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Shane P. Dawson
University of Wollongong, sdawson@uow.edu.au

Leah Macfadyen
University of British Columbia, Canada

Lori Lockyer
University of Wollongong, lori.lockyer@mq.edu.au

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RESEARCH ONLINE

Learning or performance: Predicting drivers of student motivation

Shane Dawson
Graduate School of Medicine
University of Wollongong, Australia
Leah Macfadyen
Science Centre for Learning and Teaching,
University of British Columbia, Canada
Lori Lockyer
Faculty of Education
University of Wollongong, Australia

There is substantial research demonstrating that a student's motivation for learning can be largely explained in terms of their preferred achievement orientation. This paper explores a case study investigating ICT derived lead indicators of student achievement orientation, and therefore underlying motivations. The study incorporated Tan's (2009) research on learning dispositions to quantify student achievement orientations. These findings were then correlated with student LMS data to identify if patterns of online behaviour are indicative of the observed achievement orientation scores. The results suggest that there is a significant correlation between student achievement orientation and participation in discussion forums. Students reporting a strong learning orientation were more inclined to utilise the unit's 'learning forum'. Conversely, students tending towards a performance orientation were more prone to use the 'administration forum'. The findings and data harvesting methodology employed, represent a novel, scalable and automated approach for rapidly identifying the drivers of student learning motivation.

Keywords: learning orientation, data mining, learning design, academic analytics

Introduction

The integration of online resources and communication tools for supporting student learning has become commonplace in higher education (HE) practice. Within the Australian HE context, for example, all universities have now (to varying degrees) adopted an institutional learning management system (LMS) for the provision of distance education and for further supplementing on-campus learning. This widespread adoption and easy access to Information and Communication Technology (ICT) has raised student expectations regarding the level of ICT usage by contemporary educators. It is now almost inconceivable for instructors to not utilise at least a smattering of the many ICT tools readily available for enhancing learning activities and promoting student engagement.

A key motivation driving institutional ICT adoption is the promotion of more flexible modes of student engagement with learning content and interactions with peers. The flexible affordances associated with ICTs present an opportunity for HE institutions to deliver and engage with new student markets (such as: international cohorts and domestic students unable to re-locate to urban or regional university communities) whilst also further supplementing on-campus learning and teaching activities (Gomes & Murphy, 2003; Mazzarol, Soutar, & Seng, 2003). The growing necessity for educators to further supplement and provide a more technically enhanced learning experience is reflected in part in the reduced levels of student attendance reported for on-campus teaching units (Riffell & Sibley, 2004).

While it could be argued that the flexible affordances associated with education-based technologies has supported and encouraged reduced rates of student attendance, other issues surrounding time demands also influence student motivation and ability to attend on-campus learning activities. For instance, the

cost of HE has also been identified as a contributing factor that can heavily influence student on-campus attendance. As HE costs increase, it is anticipated that the mounting financial burden to students will, in part, contribute to an even greater percentage of students undertaking part-time employment (Allen & Seaman, 2008). In their extensive study of Australian first year students, Krause *et al.* (2005) noted that part-time employed students were more inclined to forgo classes if learning content was made available via alternate means. In essence, contemporary students are increasingly being forced to balance their financial demands with their learning needs. For the financially-challenged, time-poor student, attendance at a didactic lecture may be time better spent undertaking paid work.

The need for students to supplement their income through part time employment is an obvious factor contributing to student on-campus participation. Practically, there are limited strategies an individual instructor can implement to alter this educational/ financial challenge. However, one area an individual instructor does have greater control is in the quality of their teaching practice, whether face to face or online. Numerous authors have highlighted that student motivation and attendance are heavily impacted upon by the quality of the pedagogical model adopted and the level of student engagement in both the discipline-based content and social and academic networks (Friedman, Rodriguez, & McComb, 2001; Light, 2001). In this context, the implementation of flexible modalities for study emphasises the necessity for developing an engaging and personally relevant learning environment. This is no easy task. Despite the high levels of adoption of ICTs, there remains much to learn about effective learning design in order to motivate students in their online learning endeavours.

Increased rates of online learning: Increased rates of attrition

While access to and development of online courses is increasingly easy, the rates of student attrition associated with such courses are also on the rise. Reported rates of attrition for online and distance courses are variable, but range from 20 – 50% higher than attrition rates seen for on-campus instruction (Carr, 2000). Clearly such attrition rates are of concern. Not only do they impact the return on investment of course expenditure and the overall perceived quality of the course and institution, they also represent a mismatch between students' educational goals and learning design. Reducing student attrition has therefore both long- and short-term educational, economic and quality imperatives.

The primary issue confronting online and distance education providers is how to reduce student attrition whilst maintaining course quality. If contemporary students need and even expect access to flexible modes of learning, why are dropout rates so high? Muilenburg and Berge (2005) and Hodges (2004) argue that attrition rates can largely be attributed to poor levels of student motivation – either the lack of initial motivation for students to engage in learning tasks, or the inability to sustain sufficient motivation levels for the duration of the course. In a similar vein, Carol Dweck (2000) has demonstrated a relationship between student motivation and achievement orientation, and ultimately with academic success. Through this work, Dweck identified two classes of 'achievement orientations' – *learning goals* and *performance goals*. *Learning goals* reflect a student's desire to acquire new knowledge and skills. Conversely, *performance goals* reflect a greater focus on confirming or demonstrating ability. In her book "*Self-Theories*," Dweck (2000) argues that current educational practices and values reinforce and reward the dominance of performance goals at the expense of learning. This is well exemplified in traditional approaches to academic assessment measures and student rankings (e.g. awarding grades such as distinction, credit, pass, fail). This premise is also reflected in the common place beliefs and expressions adopted amongst educators. For example, commonly heard phrases such as "students will only engage in tasks if they are assessed", and that "one should indicate the value of an activity by assessing it" emphasise the dominance of the performance orientation. In other words, the performance orientation is repeatedly given greater weight, and accepted as the logical motivator of student effort. For this reason, Dweck argues that as a student progresses through the education system, there is a shift in focus from individual construction of self-motivating learning goals to one of demonstrating and re-validating content knowledge and understanding. Moore's (2003) study on class attendance of first year science students further hints at the dominance of the performance oriented culture in higher education. Moore noted that approximately 80% of first-year students believed that their mere attendance at class lectures should directly contribute to their overall grade. Without dismissing the need for and value of some measures of academic achievement, we argue here that the rhetoric and act of assessment often focuses more on representing achievement then on progressing student learning.

Exploring students' achievement orientations

If individual achievement orientations influence student motivation and academic success, how can educators uncover the dominant achievement orientations of their students, with the goal of better

designing for and engaging with all learners? While the response to this question is obviously complex and multi-faceted, recent advances in academic analytics have the potential to provide additional insights into student learning behaviour and network relationships. For instance, Macfadyen and Dawson (2009) have demonstrated the potential pedagogical advantages associated with harvesting student interaction data from institutional Learning Management Systems (LMS) such as BlackBoard or Desire2Learn. The authors noted that LMS tracking data can provide scalable and automated predictors of student academic performance. This research approach to data mining student interactions is gathering increasing momentum and to date, has demonstrated that 1) online activity data is a significant indicator of student learning and performance and 2) informal measures of student learning can be obtained unobtrusively and without the need for labour intensive post hoc reflective surveys (see also: Campbell, De Blois, & Oblinger, 2007; Dawson, 2008, 2009; Morris, Finnegan, & Wu, 2005).

Building on this earlier research in the area of academic analytics, the pilot study reported here aimed to investigate the relationship between a student's achievement orientation (Dweck, 2000) and patterns of online behaviour. In so doing, the study sought first to validate Tan's (2009) learning dispositions survey and second, to determine the capacity of student online interaction data to indicate student achievement orientation. Specifically, the study addresses the following research questions:

- What is the relationship between a student's achievement orientation and pattern of online learning behaviour?
- What is the relationship between student discussion forum posting preference and self-reported achievement orientation?

Methodology

Study overview

The study participants included all first year enrolled medical students at the Graduate School of Medicine (GSM), University of Wollongong (UOW), Australia. The sample size of the respondents was $N = 76$, representing 88% of the total population. Generic demographic data were garnered from the study participants, indicating that females comprised 51% ($n = 39$) and males 49% ($n = 38$) of the sampled population. The mean age of the respondents was 25.3 ($SD = 4.54$) with males observed to be slightly older than the female sub-population with a mean age of 26.6 ($SD = 5.00$) and 24.18 ($SD = 3.75$) respectively.

The GSM course is a four year program with a heavy dependence on ICT mediated learning activities. These activities are primarily delivered via the institutional Learning Management System (LMS) - BlackBoard Vista (BB Vista), formerly known as WebCT Vista. As students progress through the GSM curriculum, they spend increasing amounts of time in placements within off-campus community health centres. There is a corresponding increase in the level and sophistication of the online mediated learning activities, and importance of staff and student communication. The early stages of the course can be roughly characterised as a blended model incorporating both on-campus lectures and tutorials with online learning activities and discussions. As the course progresses this model transitions towards a pedagogical model heavily incorporating work integrated learning and fully online learning activities.

Extracting online activity data
User activity data was extracted from the online learning environment (BB Vista) using the application's in-built student tracking tool. Data was extracted over a nine week period, from the start of the 2009 term to the completion of the first teaching session - "*Introduction to Medical Science*". The data variables extracted per student included time online, forum postings, content, and files viewed.

Online learning environment and discussion forum activity
In addition to examining the degree of student online engagement, the study also investigated which type of forum discussion (i.e., related to learning content or processes) individual students primarily participated in. The design of the GSM online environment offers minimal optional user pathways as the delivery of content and independent learning activities are largely provided in a time release format. This design was adopted to emulate real world practice. For example, as students investigate specific health cases they may request general health tests such as blood analyses, x-rays, biopsies etc. to assist in developing a diagnosis. This requested information is delayed to provide a more authentic learning experience comparable to current professional practice. (Blood tests, for example, may take 24hrs for results to be returned). While the case content is provided online the students discuss, debate and decide on courses of action during on-campus small group tutorials. In this context, student choice regarding on

online navigational pathways are largely dictated by the course design and associated mode of delivery. However, students can participate in alternate discussion forums which focus on either learning of the course content, or on procedural clarifications related to the learning tasks. These two forums have been titled the *"Learning and sharing"* forum and *"Administration*" forum, respectively.

The *Learning and sharing* forum was established to provide students the opportunity to engage with peers and staff regarding course content, areas of interest and to share additional learning resources. For example, discussions have generally commenced with the current health case studied and then diversified to focus on more specific medical and science agendas such as a better understanding of the science underpinning the diagnosis of lymphoma, or the physics associated with the interpretation of ECGs. The following student postings illustrate the types of discussions taking place:

> Re: Prolonged vomiting leads to...
> Could it not be metabolic acidosis? I'm curious because after PROLONGED vomiting, would you not be energy deficient, leading to the usage of other energy stores besides glycogen, developing ketoacidosis? I feel like I heard in a lecture there is only 200 grams of glycogen stored in your body - not nearly enough for the day...soooo...I guess the question is, define "prolonged". No? Yes? Or is this hypothesis out of left field…
>
> Does anyone know the relationship between oestrogen, cholesterol, bile salts and liver failure? Spider naevi are often present with liver failure thought to be related to high oestrogen. Does oestrogen determine the balance between cholesterol excretion into blood vs bile? Women, tend to have gallstones and gall bladder problems. Men, tend to suffer more from high cholesterol. Just thinking. Have I missed something.

In contrast, the *Administration* forum provides students with an area for clarifying the process for completing specific learning/ assessment tasks or requesting technical support regarding access to on-campus delivered resources such as audio recorded lectures, and PowerPoint slides. The following postings exemplify the types of discussion undertaken in the Administration forum.

> Was wondering when the CBL for this fortnight is going up
>
> Hi, could you please post the wrap up slides for CVSR wks 1-2 and 7-8 please?

Learning dispositions survey

This study employed Tan's (2009) learning disposition survey in order to quantify student achievement orientations. Tan's (2009) survey comprises 42 self-report items ranked according to a Likert scale. While this study fully adopted Tan's survey, a small modification was made in attempt to enhance the instrument's overall validity and reliability. In this instance, a 1 – 7 Likert scale replaced the original 1 – 5 scale.

The Tan (2009) survey comprises five factors – learning goals (LG); performance goals (PG); personal innovativeness (PI); cognitive playfulness – creativity (CP-cr); and cognitive playfulness – curiosity (CP-cu). For the purposes of this pilot study the student achievement orientations (learning goals and performance goals) are the dominate focus of the results and subsequent discussion. The LG and PG constructs are quantified by calculating the aggregate Likert scores. Hence, individuals can present both a high LG score and a high PG score. In order to identify an individual's preference for either an LG or PG orientation, the aggregate scores for each factor were subtracted. That is to say, the PG aggregate score was subtracted from the LG aggregate score to provide a class ranking of relative LG orientation.

Survey validation
The administered self-report survey was validated using exploratory factor analysis (EFA). The survey was administered in hard copy to all students during an assigned classroom teaching period. The completed survey responses ($N = 76$) were then used to demonstrate the factorial validity of the adopted survey instrument. The item loadings observed in the EFA largely reflected those previously ascertained by Tan (2009). However, a small number of question items loaded across multiple constructs. These question items were subsequently excluded and the EFA repeated. The second iteration of factor analysis, demonstrated discreet item loadings ranging from 0.425 to 0.794 representing an acceptable level of convergent validity (Tabachnick & Fidell, 2001) (Table 1). The reduced question items loaded discreetly into the 5 factors described by Tan (2009) – 1) learning goal, 2) performance goal, 3) cognitive playfulness – curiosity, 4) cognitive playfulness – creativity and 5) personal innovativeness.

Table 1: Factor loadings for the learning dispositions survey

Question Items	Factors				
	LG	PG	PI	CP- cu	CP – cr
1	0.772				
2	0.750				
3	0.742				
4	0.791				
5	0.755				
6	0.539				
7	0.644				
8	0.425				
9		0.662			
10		0.671			
11		0.687			
12		0.524			
13		0.692			
14		0.659			
15		0.692			
16		0.619			
17			0.660		
18			0.794		
19			0.842		
20			0.835		
21			0.738		
22			0.716		
23				0.748	
24				0.759	
25				0.630	
26				0.590	
27				0.763	
28					0.597
29					0.495
30					0.625
31					0.783
32					0.765
33					0.544
34					0.450
35					0.467
36					0.569
37					0.698

LG: Learning Goal
PG: Performance Goal
PI: Personal Innovativeness
CP-cu: Cognitive Playfulness – curiosity
CP-cr: Cognitive Playfulness – creativity

Internal reliability
Cronbach's alpha was calculated to assess the internal reliability and consistency of the survey. For the social sciences an alpha value ≥ 0.70 generally represents satisfactory internal consistency and reliability. The survey adopted for this study demonstrated an overall Cronbach alpha of 0.751 suggesting an acceptable level of internal consistency. Table 2 summarises the Cronbach alpha calculated for each factor represented in the survey.

Table 2: Cronbach alpha calculations for the learning dispositions survey

	Factors				
Cronbach alpha	LG	PG	PI	CP-cu	CP-cr
	0.860	0.817	0.879	0.778	0.826

Statistical analyses
Data collected from the sampled cohort were analysed using the software package *SPSS for Windows* (Vers 15.0) incorporating descriptive statistics and a simple parametric correlation to ascertain the degree of relationship between the investigated variables. The reported statistical analyses were undertaken to investigate the relationship between online user interactions and student achievement orientations – learning or performance goals.

Results

Online learning behaviour

The data extracted from the online learning environment indicates that student usage of the system was relatively high among the sampled population. The average number of sessions online was 64.55 equating to approximately one session per day lasting around 20 minutes per session. Despite the first block of study in the Bachelor of Medicine Bachelor of Surgery (MBBS) degree at UOW incorporating a high level of on-campus learning activities, the results suggest that the cohort has still actively engaged with the available online resources. This is further evidenced in the number of forum posts and content and files viewed (Table 3). The results also demonstrate that the male sub group exceeded the female sub group in terms of the total time online, and number of sessions and content and files viewed. Conversely, the female population was the more discursive, posting a greater proportion of the total forum messages (Table 3).

Table 3: Mean scores for ICT data variables extracted from BlackBoard Vista

Variable	All students	Males	Females
Time online (seconds)	Mean = 69774.11 (*SD* = 30651.65)	Mean = 70761.68 (*SD* = 34815.85)	Mean = 68837.18 (*SD* = 26535.36)
Total Forum postings	Mean = 5.49 (*SD* = 6.17)	Mean = 4.73 (*SD* = 5.07)	Mean = 6.21 (*SD* =7.06)
Learning forum postings	Mean = 4.24 (*SD* = 4.9)	Mean = 3.84 (*SD* =4.17)	Mean = 4.62 (*SD* = 5.62)
Administration forum postings	Mean = 1.51 (*SD* = 2.69)	Mean = 1.03 (*SD* = 1.83)	Mean = 1.97 (*SD* = 3.26)
Sessions	Mean = 64.55 (*SD* = 22.17)	Mean = 65.89 (*SD* = 20.19)	Mean = 63.28 (*SD* = 24.10)
Content folders viewed	Mean = 452.63 (*SD* = 212.33)	Mean = 467.32 (*SD* = 216.68)	Mean = 438.69 (*SD* = 209.98)
Files viewed	Mean = 207.76 (*SD* = 97.56)	Mean = 213.38 (*SD* = 112.41)	Mean = 202.44 (*SD* = 82.18)

Table 4: Self -reported learning and performance goal scores

	Total	Males	Females
LG	Mean = 48.62 (*SD* = 5.14)	Mean = 48.16 (*SD* = 5.74)	Mean = 49.05 (*SD* = 4.54)
PG	Mean = 40.93 (*SD* = 7.11)	Mean = 39.46 (*SD* = 7.50)	Mean = 42.33 (*SD* = 6.53)
* LG Range	29.00 – 56.00	29.00 – 56.00	37.00 – 56.00
* PG Range	26.00 – 56.00	26.00 – 56.00	27.00 – 56.00

* LG and PG factor scores can potentially range from a minimum of 8 to a maximum of 56

Learning dispositions:
Descriptive statistics were generated to ascertain student achievement orientations with respect to learning and performance goals as measured by Tan's (2009) survey. While females reported higher LG and PG scores compared to their male counterparts, no statistical significant difference ($p > 0.05$) was ascertained between the two populations. LG scores ranged from a minimum of 29 to a maximum of 56. A similar range was observed in the PG construct ranging from 26 to 56. Table 4 summarises the descriptive statistics related to the LG and PG factors.

Online behaviour correlations:
The extracted online data were correlated with the LG and PG learning disposition factors using Pearson's correlation coefficient (r). No significant correlations were observed between the learning disposition factors (LG, PG) and time online, number of sessions accessed or number of content pages and files viewed. However, significant correlations were noted between LG and PG factors and student discussion forum activity. More specifically, a significant relationship ($r = 0.291$, $p< 0.05$) was observed between students' self-reported LG and the number of total forum postings. Further relationships were uncovered when the data was examined in relation to participation in specific discussion forums. A significant relationship was identified between LG and the *Learning and sharing* forum ($r = 0.375$, $p<0.01$). A significant relationship was also noted for the PG and number of forum posts to the administration forum ($r = 0.393$, $p<0.01$). These correlations held true for both male and female sub-

populations. Table 5 illustrates the observed significant correlations between student learning disposition and discussion forum usage.

Table 5: Correlation between social network properties and self-reported achievement orientations

		Total forum postings	Learning and sharing forum	Administration forum
All students $N = 76$	LG	$r = 0.291$*	$r = 0.375$**	
	PG			$r = 0.393$**
Male students $n = 38$	LG	$r = 0.327$*	$r = 0.392$*	
	PG			$r = 0.435$*
Female students $n = 39$	LG		$r = 0.376$*	
	PG			$r = 0.367$*

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Limitations of the study

There are a number of limitations that impact the overall generalisability and interpretation of the findings emerging from this study. Firstly, this pilot study extracted ICT mediated data derived from student interactions with the online course content and discussions with peers. While this data is easily accessible and represents a significant portion of the implemented learning and teaching activities, it does not include all learning related practices that students undertake, both within and external to the medical education program. Second, the adopted survey instrument quantifies student achievement orientations using a self-report process. This process can be flawed as a result of individual interpretation and reflection on behaviour. However, the factorial loadings do indicate that the survey is robust and reliable. Lastly, the sample size of the pilot study was relatively small and reliant upon one case study. Although the aim of the study was to undertake an initial exploratory investigation, further large scale studies are required to substantiate and elaborate upon these initial findings and interpretations.

Discussion

New modes for determining motivation

The rapid development and integration of ICTs has forced contemporary educators to re-evaluate their pedagogical practice. Regardless of the overall didactic story telling and engagement prowess of individual presenters a shift to online necessitates a re-configuration in learning design and a conceptual shift in pedagogical practice. While this transition has been at ease for some educators – others have found the change rife with new complexities surrounding technology useability and integration in a context where communication cues and notions of student engagement are largely invisible. This has placed considerable stress on transitioning educators attempting to engage their students in what appears as a foreign medium. For instance, what observable performance indicators represent student engagement and how can these be used to better design and scaffold the online learning environment to cater to a diversity of learning needs and experiences? Dawson (2006a, 2006b) previously demonstrated that student posting to class discussion forums can be used as a predictor of student sense of community. In essence, large volumes of peer to peer forum traffic were reported to be representative of a high level of sense of community experienced among the cohort. In a similar context, Morris, et al. (2005) identified a positive correlation between session length of individual online engagement and student academic performance. These forms of analysis provide educators with a rapid, automated and scalable indicator of the overall impact of the implemented teaching and learning activities. The previously assumed invisible online cues are now readily attainable and measurable.

The current study attempted to utilise these new modes of learning indicators to determine if student achievement orientations and therefore underlying motivations resulted in differences in online learning behaviour. The study incorporated Tan's (2009) survey to quantify student achievement orientations as theorised by Carol Dweck (2000). While no significant differences were observed in terms of student time online, number of discussion posts, frequency of sessions, or content viewed, a relationship was ascertained for student forum posting preference. The GSM online environment comprises two main discussion forums – learning and sharing forum and an administrative forum. The differences in the educational intent of these discussion forums, largely reflects Dweck's achievement orientation binary; that is, learning (LG) or performance goal (PG). The study found that students with a stronger LG orientation were more likely to participate in discussion related to the learning and sharing forum.

Conversely students with a more PG orientation were more closely associated with the Administration forum. While these results are far from surprising and are in fact very intuitive, the power of the study lies in the capacity to integrate this data into the everyday learning design and activity development to enhance and better personalise the overall learning experience for all students.

The importance for ascertaining the underlying reasons for student motivations are well documented in the literature related to student attrition in distance and online courses (e.g. Merisotis & Phipps, 1999; M. Moore & Kearsley, 2005; R. Moore, 2003; Tinto, 1993). While these studies have suggested factors such as finances, employment, teaching quality, social networks and personal constraints (Merisotis & Phipps, 1999; Rovai, 2002a, 2002b, 2003) are reasons for student attrition, Oxford et al. (1993)and more recently Moore and Kearsley (2005) argue that the underpinning contributor to student drop out is motivation. Obviously, demands on student time, such as employment, or a students limited connection and participation in social networks will heavily influence their overall motivation to firstly persevere in the course, and secondly to succeed. Thus, identifying the underlying driver of student motivation i.e. performance oriented and therefore assessment motivated or learning oriented and therefore learning motivated may assist educators in better preparing students for participation in online course activities. Furthermore, in understanding individual student achievement orientations instructors are better positioned to attempt to shift students towards the development of more personally motivating learning goals.

Learning or performance?

This raises questions as to whether teachers can and should ultimately alter individual student achievement orientations – after all, students entering HE have demonstrated that the strategies they have employed have been very successful. As Dweck (2000) notes there is no significant difference in terms of student academic performance, between individuals demonstrating a strong learning orientation and those with a strong performance orientation. The difference in the constructs lies not in the variance in academic grades, but in the learning strategies employed when students are confronted with adversity. For example, when faced with a problem that cannot be easily solved students with a learning orientation are more likely to experiment, accept error, and self-motivate, demonstrating perseverance and a diversity of learning approaches. In contrast performance dominated individuals will exhibit what Dweck (2000) has termed as "helpless patterns" (p.5) of behaviour. That is, performance oriented students draw on negative emotions, denigrate their work and actively seek re-assurance and confirmation. As students progress through their academic studies there is a transition towards increasing complexity of course concepts. Students with a learning achievement orientation are therefore, better equipped with the learning strategies necessary to navigate through this complexity and uncertainty.

Sternberg and Grigorenko (1997) showed that effective instructors commonly adopt a diversity of teaching approaches and regularly review student evaluative data in order to better align learning and assessment tasks with individual student learning approaches. As Berliner and Biddle (1995) note, any class with more than one student is a classroom with more than one learning style and therefore presents a diversity of challenges for the everyday teacher. The difficulty for teaching staff is not only assessing student learning demands but being able to respond to these demands in a timely and effective manner. This study has demonstrated that academic analytics can be adopted as an approach to determine student achievement orientations and therefore drivers of motivation. By capitalising on this data instructors are better informed of student learning strategies and possible approaches for providing more personalised individual support. Future investigations into student motivations and online activity are necessary to further substantiate and build upon these initial findings.

Conclusion

There is no debate regarding the necessity for developing well designed learning activities to facilitate student learning. However, there is a scarcity of resources available that can readily assist teachers in rapidly evaluating learning progress and behaviour in order to better design learning activities to provide a more personalised and relevant learning environment. In this context, recent advances in academic analytics (for e.g. Campbell et al., 2007; Dawson, 2008; Goldstein & Katz, 2005; Phillips, 2006) offer educators new insights into student learning and possibly individual student motivations. This study aimed to further contribute to the field of academic analytics by investigating the relationship between student online learning behaviour and individual student achievement orientations. The findings from the study suggest that patterns of student participation within discussion forum types can be used as an indicator of student achievement orientations. By understanding an individual's achievement orientation educators can better identify with the underlying motivations driving student participation in teaching

units. Consequently educators are better equipped with the information necessary to design highly engaging online learning resources.

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Authors: Dr Shane Dawson, Academic Leader, Educational Development, Graduate School of Medicine, University of Wollongong. Email: sdawson@uow.edu.au

Leah Macfadyen, Science Centre for Learning and Teaching, University of British Columbia, Canada.

Lori Lockyer, Faculty of Education, University of Wollongong, Australia

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