

## **The use of student dashboards as early and ongoing warning and alert systems for identifying ‘at risk’ students**

**John G. Sharp<sup>1</sup> and Mayara Matos<sup>2</sup>**

<sup>1</sup> Professor of Higher Education and Head of the Lincoln Higher Education Research Institute, University of Lincoln

<sup>2</sup> Visiting researcher (University of Lincoln) and doctoral candidate at Departamento de Educação, Instituto de Biociências of UNESP Rio Claro

### **Introduction**

From a history of use in business and industry as executive and data-driven information systems, dashboards made their first real appearance in Higher Education in the 1990s. The subsequent development and use of dashboard indicators in student affairs is now an international and multi-disciplinary undertaking with contributions increasing in number particularly over recent years and from countries including the United States, Australia, Ireland, Belgium, the Netherlands, Switzerland, South Africa, Oman, Fiji and, of course, the United Kingdom (studies most commonly appear from the United States and Australia). This scholarly research notice, intended as an introduction for researchers looking to study the field, considers the use of student dashboards as early and ongoing warning and alert systems for tracking and identifying ‘at risk’ students particularly in the first but also subsequent years of study at university.

### **The rise and use of learning analytics**

In Higher Education institutions around the world, student dashboards continue to be designed and implemented in a bespoke and highly individualised manner; increasingly in response to the rise of learning analytics which has facilitated the measurement, collection, interrogation and reporting of data about learners and their contexts for the purposes of understanding and optimising learning and the environments in which it occurs. As summarised by Mitchell and Ryder (2013), the best Higher Education dashboards available usually combine both form and function to synthesise, aggregate and display sometimes complex and usually readily quantifiable information on a single screen in such a simple way as to be meaningful at a glance. According to Sclater and Mullan (2017), these can be used to identify where student retention for progression is critical, for performance management

where the longer-term improvement of overall attainment and success as a direct result of targeted ‘intervention’ is most effective, for addressing differential outcomes in attainment and for helping enhance ‘customer satisfaction’ more broadly (Figure 1).

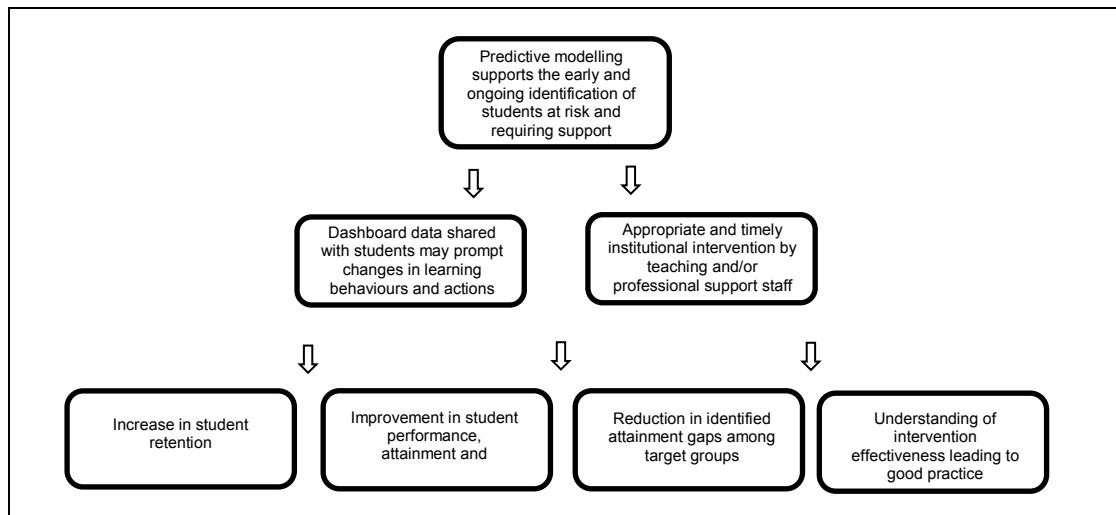


Figure 1 The potential value of student dashboard use (modified from Sclater and Mullan 2017)

While dashboards might be operational (sufficiently dynamic to track individual students and flag situations that require immediate action or a timely response), analytical (often with multi-layered information for more longitudinal consideration) or strategic (comprising high-level metrics which document, review and help develop future plans), all are usually intimately linked in terms of institutional goals and objectives. Despite opportunities for dashboard systems to contribute to Higher Education transformation, student learning and student management, Mitchell and Ryder (2013) also considered an ‘early’ range of useful dashboard opportunities and challenges, with the challenges including:

- the availability of technology, infrastructure and security;
- the use of measures and metrics;
- certain data limitations and depth of understanding among users.

Despite this, and while the algorithmic methods of predicting and modelling student outcomes and future directions can be statistically complex (Howard et al. 2018), situations whereby dashboards have been specifically employed as ‘early warning’

systems to prevent students actually failing their courses and dropping out have proved somewhat successful, with early 'intervention' even in the first few weeks of the first year of study particularly so (Ahmed and Al Hadhrami 2017; Cassells 2018; de Freitas et al. 2014; Jokhan et al. 2018; Krumm et al. 2014; Sclater et al. 2016). Sclater and Mullen (2017) also reported the following dashboard examples:

- used as a proxy for effort, VLE variables were more than four times as strongly related to achievement than gender, race and income at California State University, Chico;
- course completion rates increased from 81.1% to 86.8% in three years at Youngstown State University, Ohio;
- in one course at Marist College, New York, final grades improved by 6 percentage points among 'at risk' students subject to 'intervention' compared to others who did not;
- at Strayer University, Virginia, contact with students identified as 'at risk' in an 'intervention' study improved their attendance by 5%, increased their pass rate by 12% and saw a decrease in attrition by 8% relative to a control group;
- the drop-out rate at New England University in New South Wales was cut from 18% to 12%.

### **Student-facing dashboards**

Perhaps at their most advanced, dashboards appear to 'come into their own' when students are involved as 'primary stakeholders' or users with the ability to access and monitor their own information (the student-facing dashboard), which, in turn, provides the opportunity to support student-advisor dialogue and the overall learning process particularly with respect to goal setting, mastery orientation, the evaluation of learning activities, sense-making, reflection, self-diagnosis, self-awareness and self-regulation (McIntosh and Barden 2019); notably so when helping support students, provide insights into their progress and help plan for the future thereby taking dashboards from the realm of 'transactional' to 'transformational'. Where studies employing a range of research methodologies offer critical insight within and beyond immediate implementation, the following points have also been well made (Lonn et al. 2015; Charleer et al. 2018; Jivet et al. 2015; Lim et al. 2019):

- role of a dashboard - dashboard data can be 'basic', misleading, unreliable and sometimes difficult to interpret or to standardise interpretation (while demographic data can often help inform context this needs to be handled sensitively and ethically);

- role of 'visualisation' and 'visual salience' - dashboards are considered supportive tools with a use that can have potentially far reaching consequences (students as well as tutors may also need considerable help and support in making sense of dashboard feedback and interpreting the information presented);
- role of the personal tutor - dashboards facilitate insight and 'intervention' at many levels but may need to be moderated/mediated for students by personal tutors (overconfident students may interpret 'low level' negativity adversely and over-react unnecessarily and dashboards may inadvertently promote shallow over deep or more organised approaches to studying and learning);
- role of narrative - dashboards might be usefully modified to store the qualitative data arising from discussion/tutorials and other sources improving 'author-driven' and 'reader-driven' interpretation;
- transparency - full dashboard information need not be seen by students at all times, only during tutorials (unproductive competition, gaming, intimidation, stress, disappointment, hopelessness and demotivation should be avoided).

Interestingly, while Reimers and Neovesky (2015) also note a strong desire among students to see 'statistics' of their performance and attainment in dashboards, they remain very conscious about their privacy and do not, on the whole, wish other students to see their grades or, for that matter, to necessarily have their performance and attainment directly compared.

### **An element of critique**

As reflected in the title of her short but highly informative overview, and in common with Mitchell and Ryder (2013), Teasley (2017) reminds us that any dashboard, student-facing or otherwise, *'provides a visual display of the important information needed to achieve one or more goals, consolidated and arranged on a single screen so the information can be monitored at a glance'* (378). Teasley goes further, drawing on the contributions of others, warning readers that 'one size' does not necessarily 'fit all', and that despite their apparent technological maturity, many students do not in fact possess the data literacy or skill-set they require for unassisted dashboard decision-making or the other meta-cognitive applications and benefits they promote, including learning strategies and study behaviours, particularly if dashboard 'leader-boards' ranking students by name might be involved (lowering self-concept e.g. 'that person is smarter than me'). Conspicuously absent from most other sources too, Teasley also considers the study of dashboards and dashboard use to be largely in its infancy, missing many key elements including appropriate conceptual and theoretical frameworks, relevant analytical frameworks and

appropriate methodological considerations for empirical study with few published articles that evaluate effectiveness or impact. Teasley also noted that students find receiving consistent dashboard information (e.g. high performance feedback/high grade point average and low performance feedback/low grade point average) more helpful for decision making than conflicting feedback (e.g. high performance feedback/low grade point average and low performance feedback/high grade point average) and that dashboards which direct students to information about how to improve their work and their grades would be advantageous:

*'... dashboards hold the potential for both promise and peril for motivating students. Given the rapid pace in which student-facing dashboards are being deployed in educational technology platforms, there is still a need to inform the design and application of these systems so they can fulfil the promise to support students' awareness, self-reflection and sense-making. Knowing who should see what information and when, how it might best be presented to individual students, and how to integrate dashboards into the larger pedagogical practices in Higher Education are important questions that call out for further research.'* (382)

In the systematic reviews of dashboard research by Schwendimann et al. (2017), incorporating 55 articles selected from a total of 346, and Bodily and Verbert (2017), incorporating 93 articles from a total of 945, findings were broadly consistent with Teasley. In addition, and in terms of recommendations for practice and future research:

- the usage of different terms suggests no overall consensus on what constitutes a dashboard and, in particular, a learning analytics or student-facing dashboard across a range of Higher Education contexts;
- despite their increasing popularity, what constitutes authentic data or the 'right' information or indicators to display and how to display them for the purposes of different user-literacy levels and decision-making and learning support remains problematic, with little analysis or evaluation of the design and development process;
- while theoretical, conceptual and analytical frameworks for the purposes of study are largely absent, social-determination theory (motivation-based) offers considerable potential;
- most dashboard studies tend to focus on and track relatively simple 'click-level' data alone.

Bodily and Verbert (2017) do, however, present what they regard as nine key questions aimed at guiding the process of creating a student-facing learning analytics reporting system for consideration: What is the intended goal of the system? What visual techniques will best represent your data? What types of data support your goal? What do students need (does this align with your goal)? Is the system easy and intuitive to use? How do students perceive the reporting system? How are students using the system (frequency and why)? What is the effect on student behaviour? and What is the effect on student achievement? As also cautioned by Gray and Perkins (2018):

*'When dealing with achievement, welfare, and confidence of a student there are serious ethical considerations. Interventions, however well- intentioned, will affect a student's mindset. How large that effect, and whether it is positive or negative, will depend on the skill and care of the educator involved. Practitioners will need to adopt a new approach when dealing with students identified by any analytics ... This is something educators may end up losing sight of when algorithms make the identifications instead of their own intuition. These effects can not only be triggered by an intervention, but also just from being identified as potentially benefiting from assistance. Some students could see this as an oblique method of assessing their performance and become withdrawn.'* (30)

### **A UK case study: Nottingham Trent University**

Of all the UK university open-access dashboards available to view online, the Nottingham Trent University Student Dashboard remains one of the most widely featured and discussed, appearing as part of a broader review of learning analytics in Higher Education by Sclater et al. (2016) on behalf of Jisc and showcasing on the AdvanceHE/HEA website (2019).

As far as can be established, the NTU dashboard, developed from a limited review of literature with little evidence of any or conceptual underpinning (not uncommon in the field), is described by Lawther and Edwards (2018) as originating from a pilot conducted in 2013 and introduced the following year. In common with most dashboard application, it presents basic student demographic information while initially monitoring door swipes, library use, VLE log-ins, assignment submissions, the use of electronic resources and attendance (other variables have also been considered over time). It then uses historical data to assign individual engagement ratings ranging from high (very good: in real time or over several days and reports maximising the chances of success without guaranteeing it) to low (poor: using

university resources infrequently offering advice to seek out help). Both staff and students, who see exactly the same dashboard view, were involved in the pilot as well as in subsequent developments. Of particular interest, NTU established that low engagement as recorded by the dashboard helped identify students most at risk of withdrawing from study, failing academically or likely to achieve lower degree outcomes (twice as many highly engaged final year students are now known to get a 'good degree' than those receiving low engagement ratings). Students in the low engagement category were also found to be disproportionately male, BAME, WP and BTEC entrants. NTU felt that with their dashboard they could 'target' student behaviours rather than student characteristics while acknowledging the need for much further research to understand the scale and depth of change and what 'interventions' work for which students. Overall, 27% of students reported that they had changed their behaviour in response to data provided by the dashboard and 80% of staff felt that the data provided by the dashboard changed how they worked with students. In addition, as reported by Sclater et al. (2016):

- NTU found levels of engagement to be a stronger predictor of success than background characteristics;
- personal tutors were prompted to contact students when their engagement drops off, finding the dashboard a valuable resource;
- the provision of the dashboard helped to build better relations between students and personal tutors;
- some students found that seeing their own engagement as a positive, helping them to stay engaged;
- transparency and a close partnership approach was critical to the success of the initiative reducing ethical concerns about the use of student data;
- the provision of the dashboard is now expected by staff and students and the project has helped to extend the culture of data-driven decision-making across the university.

Work at NTU, focusing on 'no-engagement alerts', has been reported most recently by Foster and Siddle (2019) who conclude appropriately:

*'We would argue that the implementation of technology alone cannot create a more inclusive environment, but metrics output from learning analytics systems have the potential to provide institutions with the necessary data to do so.'* (9)

## Conclusion

While the introduction and escalation of dashboard use alongside a growing and highly informative literature base continues, including the recently completed pilot of a new and enhanced student dashboard at the University of Lincoln itself (full report available on request), many important questions surrounding their overall design, operation and effectiveness remain unanswered creating a fertile area for detailed investigation.

## References

ABLE (2018) *ABLE Project: Achieving Benefits from LEarning analytics*. Available at: [www.ableproject.eu/](http://www.ableproject.eu/).

AdvanceHE/HEA (2019) The NTU student dashboard. Available at: [www.heacademy.ac.uk/download/ntu-student-dashboard-developing-learning-analytics-platform-improve-student-retention-and](http://www.heacademy.ac.uk/download/ntu-student-dashboard-developing-learning-analytics-platform-improve-student-retention-and).

Ahmed, G. and Al Hadhrami, A. (2017) Learning analytics dashboard to improve students' performance and success. *Journal of Research and Method in Education*, 7(1), 39-45.

Bodily, R. and Verbert, K. (2017) Review of research on student-facing learning analytics dashboards and educational recommender systems. *IEEE Transactions on Learning Technologies*, 10(4), 1-15.

Bolton University (2019) *Learning Excellence Achievement Pathway Online Tutorial*. Available at: [www.bolton.ac.uk/leaponline/Home.aspx](http://www.bolton.ac.uk/leaponline/Home.aspx) (see also McIntosh and Barden 2019 below).

Cassells, L. (2018) The effectiveness of early identification of 'at risk' students in higher education institutions. *Assessment and Evaluation in Higher Education*, 43(4), 515-526.

Charleer, S., Moere, A.V., Klerkx, J., Verbert, K. and de Laet, T. (2018) Learning analytics dashboard to support adviser-student dialogue. *IEEE Transactions on Learning Technologies*, 11(3), 389-399.

de Freitas, S., Gibson, D., du Plessis, C., Halloran, P., Williams, E., Ambrose, M., Dunwell, I. and Arnab, S. (2014) Foundations of dynamic learning analytics: Using



university student data to increase retention. *British Journal of Educational Technology*, 46(6), 1175-1188.

Foster, E. and Siddle, R. (2019) The effectiveness of learning analytics for identifying at-risk students in higher education. *Assessment and Evaluation in Higher Education*. Available at: [www.tandfonline.com/doi/full/10.1080/02602938.2019.1682118](http://www.tandfonline.com/doi/full/10.1080/02602938.2019.1682118)

Gray, C. and Perkins, D. (2019) Utilizing early engagement and machine learning to predict student outcomes. *Computers and Education*, 131, 22-32.

Howard, E., Meehan, M. and Parnell, A. (2018) Contrasting prediction methods for early warning systems at undergraduate level. *The Internet and Higher Education*, 37, 66-75.

Jivet, I., Scheffel, M., Specht, M. and Drachsler, H. (2018) License to evaluate: Preparing learning analytics dashboards for educational practice. *Proceedings of the 8<sup>th</sup> International Conference on Learning Analytics and Knowledge*, Sydney University, New South Wales, Australia.

Jokhan, A., Sharma, B. and Sing, S. (2018) Early warning system as a predictor for student performance in higher education blended courses. *Studies in Higher Education*. Available at: <https://srhe.tandfonline.com/doi/full/10.1080/03075079.2018.1466872#.XaBuoWdYaUk>.

Krumm, A.E., Waddington, R.J., Teasley, S.D. and Lonn, S. (2014) A learning management system-based early warning system for academic advising in undergraduate engineering. In: J.A. Larusson and B. White (eds.) *Learning analytics: From research to practice*. New York: Springer.

Lawther, S. and Edwards, R. (2018) *The NTU student dashboard*. Nottingham: Nottingham Trent University. Available online: [www4.ntu.ac.uk/current\\_students/document\\_uploads/195429.pdf](http://www4.ntu.ac.uk/current_students/document_uploads/195429.pdf).

Lim, L., Joksimović, S., Dawson, S. and Gašević, D. (2019) Exploring students' sensemaking of learning analytics dashboards: Does frame of reference make a difference. *Proceedings of the 9<sup>th</sup> International Learning Analytics Conference on Learning Analytics and Knowledge*, Arizona State University, Tempe, Arizona.

Lochtie, D., McIntosh, E., Stork, A. and Walker, BW. (2018) *Effective personal tutoring in higher education*. St. Albans: Critical Publishing.

Lonn, S., Aguilar, S. and Teasley, S. (2015) Investigating student motivation in the context of a learning analytics intervention during a summer bridge programme. *Computers in Human Behavior*, 47, 90-97.

McIntosh, E. and Barden, M.E. (2019) The LEAP (Learning Excellence Achievement Pathway) framework: A model for student learning development in higher education. *Journal of Learning Development in Higher Education*, 14, 1-21.

Mitchell, J.J. and Ryder, A.J. (2013) Developing and using dashboard indicators in student affairs assessment. *New Directions for Student Services*, 142, 71-81.

Reimers, G. and Neovetsky, A. (2015) Student focused dashboards: An analysis of current student dashboards and what students really want. *Proceedings of 7<sup>th</sup> CSEDU International Conference on Computer Supported Education, Lisbon, Portugal*.

Sclater, N. and Mullan, J. (2017) *Learning analytics and student success: Assessing the evidence*. Bristol: Jisc.

Sclater, N., Peasgood, A. and Mullan, J. (2016) *Learning analytics in higher education: A Review of UK and international practice*. Bristol: Jisc.

Schwendimann, B.A., Rodríguez-Triana, M.J. and Vosniuk, A. (2017) Perceiving learning at a glance: A systematic literature review of learning dashboard research. *IEEE Transactions on Learning Technologies*, 10(1), 30-41.

Teasley, S.D. (2017) Student facing dashboards: One size fits all? *Tech, Know Learn*, 22, 377-384.