



Proceedings of the Informing Science + Information Technology Education Conference

An Official Publication
of the Informing Science Institute
InformingScience.org

InformingScience.org/Publications

June 30 – July 4 2019, Jerusalem, Israel

DO STUDENTS REALLY WANT TO KNOW? INVESTIGATING THE RELATIONSHIP BETWEEN LEARNING ANALYTICS DASHBOARDS AND STUDENT MOTIVATION

Danny Toohey	Murdoch University, Perth, Australia	d.toohey@murdoch.edu.au
Tanya McGill*	Murdoch University, Perth, Australia	t.mcgill@murdoch.edu.au
Chad Berkelaar	Murdoch University, Perth, Australia	chad.berkelaar@hotmail.com
Ananth Kadekodi	Murdoch University, Perth, Australia	ananthkadekodi@gmail.com
Dominika Kaminska	Murdoch University, Perth, Australia	kaminskadominika89@gmail.com
Melisa Lianto	Murdoch University, Perth, Australia	melisa.lianto178@gmail.com
Nathan Power	Murdoch University, Perth, Australia	nathanpower98@gmail.com

*Corresponding author

ABSTRACT

Aim/Purpose	The aim of this project was to explore the perceptions of information technology students about student-facing learning analytics dashboards that display ranking information, and whether they perceive that their motivation to study would be influenced by the use of dashboards that display their performance relative to other students.
Background	While there has been a focus on the use of learning analytics dashboards by academics to inform their teaching, there has not been as much exploration of the use of student-facing dashboards, nor on the effect that students believe these dashboards will have on their motivation to study.
Methodology	The research surveyed students enrolled in Information Technology courses at an Australian university. Data about students' academic motivation was gathered using a short, online survey.
Contribution	The paper adds to knowledge of the impact on students of student-facing learning analytics dashboards.

Accepting Editor: Eli Cohen | Received: January 25, 2019 | Revised: February 5, 2019 |
Accepted: February 25, 2019

Cite as: Toohey, D., McGill, T., Berkelaar, C., Kadekodi, A., Kaminska, D., Lianto, M., & Power, N. (2019). Do students really want to know? Investigating the relationship between learning analytics dashboards and student motivation. *Proceedings of the Informing Science and Information Technology Education Conference, Jerusalem, Israel*, pp. 321-332. Santa Rosa, CA: Informing Science Institute. <https://doi.org/10.28945/4352>

(CC BY-NC 4.0) This article is licensed to you under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/). When you copy and redistribute this paper in full or in part, you need to provide proper attribution to it to ensure that others can later locate this work (and to ensure that others do not accuse you of plagiarism). You may (and we encourage you to) adapt, remix, transform, and build upon the material for any non-commercial purposes. This license does not permit you to use this material for commercial purposes.

Findings	A majority of students (63%) would like to see their cohort-ranking via a dashboard, though a large majority (91%) preferred that their ranking not be made available to other students. Students who were highly motivated to study were more likely to wish to have their ranking made available via dashboards. Those students who viewed a dashboard showing them as highly ranked relative to the unit average for an assignment were significantly more likely to be more motivated to study in this unit than those who were shown to be ranked well below the average.
Recommendations for Practitioners	Although students were generally in favor of their cohort ranking being made available using dashboards, universities should proceed with caution when implementing these student-facing dashboards because of the potential for demotivating students.
Recommendations for Researchers	Further investigation of the reasons why students do not wish to have their rankings made available via dashboards is needed.
Impact on Society	This research contributes to the body of knowledge regarding student motivation and its relationship with student-facing learning analytics dashboards.
Future Research	Given the complexity of the issues investigated, more research is needed in this area.
Keywords	learning analytics dashboards, student motivation

INTRODUCTION

Learning Analytics (LA) has been broadly defined as "...the measurement, collection, analysis, and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" (Siemens & Gasevic, 2012, p. 1). In pursuing these objectives, there are a variety of stakeholders in LA including institutions, academics and students, each of whom have different perspectives on, and requirements of, LA. The focus of this paper is on students as stakeholders in LA.

One way of presenting LA data to students is through the use of LA Dashboards (LADs). LADs have been defined as, "a single display that aggregates different indicators about learner(s), learning process(es) and/or learning context(s) into one or multiple visualizations" (Schwendimann et al., 2017, p.37). While there has been a focus on the use of LADs for and by academics to inform their teaching, there has not been as much exploration of the use of *student-facing* LADs (Bodily & Verbert, 2017; Teasley, 2017), nor on the effect students believe the information provided by these LADs will have on their motivation to study.

Given the important role that academic motivation plays in academic performance (e.g., Abeysekera & Dawson, 2015), understanding more about student-facing LADs and academic motivation has the potential to improve outcomes for students. Therefore, the aim of the project described in this paper is to explore the perceptions of information technology (IT) students about student-facing LADs that display student ranking information and to investigate how students perceive that their academic motivation would be influenced by the use of dashboards that display their performance relative to other students.

LITERATURE REVIEW

Research into the relationship between students' motivation and outcomes has been discussed at length elsewhere (e.g., Abeysekera & Dawson, 2015) and has demonstrated that students' motivation has a significant influence on "their performance, satisfaction, and well-being" (p.8).

Similarly, LA has received much attention in a broad range of contexts in the literature, though regardless of the context, the purpose of LA remains the enhancement of learning and teaching outcomes through the collection, analysis and presentation of data about students gathered from their engagement with the institution and the learning environment (e.g., West et al., 2016).

One way in which student performance data and analyses can be presented to stakeholders is through the use of dashboards, or, as they have been referred to more specifically in this context, LADs (Verbert, Duval, Klerkx, Govaerts, & Santos, 2013). LADs use one or several visualizations to provide the stakeholder with an overview of some aspect of the learning process (Schwendimann et al., 2017). In contrast to the more traditional methods of provision of feedback to students, LADs can provide a visual representation of the student's performance and, possibly, of how their performance compares with that of their peers (Teasley, 2017). This allows "students to view their performance and engagement" (Roberts, Howell, & Seaman, 2017, p. 318) with the intention of increasing their self-reflection and self-awareness, in order to "motivate learning and improve learning outcomes and retention" (p.318). They have also been used to assist in the provision of advice to students from student advisors (Charleer, Moere, Klerkx, Verbert, & De Laet, 2018).

The use of student-facing LADs has received less attention in the literature than the use of LADs by and for other stakeholders such as teachers (e.g., Jivet, Scheffel, Drachsler, & Specht, 2017), where LADs have been employed to encourage reflection on the teachers' own teaching efficacy and to assist with the identification of at-risk students (Verbert et al., 2013). The results of research into students' acceptance of student-facing LADs has been mixed. Park and Jo (2015) investigated the use of a LAD that reported to students on their engagement with the LMS based on system access log data. They found that while there was no impact on students' learning outcomes, students liked the idea of comparing their engagement with that of their peers. Domínguez et al. (2013) suggested that while leaderboards of students' performance could serve to motivate students because of the instant, public recognition of their work, they could also be discouraging for students who did not wish to compete with their classmates. The impact of ranking of student performance has also been explored in the context of gamification; for example, Christy and Fox (2014) found that while this can have a positive impact on some students, there may also be "unexpected negative influences" (p.75). They reported that these negative consequences could include reduced motivation. Jivet et al. (2017) suggested that competition with peers is not necessarily beneficial to the learning process, and that, "the design of LA dashboards needs better grounding in learning sciences" (p. 95) if LADs are to successfully encourage students' awareness and self-reflection.

Taking the student perspective into account, Reimers and Neovesky (2015) found that while nearly all students they surveyed wanted to see their results online, almost half did not wish to compare their performance with other students. Similarly, a study by Roberts et al., (2017) found that students were divided about whether comparative results should be made available, and if so whether or not they should be anonymous. Aguilar (2016) reported that rankings in LADs evoked a large range of responses from increasing motivation to disheartening students to the extent that they would prefer to withdraw from their studies than try harder. In contrast with these findings, Fritz (2011) found that students were more likely to seek help if they were comparing their own performance with an aggregation of that of their peers.

The reasons for students' different perceptions of the value of student-facing LADs have been explored in several studies. Teasley (2017) examined how students' reactions to LADs were affected by prior academic performance and discovered that most students found the dashboard visualization informative, but that students receiving feedback that was consistent with their previous grades found the dashboard more helpful than those who received feedback that was inconsistent with their previous grades. Christy and Fox (2014) found that the negative impacts of ranking students on student motivation that they identified can result from stereotype threat (fulfillment of negative stereotype, in this context, a lowly-ranked student experiencing a lower level of motivation to improve their

ranking) and upward social comparisons (where the lower-ranked student experiences negative affect as a result of comparison with higher-ranked students).

In an educational context, student motivation has been shown to have an influence on students’ satisfaction and well-being (Abeysekera & Dawson, 2015) and on their academic performance (Abeysekera & Dawson, 2015; Lonn, Aguilar, & Teasley, 2015). Given that Reimers and Neovesky (2015) argue that successful LAD use by students requires self-directedness, critical reflection and analytical skill, academic motivation might be important in how students engage with LADs and how this engagement influences students’ subsequent motivation with the units they are studying and hence potentially their academic performance.

METHOD

The participants in this study were students who were enrolled in IT courses at an Australian university. All 1637 IT students on the three campuses of the university were emailed and invited to complete a short anonymous online questionnaire.

The questionnaire was created in Qualtrics. The first part contained definitions of learning analytics and student-facing dashboards and information about the research project. Informed consent to participate was then provided by clicking on a consent button after reading this information.

The questionnaire then collected information about General Academic Motivation. General Academic Motivation is defined in this research as the value that IT students place on participation in, and completion of, a university degree. As shown in Table 1, General Academic Motivation was measured with five items that were measured on a 5-point Likert scale from 1 ‘Strongly Disagree’ to 5 ‘Strongly Agree’. Four items were from Wohn and LaRose (2014), and one additional item from Visser-Wijnveen, van der Rijst, and van Driel (2016) was added to capture academic motivation related more specifically to IT education. Item values from negatively worded items were reversed and reliability was assessed using Cronbach’s alpha, giving a reliability of 0.611. Values of greater than 0.6 are generally considered to be acceptable for exploratory research (Nunnally & Bernstein, 1994, pp. 248-292). A General Academic Motivation score was calculated for each participant as the average of their responses to these items.

Table 1. Items used to measure General Academic Motivation

Item	Source
I enjoy academic work	Wohn and LaRose (2014)
I am not motivated to study	Wohn and LaRose (2014)
I doubt the value of a university degree	Wohn and LaRose (2014)
Most of my interests are not related to coursework	Wohn and LaRose (2014)
I am inspired to learn more about information technology	Visser-Wijnveen et al. (2016)

After further explanation of the provision of learning analytics information to students via dashboards, overall opinions about the provision of students rankings in dashboards were sought via two questions. First, students were asked whether they would like to see performance rankings relative to the class made available or not. Then they were asked, if they were to be made available, would they prefer them to be visible only to the individual student or to the whole class.

For the next question, participants in the study were randomly assigned to one of two groups and presented with a dashboard for a hypothetical unit that displayed their performance in an assignment as either significantly lower than the class average or significantly higher than the class average (see the Appendix for images of these LADs). Student perceptions of how this would impact on their motivation to study this hypothetical unit (Impact on Unit Motivation) were then measured with one item that was measured on a 5-point scale from 1 ‘Strongly Demotivated’ to 5 ‘Strongly Motivated’.

Background information was also collected on: age, gender, location of study (Australia, Singapore or Dubai), level of study (undergraduate or postgraduate), number of years studying at university and self-reported previous average academic performance across their studies. Previous average academic performance was recorded using grading scheme of the university in which the research was conducted: High Distinction (HD) 80%-100%, Distinction (D) 70%-79%, Credit (C) 60%-69%, Pass (P) 50%-59%, and Fail (N) less than 50%.

RESULTS AND DISCUSSION

A total of 237 responses were received, giving a response rate of 14.5%. However, 16 responses were excluded because of missing data, leaving 221 valid responses for analysis. The participants were 29.0% females and 70.1% males, which is consistent with the gender distribution of students in the IT courses surveyed, and slightly higher than that of Australian IT students in general (Koppi et al., 2013). This higher proportion of female respondents is because female students in Singapore are more likely to study IT than are females in Australia (MacDonald, Wong, & Sheldon, 2015) and 48.4% of the sample were from Singapore. Table 2 provides further background information about the participants, and indicates that most of the participants were under 25 (50.2%), with very few 35 years old or over (8.3%). The participants were predominantly studying at undergraduate level (84.8%).

Table 2. Background information about the participants

	FREQUENCY
AGE	
Up to 24	50.2%
25-34	41.5%
35 and above	8.3%
CAMPUS	
Australia	42.8%
Singapore	48.4%
Dubai	8.8%
STUDY LEVEL	
Undergraduate	84.8%
Postgraduate	15.2%

Students were asked if they would like to see performance rankings made available in student-facing LMS dashboards. The results showed that the majority of IT students who were surveyed would like their ranking made available via dashboards (63.3%), with only 36.7% preferring not to have this information. The proportion of students wishing to be able to compare their performance with that of other students is higher than the proportion reported in Reimers and Neovesky (2015). Their research involved German and Austrian students across a broad range of courses. The difference may reflect this, or may be due to increased acceptance of the potential value of student-facing learning analytics as it has become more available in other institutions. Many of the students who did not wish to know their performance rankings commented that it would add stress or demotivate them, for example: 'It stresses me out and makes me feel disappointed with myself if I am not on top' and 'It demoralizes people'. However others commented on the motivation benefit, as in the following comment: 'A ranking system would motivate me to push myself to achieve higher grades'. This wide range of responses was also reported by Aguilar (2016).

Despite the strong interest in having access to performance ranking information, the vast majority of IT students (91.0%) preferred that their personal ranking not be visible to other students, with only 9.0% wishing to share this information. This finding is consistent with qualitative analysis of comments from the participants in a study by Roberts et al. (2017). Comments from IT students who did

not wish others to see their rankings included ‘It just adds unnecessary stress to the students’ and ‘I think it would become embarrassing if others could see those who are in the lowest rank’. Many of those who wished to allow their rankings to be visible to other students appeared to believe it would motivate them more, with comments such as ‘Motivate me to get a better score to avoid embarrassment’ and ‘To motivate non performers to strive harder to achieve better results and also to performers to excel.’ Several students also commented that ‘It will be discussed regardless and will put everyone in the same circumstance’.

One possible reason for the wide range of different perceptions of student-facing LADs is differences in General Academic Motivation. Academic motivation has been shown to be associated with use of supplementary learning tools such as web-videoconferences (Giesbers, Rienties, Tempelaar, & Gijssels, 2013). Therefore, it could be speculated that students with high levels of General Academic Motivation are more likely to embrace both the availability of rankings and lack of anonymity of these rankings. That is, IT students who place more value on participation in, and completion of, their degree should value this additional information. They may also be more comfortable with sharing it.

The possible role of General Academic Motivation in influencing whether students would like to have their ranking in assessments provided to them via dashboards, and whether it should be visible to other students was explored using independent sample t-tests (see Table 3). The mean level of General Academic Motivation was found to be significantly higher for students who wished to have access to dashboards that display student rankings (3.82 vs 3.62, $t(219)=2.38$, $p = 0.018$). That is, students who value more highly their participation in, and completion of, a university degree are more likely to wish to have ranking made available via dashboards. Although the General Academic Motivation of the participants who would like their ranking visible was higher on average than that of those who would like only themselves to be able to view it (3.95 vs 3.72), unsurprisingly the difference was not significant given the small proportion of those who wished it to be visible to all students ($t(216)=-1.60$, $p = 0.110$).

Table 3. Comparison of General Academic Motivation for those with different preferences about use of ranking dashboards

	YES			NO			SIGN. DIFF?
	N	MEAN GENERAL ACADEMIC MOTIVATION	SD	N	MEAN GENERAL ACADEMIC MOTIVATION	SD	
Would like rankings available?	140	3.82	0.62	81	3.62	0.55	✓
Prefer rankings visible to all?	20	3.95	0.55	198	3.72	0.61	✗

Students’ previous academic performance might also be expected to influence whether they would like to have their ranking in assessments provided to them via dashboards, and whether it should be visible to other students. This was explored by first categorizing the participants’ self-reported academic performance as either High or Average, where a previous average of HD or D (80 - 100%) was considered to be High performance (47.7% of respondents) and an average of C or P (50% - 69%) was categorized as Average performance. (52.3% of respondents). As only 3 participants (1.4%) indicated that their performance was at fail level (N) they were not included in this analysis. Differences in whether students would like to have their ranking in assessments provided to them via dashboards, and whether it should be visible to other students were explored using chi-square tests but no significant differences were found. In terms of availability of rankings, 64.7% of high performing students wanted them to be available compared to 60.7% of students with average academic performance (χ^2 ($N=214$) = 0.363; $p = 0.547$). There was also no significant difference in terms of

whether high performing and average performing students wished to have rankings visible to all (χ^2 (N=214) = 0.363; $p = 0.547$), with 88.2% of high performing students wanting to keep their ranking private and 92.9% of average performing students. Whilst the lack of significant difference in visibility preference was not surprising given the low numbers of students overall who wished them to be more widely visible, the lack of difference in whether ranks are provided at all was, especially given the findings about the role of academic motivation.

General Academic Motivation is a broad characteristic of learners. Students’ motivation to study individual units in their course will vary and be impacted by a variety of factors such as quality of teaching (Lonn et al., 2015). To explore whether being informed of assessment rankings that are particularly high or low could have a differential impact on ongoing motivation to perform in the unit being studied, Impact on Unit Motivation of those shown a low ranking relative to the class average were compared to those of students who were shown a high ranking in the hypothetical unit. Of those who were shown a high ranking, 66.4% believed that it would be motivating, 26.4% did not expect it to impact on their motivation and 7.3% believe it would reduce their motivation to perform in this unit. In the group that were shown a low performance ranking, 52.4% believed that it would be motivating, 15.5% did not expect it to impact on their motivation and 32.0% believe it would reduce their motivation to perform in this unit. It was interesting to note that regardless of whether the ranking was high or low, the majority of students believed that having this information would help motivate them to study the unit.

The significance of the differences between two groups was tested using an independent sample t-test (see Table 4). Those students who viewed a dashboard showing them as highly ranked relative to the unit average for an assignment were significantly more likely to be more motivated to study in this unit (3.88 vs 2.23, $t(186.3) = 4.04$, $p < 0.01$). Understanding this differential effect and catering for it may improve student motivation going forward, and hence performance outcomes. It should be noted, though, that only one item was used to measure Impact on Unit Motivation; future research could develop and validate a multi-item measure.

Table 4. Comparison of Impact on Unit Motivation between those receiving high and low rankings

	HIGH RANK			LOW RANK			SIGN. DIFF?
	N	MEAN	SD	N	MEAN	SD	
Impact on Unit Motivation	110	3.88	0.97	103	3.23	1.33	✓

CONCLUSION

Previous research suggests that an important determinant of students’ performance in their studies is their motivation to study. The research reported in this study was undertaken to investigate the perceptions of IT students about student-facing LADs that display student ranking information and to explore how students perceive that their motivation to study would be influenced by the use of these dashboards.

The findings related to the desire of students to see their ranking in their cohort suggest that while a clear majority want this option, a significant portion do not, primarily for reasons associated with added stress or de-motivation. More than 90% of the students in this study preferred that if this ranking was to be made available, it should remain private.

Differential effects of good and poor ranking on students were also observed. Those students who viewed a dashboard showing them as highly ranked relative to the average for an assignment were significantly more likely to be more motivated to study in this unit than those who were shown to be ranked well below the average. Given the findings reported here, and taking the mixed results report-

ed in the previous literature into account, it would seem that universities should proceed with caution when implementing student-facing LADs which incorporate cohort rankings of students. The positive outcomes for some students from implementation of LADs would need to be viewed in the context of the potentially negative outcomes for some others, and future research is needed to understand potential demotivating factors associated with student-facing LADs. Teasley (2017) recommended against the design of a 'one-size-fits-all' dashboard for these reasons. In order to provide the best outcomes in terms of student motivation, it may be that providing the opportunity for students to become active participants in the LAD design process (as highlighted by Roberts et al. (2017)) may improve acceptance. Also, allowing for the individual student to choose if they see this information and who else sees it may mitigate the potential negative impact.

Further research is needed to more fully understand how to best accommodate the various needs of students in order to provide them with performance data that can be both useful to, and motivating for, them.

REFERENCES

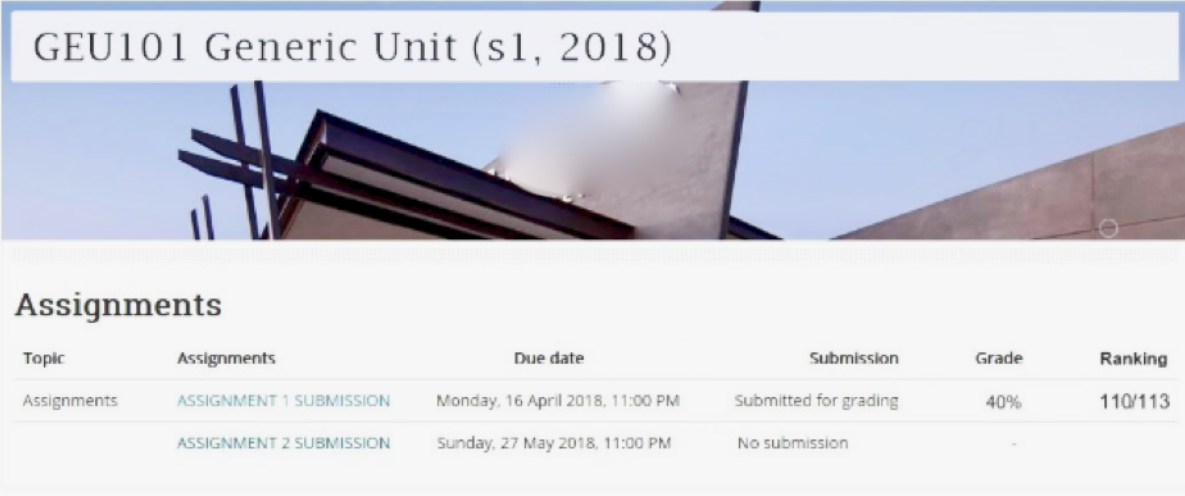
- Abeyssekera, L., & Dawson, P. (2015). Motivation and cognitive load in the flipped classroom: Definition, rationale and a call for research. *Higher Education Research & Development*, 34(1), 1-14. <https://doi.org/10.1080/07294360.2014.934336>
- Aguilar, S. J. (2016). *Perceived motivational affordances: Capturing and measuring students' sense-making around visualizations of their academic achievement information*. PhD Dissertation. University of Michigan, USA. Retrieved from https://deepblue.lib.umich.edu/bitstream/handle/2027.42/133441/aguilars_1.pdf
- Bodily, R., & Verbert, K. (2017). Trends and issues in student-facing learning analytics reporting systems research. In *Proceedings of the Seventh International Learning Analytics & Knowledge Conference* (pp. 309-318). ACM. <https://doi.org/10.1145/3027385.3027403>
- Charleer, S., Moere, A. V., Klerkx, J., Verbert, K., & De Laet, T. (2018). Learning analytics dashboards to support adviser-student dialogue. *IEEE Transactions on Learning Technologies*, 11(3), 389-399. <https://doi.org/10.1109/TLT.2017.2720670>
- Christy, K. R., & Fox, J. (2014). Leaderboards in a virtual classroom: A test of stereotype threat and social comparison explanations for women's math performance. *Computers & Education*, 78, 66-77. <https://doi.org/10.1016/j.compedu.2014.05.005>
- DomíNquez, A., Saenz-De-Navarrete, J., De-Marcos, L., FernáNdez-Sanz, L., PagéS, C., & MartíNez-HerráIz, J.-J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education*, 63, 380-392. <https://doi.org/10.1016/j.compedu.2012.12.020>
- Fritz, J. (2011). Classroom walls that talk: Using online course activity data of successful students to raise self-awareness of underperforming peers. *The Internet and Higher Education*, 14(2), 89-97. <https://doi.org/10.1016/j.iheduc.2010.07.007>
- Giesbers, B., Rienties, B., Tempelaar, D., & Gijsselaers, W. (2013). Investigating the relations between motivation, tool use, participation, and performance in an e-learning course using web-videoconferencing. *Computers in Human Behavior*, 29(1), 285-292. <https://doi.org/10.1016/j.chb.2012.09.005>
- Jivet, I., Scheffel, M., Drachslar, H., & Specht, M. (2017). Awareness is not enough: Pitfalls of learning analytics dashboards in the educational practice. In *European Conference on Technology Enhanced Learning: Data Driven Approaches in Digital Education* (pp 82-96). https://doi.org/10.1007/978-3-319-66610-5_7
- Koppi, T., Ogunbona, P., Armarego, J., Bailes, P., Hyland, P., McGill, T., Naghdy, F., Naghdy, G., Pilgrim, C., & Roberts, M. (2013). Addressing ICT curriculum recommendations from surveys of academics, workplace graduates and employers. Australian Learning & Teaching Council Retrieved from <http://www.acdict.edu.au/documents/ALTCReportEditedfinal3.pdf>
- Lonn, S., Aguilar, S. J., & Teasley, S. D. (2015). Investigating student motivation in the context of a learning analytics intervention during a summer bridge program. *Computers in Human Behavior*, 47, 90-97. <https://doi.org/10.1016/j.chb.2014.07.013>

- MacDonald, E., Wong, R., & Sheldon, D. (2015). Gender profile: Singapore. *Commonwealth of Learning: Learning for Sustainable Development*. Retrieved from <http://oasis.col.org/handle/11599/927>
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory* (3rd ed.). New York: McGraw-Hill.
- Park, Y., & Jo, I.-H. (2015). Development of the learning analytics dashboard to support students' learning performance. *Journal of Universal Computer Science*, 21(1), 110-133. Retrieved from <https://dspace.ewha.ac.kr/bitstream/2015.oak/230480/1/001.pdf>
- Reimers, G., & Neovesky, A. (2015). Student focused dashboards. In *Proceedings of the 7th International Conference on Computer Supported Education* (pp. 399-404). Retrieved from <https://pdfs.semanticscholar.org/9658/a0a0bcabb0e7f06fdc4ee9d0af3d497a5399.pdf>
- Roberts, L. D., Howell, J. A., & Seaman, K. (2017). Give me a customizable dashboard: Personalized learning analytics dashboards in higher education. *Technology, Knowledge and Learning*, 22(3), 317-333. <https://doi.org/10.1007/s10758-017-9316-1>
- Schwendimann, B. A., Rodriguez-Triana, M. J., Vozniuk, A., Prieto, L. P., Boroujeni, M. S., Holzer, A., Gillet, D., & Dillenbourg, P. (2017). Perceiving learning at a glance: A systematic literature review of learning dashboard research. *IEEE Transactions on Learning Technologies*, 10(1), 30-41. <https://doi.org/10.1109/TLT.2016.2599522>
- Siemens, G., & Gasevic, D. (2012). Guest editorial – Learning and knowledge analytics. *Educational Technology & Society*, 15(3), 1-2. Retrieved from https://www.j-ets.net/ets/journals/15_3/1.pdf
- Teasley, S. D. (2017). Student facing dashboards: One size fits all? *Technology, Knowledge and Learning*, 22(3), 377-384. <https://doi.org/10.1007/s10758-017-9314-3>
- Verbert, K., Duval, E., Klerkx, J., Govaerts, S., & Santos, J. L. (2013). Learning analytics dashboard applications. *American Behavioral Scientist*, 57(10), 1500-1509. <https://doi.org/10.1177/0002764213479363>
- Visser-Wijnveen, G. J., van der Rijst, R. M., & van Driel, J. H. (2016). A questionnaire to capture students' perceptions of research integration in their courses. *Higher Education*, 71(4), 473-488. <https://doi.org/10.1007/s10734-015-9918-2>
- West, D., Huijser, H., Heath, D., Lizzio, A., Toohey, D., Miles, C., Searle, B., & Bronnimann, J. (2016). Higher education teachers' experiences with learning analytics in relation to student retention. *Australasian Journal of Educational Technology*, 32(5), 48-60. <https://doi.org/10.14742/ajet.3435>
- Wohn, D. Y., & LaRose, R. (2014). Effects of loneliness and differential usage of Facebook on college adjustment of first-year students. *Computers & Education*, 76, 158-167. <https://doi.org/10.1016/j.compedu.2014.03.018>

APPENDIX

Hypothetical unit dashboards showing significantly higher or lower than average class performance in an assessment.

High Ranking example

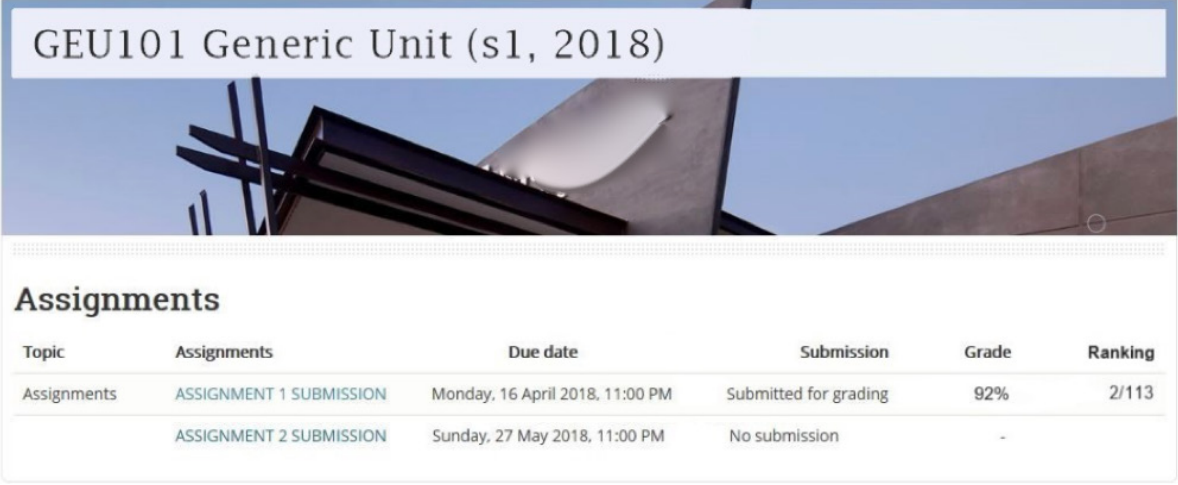


GEU101 Generic Unit (s1, 2018)

Assignments

Topic	Assignments	Due date	Submission	Grade	Ranking
Assignments	ASSIGNMENT 1 SUBMISSION	Monday, 16 April 2018, 11:00 PM	Submitted for grading	40%	110/113
	ASSIGNMENT 2 SUBMISSION	Sunday, 27 May 2018, 11:00 PM	No submission	-	

Low Ranking example



GEU101 Generic Unit (s1, 2018)

Assignments

Topic	Assignments	Due date	Submission	Grade	Ranking
Assignments	ASSIGNMENT 1 SUBMISSION	Monday, 16 April 2018, 11:00 PM	Submitted for grading	92%	2/113
	ASSIGNMENT 2 SUBMISSION	Sunday, 27 May 2018, 11:00 PM	No submission	-	

BIOGRAPHIES



Danny Toohey lectures at Murdoch University in the Discipline of Information Technology, Mathematics and Statistics in the areas of databases and business analytics. He has been at Murdoch since 2000 and is currently the Academic Chair for Cybersecurity and Forensics. Danny has been nominated for various teaching excellence awards and was awarded the Vice Chancellor's Citation for Excellence in Enhancing Learning in 2013, and a national Office of Learning and Teaching (OLT) Citation for Outstanding Contribution to Student Learning in 2014.



Tanya McGill is a Professor in Information Technology at Murdoch University in Western Australia. Her major research interests include ICT education, information security, and technology adoption. Her work has appeared in various journals including *Computers and Human Behavior*, *Computers & Education*, *Decision Support Systems*, *Journal of Computer Assisted Learning*, and *Behaviour and Information Technology*.



Chad Berkelaar is a student at Murdoch University. He is studying Computer Science and Business Information Systems. He is also working in the manufacturing industry as an enterprise architect and has recently launched his company, True Sight Technology, focussing on business Information Technology solutions. He is also contributing to the development of a Learning Management System for a software development company.



Anath Kadekodi is a graduate of Murdoch University. He received a Bachelor of Science in Computer Science in 2018 and is currently working as a data scientist.



Dominika Kaminska is a student at Murdoch University. She is studying Business Information Systems.



Melisa Lianto is a graduate of Murdoch University. She received a Bachelor of Science in Business Information Systems in 2018.



Nathan Power is a student at Murdoch University. He is studying Computer Science and Business Information Systems.