clear psycho-pedagogical ideas of how to use the fantastic new opportunities of technology (ranging from Facebook to Minecraft). On the other hand, we do know that a smart application and analysis of educationally relevant data is the most effective way to improve personalised teaching and learning. Only if a teacher has a detailed and in-depth understanding of each individual learner's learning trajectory, particular strengths and weaknesses and, perhaps most importantly, the competency gaps, then and only then, teachers can support their learners in an optimal formative manner, highly tailored to the concrete educational needs and goals. Certainly, teachers across Europe do a fantastic job, however, a large body of research yields that the necessary level of insight can only be reached when teachers are supported by smart technologies tailored to their particular needs and the given context conditions – technologies we can subsume under the term learning analytics.

Learning analytics is defined by the Society of Learning Analytics Research (www.solaresearch.org) as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs". Learning analytics consists in a multi-step, cyclical process of data collection and pre-processing, analytics and action, and post-processing. Data collection and pre-processing refers to the gathering of educational data from different learning tools and applications and preparing and translating it into an appropriate format. The analytics and action phase denotes the actual application of analytic methods, to extract meaningful patterns and information from the data and to make use of the obtained results (e.g., visualisation, feedback, recommendations, adaptation). Post-processing includes ideas of continually improving analytics by refining analytics methods or using new methods, including new data sources. Ryan Baker and George Siemens distinguish five classes of key methods currently used in learning analytics: prediction methods, structure discovery, relationship mining, discovery with models, and distillation of data for

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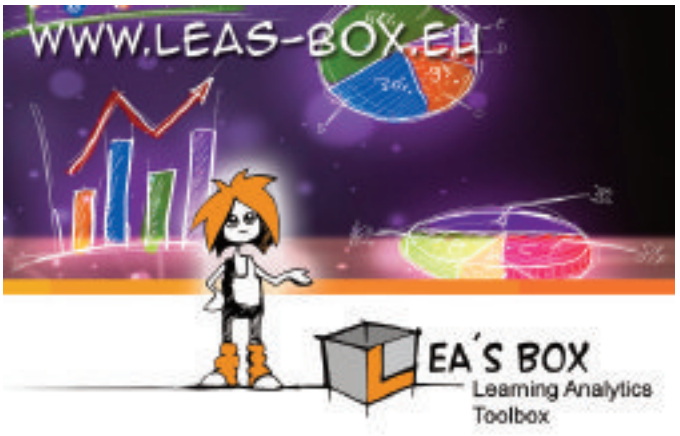

human judgment. Rebecca Ferguson highlights that the traditional research results must now increasingly find their way into classrooms. Summarising this, the fundamental idea of learning analytics is to bring together all bits and pieces of educational relevant data, no matter from which source.

One of the most successful recent European initiatives to provide teachers with such smart educational and analytical technologies is LEA's BOX (www.leas-box.eu). The name stands for a Learning Analytics Toolbox that aims to provide teachers and learners with a range of tools to collect, aggregate and analyse data. The LEA's BOX project provides tools that allow teachers to collect data and events (e.g., test results or in-class activities) in a very simple and effective way, independent from devices or particular technological infrastructures. On the basis of data and on the basis of robust psycho-pedagogical theories, the project provides visualisations of learning progress and the structure of competencies in a variety of ways.

A key aspect when using complex intelligent technologies is also to open learner models to the users (teachers and students) to facilitate a reflection about learning and skills. Exactly this active involvement in assessment and the communication of results is the nature of effective learning; it ignites self-reflection and a suitable adaptation of learning as well as teaching strategies. Different visualisations can be useful for supporting different needs for viewing learning data. Learning analytics visualisations tend to be closer to those found in visual analytics more generally, such as pie charts, bubble charts, or line graphs, whereas open learner models have developed visualisations such as skill meters, concept maps or hierarchical tree structures. Bringing together statistical analyses and structural, non-numerical views of competency development, most recent developments focus on structural graphs and lattices to illustrate the details of learning.

In conclusion, it is clear that the best way to support teaching and learning is to have an eye on competency development on a highly detailed and highly individualised level. In addition, we need to consider learning as a structural process that doesn't occur arbitrarily; we need to link competencies as well as prerequisite structures among them to actual curricula and teaching. The most important step is to translate such considerations into technology that supports teachers and learners in their particular settings and infrastructural context conditions. Most likely, not the most sophisticated technology is the most effective one but that technology that meets teachers and learners where they are – today! Of course, there is no doubt that future teacher education must address an appropriate use of technology for educational purposes way more than presently it is the case. Until then, projects like LEA's BOX envision to fill the gap and make education and training smarter, more effective, and perhaps more enjoyable.

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