



Paper 1: Monitoring attendance and its impact on Engineering students.

Giles Tewkesbury^a, Simon Chester^a, David Sanders^a, Manish Malik^a

University of Portsmouth, U.K.^a

Corresponding Author's Email: Giles.Tewkesbury@port.ac.uk

KEY WORDS: Attendance monitoring, degree outcomes, engagement, learning analytics, engineering education.

SUMMARY

This paper presents the findings of a two-year study with foundation (level 3) student attendance and performance. Learning analytics has become a popular term within higher education and there are several dashboard applications available for institutions to invest in. There has also been an increase in attendance monitoring activity across the higher education sector. Some dashboards merge attendance monitoring with other learning analytics data to provide reports and in some cases encourage better engagement by students. The drivers and outcomes linked to such monitoring may be different in different institutions. At Portsmouth, the School of Engineering developed a bespoke in-house attendance monitoring system and has been carrying out research looking at the benefits of such a system for staff and students. Quantitative data was used from the attendance monitoring system along with course specific data collected in previous years before the introduction of the system to evaluate progression. This paper highlights some challenges faced during the implementation of the attendance monitoring trial system with the School of Engineering and presents some observations on the effects that attendance monitoring had on the progression and achievement of students.

BACKGROUND / CONTEXT

The School of Engineering at the University of Portsmouth collected student attendance information by either a roll call or by passing around a sign-in sheet during lectures. This activity was historically initiated by academic staff, sometimes in an attempt to encourage students to attend. The rationale behind this was a belief that if students were aware their attendance was being monitored, then they would be more likely to turn up, and if they were present, they would be more likely to learn. This viewpoint however, has never been universally accepted or agreed (Muir, 2009; Marburger, 2006; Massingham & Herrington,

2006), and so there was a reluctance to pursue formalised attendance monitoring. With the introduction of UK border agency Tier 4 Sponsor licences in February 2009, and the associated monitoring requirements, there was a fresh interest in formalised attendance monitoring. Manual, paper-based attendance monitoring methods were reported as being time consuming and tedious for students and staff alike. The accuracy of paper registers, especially where students were only required to tick against their name, was questionable. A University of Portsmouth learning and teaching grant was awarded in 2015 to investigate the use of electronic systems to monitor attendance and the results are presented in this paper.

AIM AND OBJECTIVES / RESEARCH QUESTION(S)

The prototype system aimed to evaluate:

1. The speed of the registering process.
2. The accuracy of the register data collected.
3. The student and staff experience.

Through selecting a well established course, this research also aimed to observe if the introduction of full attendance monitoring had an effect on either student progression or achievement, by using metrics measured in the course Annual Standards & Quality Evaluative Reviews (ASQER).

This study investigated the use of a prototype electronic attendance monitoring system to establish if it would be beneficial to use such a system, throughout Portsmouth University.

RATIONALE

Several studies have shown a link between performance and attendance and or engagement in class. The School of Engineering felt the need to create and evaluate an in-house attendance monitoring system to investigate the effects of such a system to student experience and attainment. This study investigated the speed of registering, accuracy of data and the staff and student experiences in the implementation of a prototype electronic attendance monitoring system. Observations regarding changes in performance metrics based on the presence of the attendance monitoring system were obtained from historic and current ASQER reports.

The authors believed that there could be benefits from the implementation of an attendance monitoring system through increased student attendance.

Level 3 Foundation Students were academically the weakest of all entry level students and therefore had the most to gain. Trends within the data provided important indicators and previous correlations between the student attendance data over the period of the study and their outcomes can suggest links between the two. A Google form survey was used to obtain feedback from staff and students involved in the trial. The speed of the registering process, accuracy of the register data collected and student and staff experience were evaluated.

The findings presented here may be useful for other engineering schools who are considering implementing attendance monitoring.

LITTERATURE REVIEW

The higher education sector has seen an increase in attendance monitoring activity (Tickle, 2015). With the data available, decision making algorithms (Haddad et al, 2018) and AI techniques can provide useful analysis. Some dashboards merge attendance monitoring with other learning analytics data (Sanders and Bergasa-Suso, 2010) to provide reports and in some cases encourage better engagement by students.

Several review studies have highlighted the complicated nature of investigating a link between attendance and student performance and achievement across different subject domains (Dollinger *et al*, 2008; Schneider and Preckel, 2018; Credé *et al*, 2010). Studies often have struggled to separate the effect of indirect variables, such as intrinsic motivation, prior performance and preparedness on attendance and student performance (Schneider and Preckel, 2018). Instead of conceptual segregation, Stajkovic *et al* (2018) stressed the importance of an integrative approach to understanding student performance as they linked it to the “big five” personality traits and self-efficacy. A systematic review of meta-analyses linking student achievement with 105 variables was carried out by Schneider and Preckel (2017). They ranked all the correlations of student achievement from 38 meta-analyses involving nearly 2 million students. At the top was instruction methods that use peer-assessment and attendance as an antecedent was at 6th position in their ranking based on its effect size. Schneider and Preckel (2017) noted that there have been no controlled studies looking at the impact of mandatory attendance on students performance so far.

Schneider and Preckel (2017) highlighted limitations in research studies in terms of the large Confidence Interval (CI) sizes noted and or Heterogeneity in the results that was not explored, meaning that this is a complex area needing more research. Instruction styles that used social interaction had the most frequent high positive effect sizes. This included lectures, small group learning and project based learning as long as they could balance

teacher-centric and student-centric instructional elements (*ibid*). In other words, what the teaching staff and students do in class impacts the interrelationship between attendance and student performance. For example, proponents of classroom response systems (CRS) and peer-instruction claim that using it enhances students performance highlighting socio-cognitive benefits of the interactions between students and with the teaching staff (Balta *et al.*, 2017).

Overall, many studies conclude that there is a correlation between attendance and student performance (Anikeef, 1954; Garther and Manning, 1998, Newmann-Ford *et al.*, 2008, Lockwood *et. al*, 2006 and Credé *et al*, 2010) but there are some that report opposite and or mixed findings too (Hammen and Kelland, 1994; McCarey *et. al*, 2007; Rodgers, 2002; Grabe, 2005). Credé *et al* (2010) carried out a meta-analysis of studies (K=68) that studied the correlation between attendance and student performance and found a strong correlation ($\rho=0.44$, N=21,164), however, the relatively large 90% Credibility Interval (0.26, 0.62) suggested the presence of moderator variables. Mandatory attendance has been shown to be effective here (Cohn and Johnson, 2006) but authors have shown that not attending a one or two sessions is not as detrimental as not attending majority of sessions. Monitoring attendance and identifying 'at-risk' students in order to prioritise the support provided to such students is another dimension that has gained recent attention, although very few studies have shown positive impact (Larrabee *et al*, 2018; Tickle, 2015).

Within engineering education, a range of studies show a positive correlation between attendance and performance (Purcell, 2007; Nyamapfene, 2010; Obeidat *et al*, 2012; Laguador, 2013; Moldabayev *et al*, 2013; McCool *et al*, 2015). However, these don't always report that such a correlation is significant. Purcell (2007) showed at 68% average attendance, a strong correlation between attendance at lectures and student performance exists. Obeidat *et al* (2012) analysed the relevant data statistically and proposed some reasons for this affect including additional information given in lectures that is not present in power-point slides posted online as a tactic used by some staff. Moldabayev *et al* (2013) presented data on 14 modules with correlation coefficients ranging from -0.048 (Fluid Mechanics) to 0.597 (Introduction to Civil Engineering) with only 3 modules above 0.30 value. Here only 9 modules had significant positive correlation between attendance and performance irrespective of strength. A major shortcoming in almost all Engineering Education Research studies is that there are very few studies that study other factors that may affect performance alongside attendance or designs with control built in them (McCool *et al*, 2015). Other limitations in this literature include incomplete attendance data (Romer,1993) or self-reported absences (Durden and Ellis,1995) and limited sample size (Purcell,2007; Nyamapfene,2010). Since engineering education makes use of project based learning where students may engage in peer interactions and assessment, the data on attendance to events where the balance between teacher-centred and student-centred approach is optimal can lead to interesting findings. This study is unique as it does not evaluate or use a commercial system to monitor student attendance and one where student

support is also monitored and it explores benefits other than already established effects on student performance.

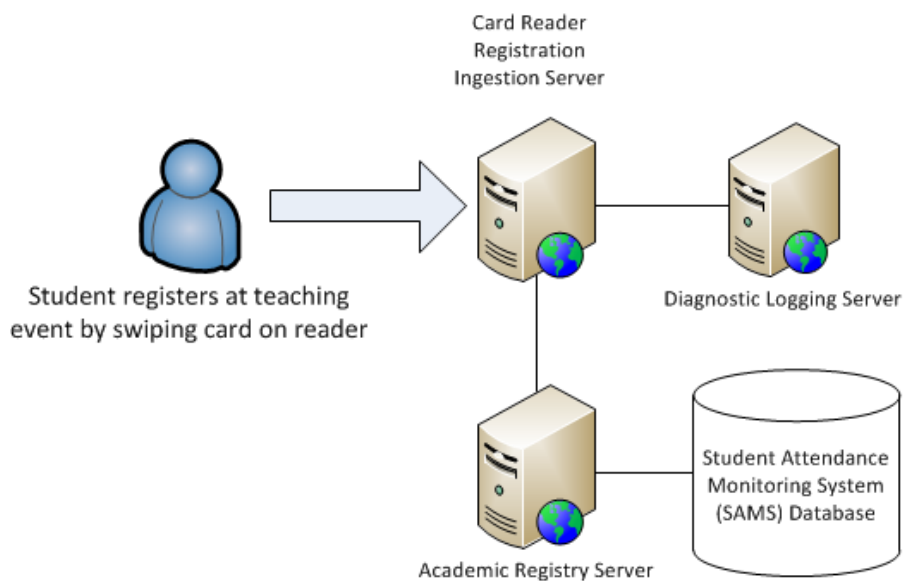
METHODOLOGICAL APPROACH

Electronic card reader hardware was purchased and installed in selected rooms in the University as part of a University learning and teaching grant. These were TCP/IP, Ethernet-based RFID terminals for contactless smart cards, which used Power-over-Ethernet and eliminated the need for external power supplies.

The card readers operated as standalone HTTP web clients. When a contactless card was detected by a reader, it sent a HTTP GET request to the web server. The server responded with standard HTTP reply to the reader. The content of the response controlled the sounding of a beeper and illumination of LED indicators on the device.

Students would register at events by scanning their cards on a card reader. Bespoke software was created to form an ingestion server, to handle the registrations data from the card readers and interface to the University corporate systems (Fig 1). The ingestion server, which was setup for the trial, would receive and capture registration information from card readers and ensure a timely response to the card readers.

Fig 1. Prototype card reading system used in the attendance monitoring trial.



Academic staff were asked to use the electronic card readers to assist with taking class registers. Students were asked, by academic staff, to present their cards to the electronic reader on entry to a classroom. At the end of the study staff and students were asked to complete a questionnaire about their experiences. A participant information sheet was provided to staff and made available to students participating in the electronic card reader study. Taking part (ie using electronic card readers) was voluntary. Students however were required to participate in the universities student attendance monitoring, and although participation in the electronic card reader registration was optional, there were alternative means for students to register their attendance at the selected sessions. Students were able to opt-out by simply not presenting their card to the electronic reader. Participation in feedback was also optional and anonymous.

A trial group of academic staff and students including (but not limited to) Level 3 foundation students were selected for the study and asked to use the electronic card readers to register student attendance at compulsory events.

A Google form survey was used to obtain feedback from staff and students involved in the trial. 60 members of academic staff who had indicated that they were willing to be a part of the trial were emailed the staff feedback questionnaire and 42% (25) responded. Students who had used their cards to register for six or more events were selected to participate in the student feedback questionnaire, and these 3367 students were emailed the survey, of which, 16% (532) responded.

This study compared the progression rates of students onto M level degree programs to historic data collected when the same cohort of students were not having their attendance monitored.

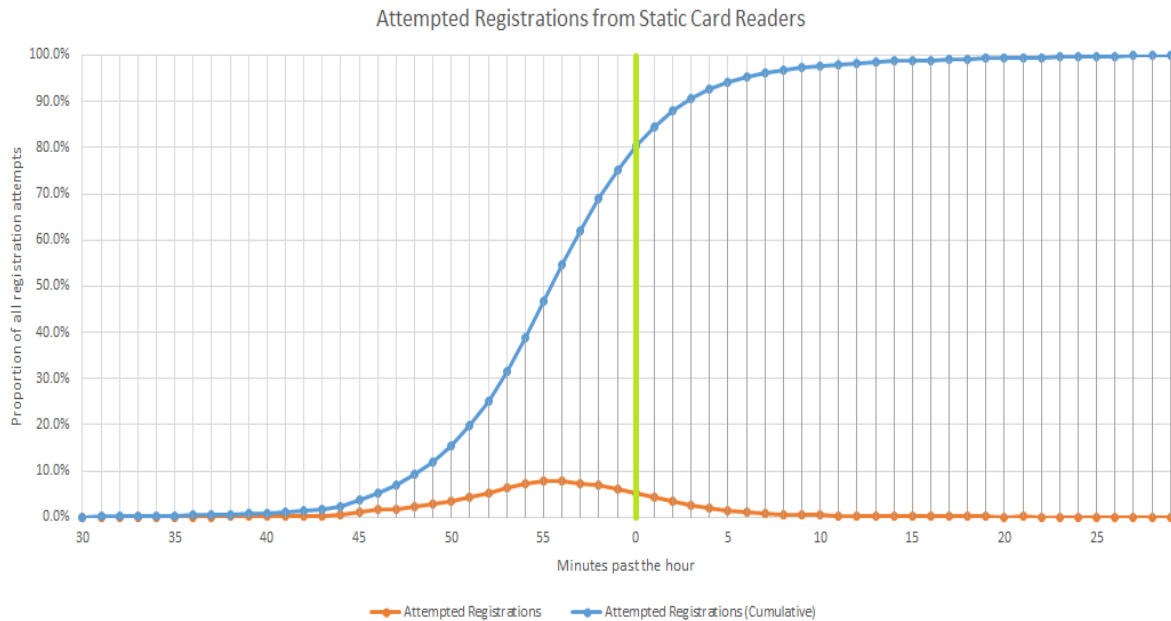
KEY FINDINGS

The key findings can be split into four areas; the accuracy of the register data collected, the student & staff experience, the speed of the registering process, and the effect on either student progression or achievement. This paper presents the latter two findings (the speed of the registering process and the effect on either student progression or achievement).

The speed of the registering process was assessed through analysis of diagnostic logging data from the card reading system and through specific questions in the staff and student survey.

The diagnostic logging system recorded the time at which students registered and it was therefore possible to plot the time at which students registered with respect to the timetabled start time for events. The graph in Fig 2 shows that the highest throughput of registrations occurred at five minutes before the start time. At the start time, 80% of students had already been registered.

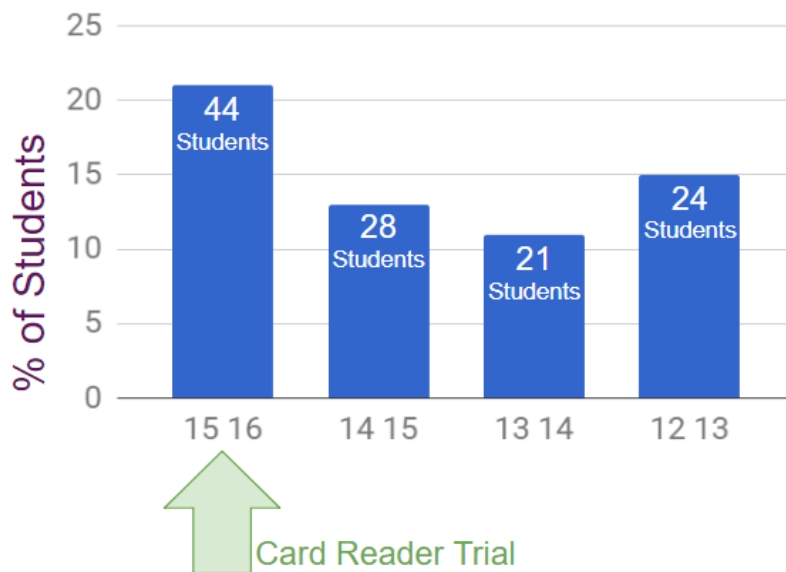
Fig 2. The normalised proportion of all registrations plotted against lecture start time.



All staff except one responded that the card readers never cause students an unacceptable delay in entering the classroom. The single member of staff who responded that sometimes there were unacceptable delays, noted in the free text field ‘Delays were only early on. Students got used to it quickly enough and then it worked smoothly’. 56% of students never had any unacceptable delay in entering a classroom, 38% reported delays sometimes and 6% reported that they were always delayed.

The effect on either student progression or achievement was measured by using metrics taken from the Course Annual Standards & Quality Evaluative Reviews (ASQER). The data showed that there was no significant change in the student progression statistics (i.e. the same percentage of students were failing or repeating the year) for the year where students attendance was being monitored compared with the previous three years.

Fig 3. Showing the increase in the percentage of Students progressing to integrated Masters Degrees during the Card Reader Trial (15-16) and in the preceding three years.



However, the study found that students who were potential high performers benefited from attendance monitoring in terms of better achievement and were more inclined to transfer to MEng courses. To do this, students needed to achieve an average mark of 70% in all modules and in the past, when the monitoring was not present, fewer students were eligible to progress to MEng courses. However, with attendance monitoring there was over 75% increase in the numbers transferring to MEng courses, that is 12% to 21%. (Fig. 3)

DISCUSSION

A trial card reading network was created and evaluated to investigate the effects of such a system on student experience and attainment.

The project investigated the use of electronic card readers and identified ways in which they could interface with existing University systems.

The study concluded that the introduction of an electronic card reader system at the University of Portsmouth would not cause unacceptable delays for students entering classrooms and would contribute positively to student experience.

Results from this study indicate a correlation between the practice of monitoring attendance and an increase in performance of students with the potential to perform well. The study could not find any correlation between the introduction of attendance monitoring

and increase in student progression/retention for the level 3 engineering students involved in the study. The data from attendance monitoring system is now available to personal tutors as well as to students from the university's new personal tutoring platform as well as from student portal. This was not the case for this study however. Although not the focus of this study, the data may in future influence student behaviour, either when used by the students themselves or by their personal tutors to discuss and influence attendance patterns.

It is acknowledged that other factors may affect these results such as changes in teaching or course material, however this cohort was selected because the course was well established and the modules and teaching teams has remained consistent for a number of years, thus minimising the possible effects.

The findings may be useful for other Engineering Education schools who are considering implementing electronic attendance monitoring.

CONCLUSIONS & RECOMMENDATIONS

The project investigated the use of electronic card readers and the effect this has had on foundation-engineering students' attainment and student experience. The study recommends the introduction of attendance monitoring systems since students who are potential high performers have benefited from attendance monitoring in terms of better achievement. The study concluded that the introduction of an electronic card reader system at the University of Portsmouth would contribute positively to student experience.

During this study there was no feedback to students about their attendance, which was recognised as being a weakness. A strong recommendation would be that all attendance data collected about a student is made visible to them. This would allow better verification of the data collected (as students could complain if it was incorrect) and would provide students with important feedback about their attendance, which again might encourage improved engagement. Additionally, personal tutors may be able to influence change with access to this important set of data.

REFERENCES

Anikeef, A.M., 1954. The relationship between class absences and college grades. *Journal of Educational Psychology*, 45(4), p.244.

Balta, N., Michinov, N., Balyimez, S., & Ayaz, M. F. (2017). A meta-analysis of the effect of Peer Instruction on learning gain: Identification of informational and cultural moderators. *International Journal of Educational Research*, 86, 66-77.

Cohn, E. and Johnson, E., 2006. Class attendance and performance in principles of economics. *Education Economics*, 14(2), pp.211-233.

Credé, M., Roch, S.G. and Kieszczynka, U.M., 2010. Class attendance in college: A meta-analytic review of the relationship of class attendance with grades and student characteristics. *Review of Educational Research*, 80(2), pp.272-295.

Dollinger, S.J., Matyja, A.M. and Huber, J.L., 2008. Which factors best account for academic success: Those which college students can control or those they cannot?. *Journal of research in Personality*, 42(4), pp.872-885.

Durden, G.C. and Ellis, L.V., 1995. The effects of attendance on student learning in principles of economics. *The American Economic Review*, 85(2), pp.343-346.

Gatherer, D. and Manning, F.C., 1998. Correlation of examination performance with lecture attendance: A comparative study of first-year biological sciences undergraduates. *Biochemical Education*, 26(2), pp.121-123.

Grabe, M., 2005. Voluntary use of online lecture notes: Correlates of note use and note use as an alternative to class attendance. *Computers & Education*, 44(4), pp.409-421.

Haddad, M., Sanders, D., Bausch, N., Tewkesbury, G., Gegov, A., & Hassan, M. (2018, September). Learning to make intelligent decisions using an expert system for the intelligent selection of either PROMETHEE II or the analytical hierarchy process. In *Proceedings of SAI Intelligent Systems Conference* (pp. 1303-1316). Springer, Cham.

Hammen, C.S. and Kelland, J.L., 1994. Attendance and grades in a human physiology course. *Advances in physiology education*, 267(6), p.S105.

Laguador, J.M., 2013. Observed classroom behaviour as predictor of the major examination results in advanced statistics of BS Industrial Engineering Students. *International Journal of Management, IT and Engineering*, 3(7), p.349.

Larrabee Sønderlund, A., Hughes, E., & Smith, J. (2018). The efficacy of learning analytics interventions in higher education: A systematic review. *British Journal of Educational Technology*.

Lockwood, P., Guppy, C. and Smyth, R., 2006, October. Should lectures be compulsory?. In *Proceedings of The Australian Conference on Science and Mathematics Education (formerly UniServe Science Conference)*.

Marburger, D. R. 2006, Does Mandatory Attendance Improve Student Performance? *The Journal of Economic Education*, 37(2), 148-155. doi: 10.3200/JECE.37.2.148-155

Massingham, P., & Herrington, T. (2006). Does attendance matter? An examination of student attitudes, participation, performance and attendance. *Journal of University Teaching & Learning Practice*, 3(2).

McCarey, M., Barr, T. and Rattray, J., 2007. Predictors of academic performance in a cohort of pre-registration nursing students. *Nurse Education Today*, 27(4), pp.357-364.

McCool, R., Kelly, S., Maguire, M., Clarke, D. and Loughran, D., 2015. Factors which influence the academic performance of level 7 engineering students. *AISHE-J: The All Ireland Journal of Teaching and Learning in Higher Education*, 7(2).

Moldabayev, D., Menicucci, J.A., Al-Zubaidy, S. and Abdulaziz, N., 2013, March. Attendance, performance and culture Experience of the School of Engineering, Nazarbayev University-An update. In *Global Engineering Education Conference (EDUCON), 2013 IEEE* (pp. 5-10). IEEE.

Muir, J., 2009. Student Attendance: Is It Important, and What Do Students Think? *CEBE Transactions*, Vol. 6 (2), pp 50-69 ISSN: 1745-0322.

Newman-Ford, L., Fitzgibbon, K., Lloyd, S., & Thomas, S. (2008). A large-scale investigation into the relationship between attendance and attainment: a study using an innovative, electronic attendance monitoring system. *Studies in Higher Education*, 33(6), 699-717.

Nyamapfene, A., 2010. Does class attendance still matter?. *engineering education*, 5(1), pp.64-74.

Obeidat, S., Bashir, A. and Jadayil, W.A., 2012. The importance of class attendance and cumulative gpa for academic success in industrial engineering classes. *Int J Soc Hum Sci*, 6, pp.139-142.

Purcell, P., 2007, September. Engineering student attendance at lectures: Effect on examination performance. In *International Conference on Engineering Education, Coimbra, Portugal*.

Rodgers, J.R., 2002. Encouraging tutorial attendance at university did not improve performance. *Australian Economic Papers*, 41(3), pp.255-266.

Romer, D., 1993. Do students go to class? Should they?. *Journal of Economic Perspectives*, 7(3), pp.167-174.

Sanders D and Bergasa-Suso J, 2010, Inferring learning style from the way students interact with a computer user interface and the WWW. *IEEE Transactions on Education*, Vol 53, no. 4, pp. 613-620.

Schneider, M. and Preckel, F., 2017. Variables associated with achievement in higher education: A systematic review of meta-analyses. *Psychological Bulletin*, 143(6), p.565.

Stajkovic, A.D., Bandura, A., Locke, E.A., Lee, D. and Sergent, K., 2018. Test of three conceptual models of influence of the big five personality traits and self-efficacy on academic performance: A meta-analytic path-analysis. *Personality and Individual Differences*, 120, pp.238-245.

Tickle, L., 2015. How universities are using data to stop students dropping out. *Retrieved from: <https://www.theguardian.com/guardian-professional/2015/jun/30/how-universities-are-using-data-to-stop-students-dropping-out>*