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Abstract

A major obstacle in the practice of e-learning is the limited understanding of learners' characteristics and perceptions about technology use. In this case, understanding the relationship between learning styles and Twitter usage could help educators to design better instructional strategies. This would also lead to better student experience and improved learning outcomes. Hence, in this study we investigate learning styles of an Information Systems undergraduate class and its influence on the use of micro-blogging (Twitter). The end of semester survey reveals that the majority of students were "well-balanced" on all learning style scales except 'visual-verbal' scale where visuals outclassed verbals. More importantly, active and visual learners emerged as the most significant adopters of Twitter. The study has implications for educators who wish to accommodate their students' learning preferences and to enhance Web 2.0 usage in their teaching, in particular micro-blogging.

Keywords

Micro-blogging, Twitter, Higher education, Learning styles, Technology adoption, Web 2.0.

INTRODUCTION

The usage of Web 2.0 is almost a norm within the higher education scene. Educators have used a variety of web 2.0 technologies and micro-blogging is one such application. Features of a mirco-blog draws similarity from any Weblog however it is restricted to 140 characters per post and is enhanced with social networking facilities (McFedries, 2007). Earlier studies on micro-blogging highlights three distinct features: information sharing; information seeking; and, friend-ship wide relationships (Java, Song, Finin, and Tseng, 2007). These three features make micro-blogging worth investigating in higher education (Ebner, Lienhardt, Rohs, and Meyer, 2010). Twitter is seen as the most popular micro-blogging application with million users worldwide however has been scarcely reported for educational usage. Few studies have shown that microblogging has great potential for use in higher education (Dunlap and Lowenthal, 2009a; Dunlap and Lowenthal, 2009b; Junco et al. 2010; Sinnappan and Zutshi, 2011) while one had concerns (see Grosseck and Holotescu, 2008). However, there is limited understanding of learners' characteristics and perceptions when it comes to Twitter usage. Understanding the relationship between student learning styles and a technology use could help educators to design better instructional strategies. This would also lead to better student experience and improved learning outcomes. Hence, we aim to investigate learning styles of an undergraduate class in an Australian higher education institution and its influence on the intention to use micro-blogging (Twitter) in an Information Systems unit. The paper is organised as follows. First, in the background section we introduce Twitter and learning styles. This is followed by the methodology section where we discuss about the participants and outline the measures used for the study. Third, the results are presented before the discussion and implications section after which conclusion and future direction are presented.

BACKGROUND

Micro-blogging (Twitter)

Micro-blogging in general has been around for a number of years now and has been a key feature in the suite of Web 2.0 technologies. Originating from blog, micro-blogging is just smaller in size and normally posted by one person and is in reverse chronological order. Since 2006 with the inception of Twitter, micro-blogging has become very popular. Other similar featured application like Jaiku, Plurk, MySay, Hitcu, Tumblr, Pownce, Edmodo and Laconica (open source) followed. Comparative to all micro-blogging platforms, Twitter is the fastest growing Web 2.0 technology (CrunchBase, 2011). Micro-blogging became quickly popular due to its communication features which allowed the exchange of information in 140 characters or less with the ability to include hypertext links. These links could lead users to images, text or other sites. Further, the explosion of micro-blogs was due to its portability as it could be accessed and written by any Web interface and mobile phone via Short Messaging Services (SMS) and instant messaging (IM) services. One can even post via email and receive micro-blog messages via RSS (Really Simple Syndication). Despite this, there have been few reported examples of micro-blogging usage within the Australian higher education scene. Comparatively, though there has been an increase in the usage of Twitter at higher education worldwide, a report from Faculty Focus in 2010 noted that Twitter's potential has yet to be harnessed (Faculty-Focus, 2010). Most higher education institutions are currently using Twitter for sharing information among peers and as a real time news source. There has been little or limited examples of pedagogical use. One of the most important points here is how appropriate such technologies meet the needs of the learners (Naimie, Siraj, Ahmed Abuzaid, and Shagholi, 2010). Therefore, having knowledge of the learners' needs is an important factor to choose the right technology. This study intends to extend research on Twitter by looking at how different learning styles perceive mirco-blogging usage in academia.

Learning styles and instructional preferences

Learning style is a distinctive and habitual manner of acquiring knowledge, skills or attitudes through study or experience while instructional preference is favouring of one particular mode of teaching over another (Sadler-Smith, 1996). In academic settings, students learn in a variety of ways. Some tend to focus on facts, data and algorithms; others feel more comfortable with theories and mathematical models. Some conceive more from visual information like pictures, diagrams and simulations; others get more from spoken and written information. Some prefer interactive learning; others learn well individually (Felder, 1996).

Understanding the relationship between learning styles and instructional strategies holds great promise for enhancing students' perceptions of their own learning (Claxton and Murrell, 1987). As learning styles provide information about individual differences in learning preferences, they can suggest how instruction can be best designed to support learning preferences (Akdemir and Koszalka, 2008). A review of the learning theory literature suggests that learning styles and instructional preferences influence the effectiveness with which individuals learn and the match between these two is advantageous for academic achievements (Huey Wen Chou and Wang, 1999; Lipsky, 1989; Smith and Dalton, 2005). Therefore, a firsthand knowledge of students' learning styles and instructional preferences can help lecturers choose the right methods of instruction for the right audience. The knowledge of students' learning styles is also important in order to design and manage online environments or other learning materials in various subject areas (Akkoyunlu and Soylu, 2008). For example, Sun et al. (using Kolb's learning style inventory) reported that 'accommodators' made the most significant achievements, in their study of analysing learning effect among different learning styles in a Web-based lab for science students (Sun, Lin, and Yu, 2008). Similarly, Chou found clear differences in the performance and learning preferences of 'field-dependent' and 'field-independent' students in their study of comparing learning styles with training methods (Chou, 2001). Butler and Pinto compared students' learning styles with online teaching preferences and reported 'dual' learning style (Concrete-Random / Abstract-Sequential) as dominant with strong preferences for asynchronous interactions (Butler and Pinto-Zipp, 2006). Other studies also highlight the influence of learning styles on academic performance and reported that the learners with particular learning styles performed better than others (Allert, 2004; Chamillard and Karolick, 1999; Thomas, Ratcliffe, Woodbury, and Jarman, 2002). McKenzie also suggested that institutions must consider learners preferences while designing curriculum and also focus on activities that support technology merged with the education (McKenzie, 2001). This study focuses on analysing students' learning styles in an Information Systems unit being offered in a local higher education institution with more emphasis on the influence of various learning styles on adoption of a popular micro-blogging service (Twitter).

METHODOLOGY

Study participants

Participants for the study were made up of second year undergraduate students from a local higher education institution. As part of their program, students were required to undertake an Information Systems unit which ran for 12 weeks. They were exposed to micro-blogging and were encouraged to use Twitter as part of weekly tutorials. This was done by giving students tutorial's activities matching the subject content covered in lectures. The usage of Twitter was not assessed as part of the unit but was monitored by the instructor constantly. Students were taught how to use and communicate via Twitter in the first two weeks of the semester. The survey was conducted at the end of the semester where all students were invited to take part. Though all students had used Twitter for tutorials about 60 per cent of 45 students responded. As part of the tutorial students were exposed to Twitter management tool such as TweetDeck for convenient micro-blogging communication.

Measures

Learning styles data was collected using Felder-Soloman's Index of Learning Styles (ILS) (Felder and Soloman, 1993). Felder's model classifies students as: active–reflective; sensing–intuitive; visual–verbal; and sequential–global learners (Felder, 1996). According to Felder's model: active learners tend to retain and understand information best by doing something active with it, discussing or applying it, or explaining it to others while reflective learners prefer to think about it quietly first (Felder and Silverman, 1988). Sensing learners tend to like learning facts, whilst intuitive learners often prefer discovering possibilities and relationships. Intuitors tend to work faster and be more innovative than sensors, while sensors tend to be more practical and careful than intuitors counterparts (Felder and Soloman, 1993). Visual learners remember best what they see, for example pictures, diagrams, flow charts, time lines, films, and demonstrations while verbal learners get more out of words (written and spoken explanations) (Felder and Silverman, 1988). Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it" (Brown, Zoghi, Williams, Sim, and Holt, 2009).

The Felder-Soloman's ILS consists of 44 questions each carrying two responses ('a' or 'b'). It provides the scores (as 11A, 9A, 7A, 5A, 3A, 1A, 1B, 3B, 5B, 7B, 9B, 11B) for each of the four scales. Scores 1-3 on either side of the scales represent 'mild' or 'well-balanced' preferences, scores 5-7 represent 'moderate' and scores 9-11 represent 'strong' preferences - a total of 12 possible outcomes on each scale. Felder's learning model deemed suitable for this study because it focuses on those aspects of learning styles that are particularly significant in IT-related education (Zywno and Waalen, 2002). It is also considered as one of the mostly used models to capture individual differences during the last decade (Dag and Gecer, 2009). Its free Web-based presence, ease of use, automatic reporting feature and the accompanying descriptive information provided by its authors were some other good reasons for adopting this instrument in this thesis. A number of previous studies have also confirmed the reliability of Felder-Soloman's ILS. For example, Zywno provided support for the reliability of Felder-Soloman's ILS for its intended purpose of identifying learning styles (Zywno, 2003). Litzinger et al. conducted a study to assess the reliability, factor structure and construct validity of Felder-Soloman's ILS and reported that the original ILS generated data with acceptable levels (0.55 and 0.77) of internal consistency. The factor analysis and student feedback also provided strong evidence for its construct reliability (Litzinger, Lee, Wise, and Felder, 2007). Felder's ILS questionnaire is freely available at: http://www.engr.ncsu.edu/learningstyles/ilsweb.html.

The scales to measure students' behavioural intentions (BI) to use Twitter were adopted from (Venkatesh, Morris, Davis, and Davis, 2003), which consists of 3 items measured on a 5 point Likert scale (available in the Appendix). Behavioural intention is an indication of an individual's readiness to perform a given behaviour. It is assumed to be an immediate antecedent of behaviour in several theories of technology adoption in the Information Systems literature, such as Theory of Planned Behaviour (Ajzen and Fishbein, 1980), Theory of Reasoned Action (Fishbein and Ajzen, 1975), and Technology Acceptance Model (Davis, 1989).

RESULTS

The survey data was analysed using SPSS software. Table 1 shows the mean and standard deviation values for all learning styles and behavioural intention scales. The results clearly show that the majority of students on all learning style dimensions were mild (values between 1 through 3) except visual, where most of the students were moderate (values between 5 through 7). Table 2 shows the frequency distribution of 4 learning styles scales. For the sake of simplicity, we combined the strong (9-11) and moderate (5-7) values on each dimension of the scale. Similarly, the mild values on both dimensions were combined together and termed as "well-balanced" (in the middle of two dimensions). For example, on active-reflective scale, values 1a, 3a, 1b, and 3b

were collectively considered as "well-balanced"; values 5a through 11a as "Active"; and, values 5b through 11b as "Reflective". Table 2 also confirms that the majority of students were well-balanced on all learning style scales except visual-verbal, where visuals were dominant.

Table 1: Descriptive statistics

Scale	Mean	Standard deviation
Active	1.7037	2.36667
Reflective	1.0000	1.56893
Sensing	1.9630	2.69589
Intuitive	1.3333	2.05688
Visual	5.2593	3.88877
Verbal	.6296	1.30526
Sequential	1.0741	2.16486
Global	2.1481	2.19622
Intention to use Twitter	3.074	.8439

Table 2: Frequency distribution of learning style dimensions

Learning style dimension	Frequency		Percentage	
Active	4		14.8	
Reflective	2		7.4	
Well-balanced	21	Total = 27	77.8	Total = 100%
Sensing	6		22.1	
Intuitive	3		11.1	
Well-balanced	18	Total = 27	66.7	Total = 100%
Visual	18		66.7	
Verbal	1		3.7	
Well-balanced	8	Total = 27	29.6	Total = 100%
Sequential	3		11.1	
Global	7		25.9	
Well-balanced	17	Total = 27	63	Total = 100%

To analyse the influence of various learning styles on students' intentions to use Twitter, we performed some more statistical analysis in SPSS. Correlation analysis is a commonly used technique to describe strength and direction of linear relationship between the two variables (Pallant, 2005). In our case, these two variables are learning styles and behavioural intention. Table 3 shows the results of Pearson correlation analysis. For the sake of simplicity, learning styles data was re-coded as 1-12 (1 = 11a, 2 = 9a, …….,12 = 11b) while behavioural intention variable was the mean of three measurement items (see Appendix). In Table 3, Pearson correlation coefficient (r) demonstrates the strength and direction of relationship, while Sig. and N represent the significance level and the number of cases respectively. Only two significant ($p < 0.05$) relationships were obtained: a medium negative relationship between active-reflective scale and behavioural intention; and, a similar relationship between visual-verbal scale and behavioural intention. The strength of relationships were measured as suggested by (Cohen, 1988):

r = .10 to .29 or -.10 to -.29	small
r = .30 to .49 or -.30 to -.49	medium
r = .50 to 1.0 or -.50 to -1.0	large

In the first significant relationship, the negative direction indicates that lower values on active-reflective scales would yield higher values of behavioural intention variable. This means that the more the student is active the more likely he or she would like to use Twitter as compared to a reflective student. Similarly, visual learners are more likely to use Twitter as compared to verbal learners.

Table 3: Correlation between learning styles and intentions to use Twitter

	Active - Reflective	Sensing - Intuitive	Visual - Verbal	Sequential - Global
Behavioural Intention				
Pearson correlation coefficient (r)	-.383*	-.222	.419*	-.066
Sig. (2-tailed)	.049	.265	.030	.743
N	27	27	27	27

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

DISCUSSION AND IMPLICATIONS

There were two main objectives of this study; first, to ascertain the learning styles of students and second, to experiment if there was any relationship between the learning styles and their intention to use Twitter as part of class. The result of the study as presented in Tables 1, 2 and 3 showed interesting findings especially linking active and visual learners with the intention to use Twitter. The results indicate that active learners could actively engage with materials and discussions in real-time capitalising from Twitter's simple communication conventions. Twitter is known for its brevity and real-time communication which is a good example of synchronous communication more so than its asynchronous attributes. Utilisation of @ mentions, reposting Twitter messages (RT) and the ability to shorten links are key contributors to this. Further, the interactivity of the discussions and the requirement of physical participation to tweet reinforced the intention to use Twitter for learning purposes. To support active learners, educators need to design activities that involve investigation and exploration. Ideally students could be asked to explore a topic by searching Twitter with hashtag (#) or going through Twitter lists dedicated to the topic while being facilitated by the educator. For example, students could be asked to search the latest issues involving 'internet privacy' by first going through sulia.com[1]. This will expose the students to numerous hashtags (e.g. #security, #privacy and #idtheft) and thought leaders (e.g. @TRUSTe, @Privacyactivism and @PrivacyCamp) within the Twitter-verse which could assist their exploration and lead them potentially engage in discussions about the topic.

Further, usage of free applications such Trendistic.com which provides free timeline trends based on topics is a great tool. Figure 1 below depicts a Trendistic chart based on result of a search on the topic 'privacy' for the last 7 days (as of 19 July 2011). Rather than looking at all the tweets listed under the chart at one time, educators could direct students to focus on the spikes. In this example, the main spike involved the discussions surrounding Goolge plus, Facebook and privacy. Students could then make note and initiate in-class discussions based upon these activities.

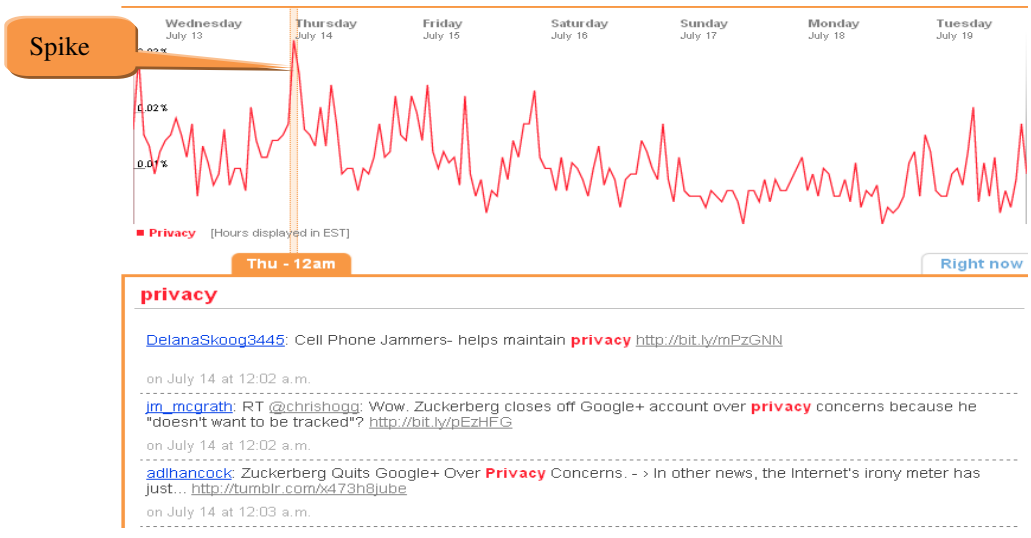

Figure 1: A chart generated by Trendistic.com based on the term "privacy"

Though Twitter accommodates the active learners well, it is important to also consider reflective learners. To support reflective leaners educators will need to capitalise on the asynchronous features of Twitter. This could be

[1] Sulia.com is a prominent media company which provides filtered Twitter messages compiled into topics.

done by asking students to use the search facilities within Twitter to make notes of recent messages involving the topic. Further, reflective learners could observe and participate in the on-going in-class discussions asynchronously by following tweets posted by their peers. Here, educators need to allow more time to response rather than asking students to spontaneously comment.

The results also show that visual learners are more likely to use Twitter as compared to verbal learners. This reflects the need for application to be more visually appealing especially in introducing new technology for educational purposes. Introduction of new technologies often raise usability issues apart from confusing on how it operates and the benefits. Here, it is indicative that visuals help to breakdown the complexity in understanding how Twitter works. Though Twitter has its own website as shown in Figure 2, the concept of communicating via Twitter is not that obvious. Though it has links to @mentions, retweets, searches and list on the left hand side the overall presentation is restricted. Other information such as the numbers of followers and following does provide some clarity as to who can or is communicating; however having a singular column of tweet messages is restrictive. Given these limitations, we opted to use Tweetdeck which has been one of the more popular interfaces to manage Twitter communication intuitively. Tweetdeck is a free client-side software with various features as presented in Figure 3. All students as part of this research were exposed to Twitter's main website among other Twitter management tools like TweetDeck, HootSuite and similar. However, due to constraint of time not all of the tools were tested and used in tutorials except for Tweetdeck.

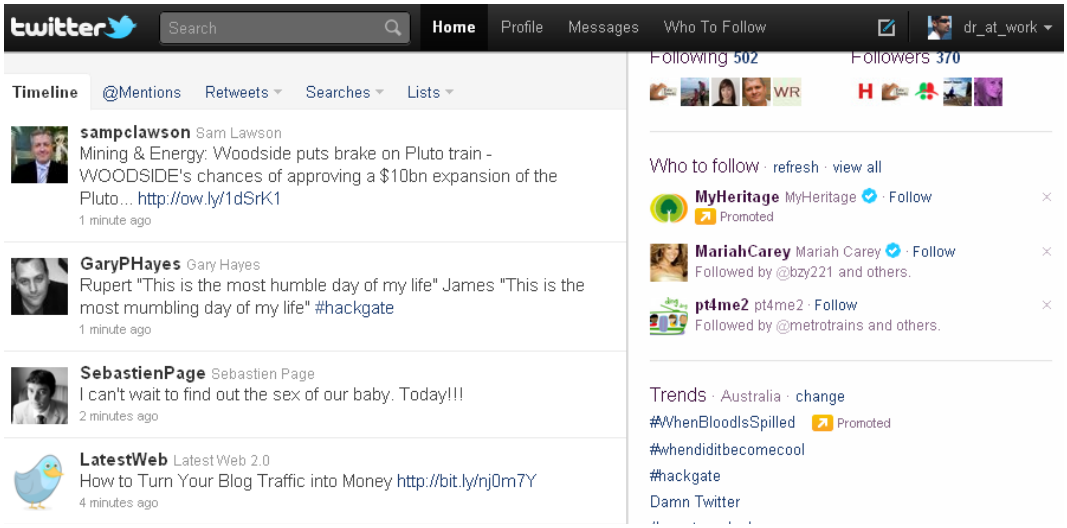

Figure 2: An image of Twitter's website and restricted management of tweet messages

The most noticeable contrast between both of the applications lies in the ability of Tweetdeck users to create more columns as they either search for a hashtag (#) or follow a particular user as compared to the single column presented by Twitter. Having different streams of information presented in one column presented a monumental task in understanding flow of communication. In contrast as presented in Figure 3, the first column on the left represents a hashtag "privacy" only. The next two columns represent tweets that were sent out by twitter users PrivacyCamp and TRUSTe who are considered as thought leaders within the domain of internet privacy. Here, students could easily follow the discussion of streams and if required they can double-click on any of the link to open more columns for further visuals. From this, we could intuitively point out that students will avoid a useful technology if the visual features are not appealing.

Though Tweetdeck supports visual learners well it is important for educators to explain how Twitter operates. We found it important to explain and discuss the features of Tweetdeck in class for all and this would have well benefitted the verbal learners. We envisage that having in-class discussions on the required task and clear explanation of the expectations from the students increases clarity on learning outcomes, which indirectly facilitates Twitter usage in class. Thus, it is important that educators hand out digital or printed instructions together with clear verbal instructions for verbal learners. This could be easily achieved in a face to face class situation. For asynchronous situations an audio or video could be posted in the learning management system. No audio or video postings were done as part of our class; however, in future this would certainly be implemented.

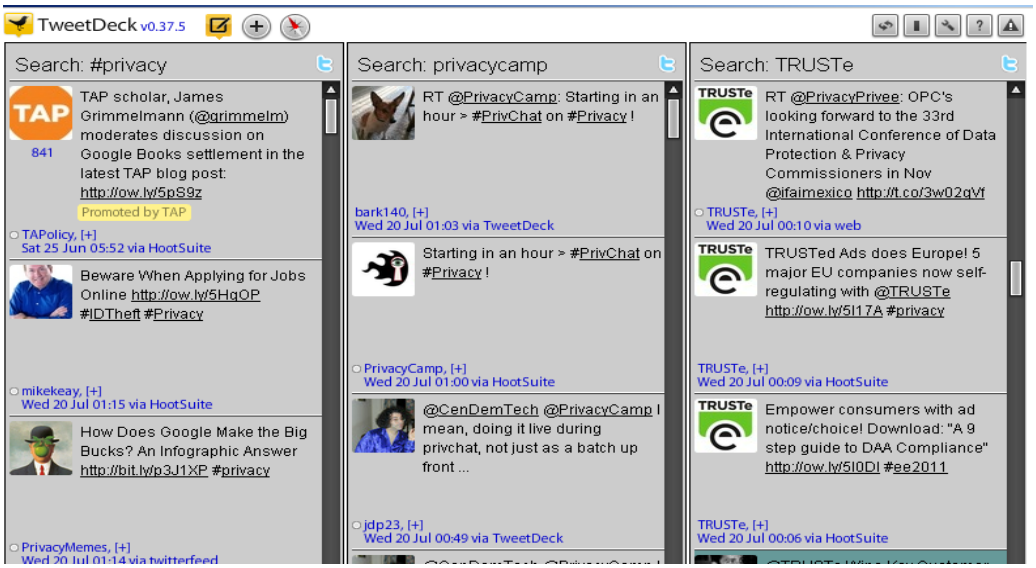

Figure 3: An image of Tweetdeck, a popular tweet management software.

CONCLUSION AND FUTURE RESEARCH

The study provides a useful insight into the usage and adoption of Twitter in a higher education context. The empirical evaluation highlights the different types of learners and their relationship to the intention of using Twitter. The findings highlight how Twitter facilitates active learners through its brevity and simple communication conventions apart from the importance of visual features in introducing a new technology for educational purposes. The study also re-iterates the need to conduct more research on technology adoption of Web 2.0 within higher education especially micro-blogging. Though the paper had limitations given the small student sample the findings were valuable given the limited research on micro-blogging in higher education (Faculty-Focus, 2010). We have also offered suggestions to educators on how to cater the use of Twitter for active and reflective learners apart from visual and verbal learners.

In this light, the paper provides useful contribution towards the usage of Twitter in higher education that may pave way to further utilisation of Twitter for pedagogical usage. In particular, there has been only a handful empirical research done with regards to learner styles and micro-blogging let alone within the Australian context. We also aim to conduct similar studies in other courses and among cross institutions / cultures in order to get a better understanding of the adoption of Twitter in higher education settings.

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APPENDIX 1 - MEASUREMENT ITEMS

Behavioural Intentions (BI)

BI1: Assuming I had access to Twitter, I intend to use it.
BI2: Given that I had access to Twitter, I predict that I would use it.
BI3: I will use Twitter frequently in the future.

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