Media richness and user acceptance of *Second Life*

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Second Life is a 3-D multi user virtual environment and is used as a platform for education by many institutions around the world. It offers a variety of communication channels to perform academic activities for both distance and on-campus education. As such, *Second Life* provides an excellent platform to test the implications of media richness theory (MRT). This paper aims at examining the media richness of *Second Life* and its impact on the user acceptance. Media Richness Theory and Technology Acceptance Model have been used as its theoretical basis. PLS approach is used to test the hypothesised relationships. Our study results suggest that *Second Life* is highly rich medium and is capable of promoting effective communication among its users. We found that media richness has a direct positive effect on the perceived usefulness and perceived ease of use of *Second Life* which in turn leads to actual usage. Some implications of our findings are discussed and ideas for future research are also presented.

Keywords: *Second Life*, education, media richness theory, TAM, PLS

Introduction

Second Life (SL) has been gaining attention of teachers, students and academic researchers from all over the world. Almost every prominent educational institution in the world today has got its presence in SL[i] It offers unique opportunities for educational activities that were previously not possible to perform in real world. For example: performing Chemistry experiments without coming in contact with hazardous chemicals or experiencing weightlessness in virtual space laboratory; taking a virtual tour of ancient world civilisations non-existent today; role playing as an entrepreneur or employer to get a flavour of work place experience from your desktop, and so on. SL also offers a variety of communication channels including 3-D visuals, animated characters, voice, text and gestures. However, due to infancy of SL, very little is known about its media richness. Despite its huge popularity and increasing adoption rate among academics and researchers, no formal study is available that addresses the user acceptance of SL. Therefore there is a need to examine the media richness of SL and its impact on user acceptance of SL in order to better understand this virtual learning environment. This paper presents details of an empirical study to propose a model using media richness theory (MRT) and technology acceptance model (TAM) as its theoretical basis and applying the partial least squares (PLS) approach to validate the proposed model.

Literature review

Second Life in education

SL is a 3-D multi user virtual environment (MUVE) developed by Linden Labs in 2003. SL is currently inhibited by millions of its users (called Residents). Residents create their digital proxies called avatars which can walk, run, or even fly. They also converse with other avatars using text, images, gestures or even voice. They can also move (teleport) from one location (Island) to another. A large and active education community is also engaged in SL. Institutions such as Harvard, Texas State, Princeton and Stanford have set up their virtual campuses in SL where students can meet, attend classes and create content together (http://secondlifegrid.net/programs/education/).

Educators have explored the use of MUVEs such as SL to develop models, simulations, historical recreations, scientific collaborations, and role-playing scenarios tied to academic content. Similarly,

teachers in higher education have also found SL to be a convenient place to conduct online classes, conferences, presentations, and meetings with students (Richter, Anderson-Inman, & Frisbee, 2007). However, to better understand how SL can be used in educational settings, it is important to know that what are the main factors affecting use of SL? In this paper, we try to examine the media richness as a key determinant affecting use of SL within educational domain.

Media richness theory

MRT, originally developed by Daft and Lengel, states that the communication efficiency between people is affected by the fitness of the media and the characteristics of the communication task (Daft & Lengel, 1986). The richness of media is based upon the following four criteria: (1) capacity for immediate feedback; (2) capacity of the medium to have a personal focus; (3) capacity to transmit multiple cues, and; (4) language variety (Daft, Lengel, & Trevino, 1987). Using these categories, they consider face-to-face communication as the richest. They also include technologies such as telephone, email, postal letter, note, memo, flier, and bulletin along their spectrum of media richness. Several other researchers follow a similar approach to classify other media such as video, voice, pictures, and text (Rice, 1992; Schmitz & Fulk, 1991; Zmud, Lind, & Young, 1990). With regard to the characteristics of communication task, MRT states that the purpose of communication is to reduce uncertainty and equivocality in order to promote communication efficiency, whereas uncertainty is associated with the lack of information and equivocality is associated with negotiating meanings for ambiguous situations. Therefore, a rich medium should be able to transmit sufficient amount of correct information in order to reduce uncertainty and should be able to process rich information in order to reduce equivocality (Sun & Cheng, 2007). In this paper, we try to examine if SL has the ability to reduce uncertainty and equivocality. We would also like to examine the effects of media richness on usage of SL.

Technology acceptance model

Investigation of technology acceptance by target users have received considerable attention from information systems researchers and practitioners and several theoretical models and frameworks attempt to explain or predict a person's decision to accept a new technology (Chakraborty, Hu, & Cui, 2008). The most notable among these are Theory of Reasoned Action, Technology Acceptance Model, Theory of Planned Behaviour, Self-efficacy Theory and Innovation Diffusion Theory. Of particular importance is the Technology Acceptance Model (TAM), a widely used model originally developed by Davis and his colleagues (Davis, Bagozzi, & Warshaw, 1989) to explain or predict individuals' acceptance of computer based systems in various scenarios and organisational contexts (Chakraborty, Hu, & Cui, 2008). TAM posits that user perceptions of usefulness and ease of use determine attitudes towards using the system. Several researchers have validated TAM for a variety of applications such as word processors, e-mail, spread-sheets (Lederer, Maupin, Sena, & Zhuang, 2000). TAM has also been used to predict the user acceptance of Web-browsers (Morris & Dillon, 1997), Web-based learning systems (Leila Halawi & McCarthy, 2007), and multimedia learning systems (Saade, Nebebe, & Tan, 2007). Several modifications in the original TAM have also emerged in recent years. For example, (Saade & Bahli, 2005) extend the TAM by including cognitive absorption to explain the acceptance of Internet-based learning systems; (Moon & Kim, 2001) introduce playfulness as a new factor in TAM that reflects user's intrinsic belief in WWW acceptance; and (Shih, 2004) combines TAM and the information behaviour model to develop an extended TAM for Internet use, which is based on the belief-attitude-performance chain. In this paper, we extend the original TAM using media richness as antecedent of perceived usefulness and perceived ease of use, in order to predict user acceptance of SL within educational domain.

Research model and hypotheses

As discussed earlier, TAM assumes that both perceived usefulness and perceived ease of use of the new technology are central in influencing the individual's attitude towards using that technology. An individual's attitude is hypothesised to influence the behavioural intention to use a technology (Davis, Bagozzi, & Warshaw, 1989). We propose a model including MRT and TAM to examine the effects of media richness on user acceptance of SL, as shown in Figure 1. We further hypothesise that:

H1a: The perceived media richness (PMR) of SL will have a positive effect on the perceived usefulness (PU) of SL.
H1b: The perceived media richness (PMR) of SL will have a positive effect on the perceived ease of use (PEOU) of SL.
H2: The perceived usefulness (PU) of SL will have a positive effect on the behavioural intention (BI) to use SL.

H3a. The perceived ease of use (PEOU) of SL will have a positive effect on the behavioural intention (BI) to use SL.
H3b. The perceived ease of use (PEOU) will have a positive effect on the perceived usefulness (PU) of SL.
H4: The behavioural intention (BI) to use SL will have a positive effect on the actual use (AU) of SL.

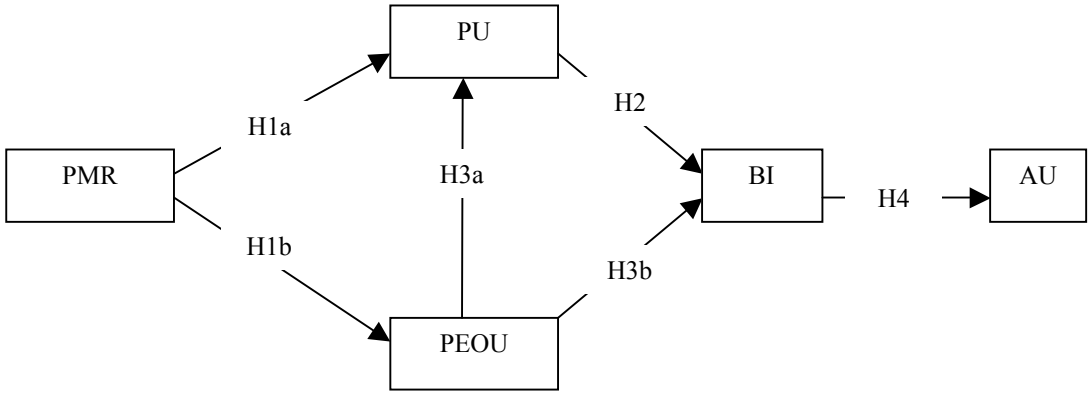

Figure 1: The proposed model depicting media richness and technology acceptance of SL

Data collection and participants

An online survey has been developed by the authors. The survey was announced in March 2008 on various educational forums and groups in SL. *Second Life* Education (SLED) and *Second Life* Research (Slrl) lists were used to invite survey participants. This has been an accepted practice among other SL researchers. Our target subjects were students, educators and researchers with at least 4-6 months experience of using SL. The survey resulted with 112 responses, which met the requirements to perform data analysis using Partial Least Squares (PLS).

Measures

Multiple items were used based on previously published scales for the various constructs. The wordings were changed according to the targeted technology acceptance context. All items were measured on a seven point Likert-type scale, where respondents had to indicate the extent to which they agreed with a given statement, ranging from 'strongly disagree' (1) to 'strongly agree' (7).

The scales for PMR were adopted from (Carlson & Zmud, 1999). The scales for PU and PEOU were adopted from (Davis, Bagozzi, & Warshaw, 1989) and (Igbaria, 1990), the scales for BI were adopted from (Venkatesh, Morris, Davis, & Davis, 2003) and the scales for AU were adopted from (Moon & Kim, 2001). Complete questionnaire is available in Appendix A.

Demographics

As mentioned earlier, 112 participants responded to our survey including 72 females and 40 males. Nearly half of them were students. The mean age of participants was 41.9, which shows maturity of our participants. As Table 1 indicates, survey participants are well educated with over 68% holding a postgraduate degree. It also shows that majority (82.1%) of participants have internet experience of more than 9 years, 93.8 % of them use internet several times a day and the primary use of internet of 56.2% of participants is at work. Table 1 also shows that majority (83%) of participants have at least 6 months experience of using 3-D virtual environments; about half of them use at least once a day and the primary use of 3-D virtual environments of 73.2% of participants is at home. *Second Life* is also voted as the most preferred 3-D virtual environment by 98.2% participants. These results suggest that our participants have sufficient experience of using SL and majority of them come from academic background thus fit well into our target subjects' profile.

Table 1: Demographic information

		% of respondents
Gender	Males	35.7
	Females	64.3
Education level	High school	9.8
	TAFE	1.8
	Undergraduate	14.3
	Postgraduate	68.5
	Others	5.4
Internet experience	Less than 2 years	1.8
	3-4 years	1.8
	5-6 years	3.6
	7-8 years	10.7
	9 years or more	82.1
Internet use	Not at all	0.0
	Less than once a week	0.0
	About once a week	0.0
	2-3 times a week	0.9
	Several times a week	0.0
	About once a day	5.4
	Several times each day	93.8
Primary place of internet use	Campus	4.5
	Home	56.2
	Work	32.1
	Internet café	0.0
	Others	7.1
3-D virtual environments Experience	Less than 3 months	4.5
	4-6 months	12.5
	7-12 months	29.5
	1-2 years	34.8
	2 years and more	18.8
3-D virtual environments use	Not at all	0.9
	Less than once a week	3.6
	About once a week	3.6
	2-3 times a week	17
	Several times a week	25
	About once a day	21.4
	Several times each day	28.6
Primary place of 3-D virtual environments use	Campus	7.1
	Home	73.2
	Work	16.1
	Internet café	0.9
	Others	16.1
Most preferred 3-D virtual environment	*Second Life*	98.2
	Vast Park	0.9
	HipiHi	0.0
	CyWorld	0.0
	Habbo Hotel	0.0
	There.com	0.0
	Others	0.9

Data analysis

The research model was tested using PLS approach with PLS-Graph 3.0. PLS-Graph is a graphical user interface (GUI) based software which allows to perform latent path variables modelling using the partial least squares (PLS) approach (Chin, 2001). PLS is a powerful tool in analysing structural models involving multiple constructs and multiple indicators (Muthaly & Selvarajah, 2007) and has been used in other technology acceptance studies such as (Raaij & Schepers, 2008) and (Mun & Hwang, 2003). After ensuring the reliability and validity of the scales, PLS was used to test the hypothesised relationships

among media richness and user acceptance of SL. We conducted tests of significance for all the paths using the bootstrap re-sampling method (Cotterman & Senn, 1992).

Validity and reliability

To verify the validity and reliability of the measures, factor loadings from the confirmatory factor analysis (CFA) were observed. The factor loadings from the CFA provide evidence for convergent validity as all construct items load greater than the threshold value of 0.50 as suggested by (Peterson, 2000). Table 2 presents a summary of all measurement scales. Internal consistency was checked using composite reliability measures (_) (Chin, 1998) and the average variance extracted (AVE). Composite reliability values also exceed the minimum value of 0.7 as suggested by (Nullany & Bernstein 1994). Table 2 also illustrates the t-statistic values for all our constructs which are exceptional except for PEOU which is relatively low but still above the minimum threshold value of 1.96 as suggested by (Gefen & Straub, 2005).

Table 2: Summary of measurement scales

Constructs items	Mean	Standard deviation	Factor loadings	Composite reliability	AVE	t-statistics
PMR:				0.87	0.62	
PMR1	5.35	1.31	0.74			12.00
PMR2	5.88	1.20	0.69			9.56
PMR3	4.91	1.71	0.86			29.10
PMR4	5.15	1.75	0.83			27.73
PU:				0.89	0.58	
PU1	4.0	1.55	0.74			18.03
PU2	4.5	1.57	0.85			29.07
PU3	4.18	1.72	0.81			22.99
PU4	4.37	1.51	0.71			11.11
PU5	5.28	1.64	0.78			16.64
PU6	5.79	1.46	0.67			11.45
PEOU*				0.77	0.55	
PEOU2	4.40	1.68	0.54			3.89
PEOU3	5.10	1.45	0.90			19.41
PEOU4	4.82	1.66	0.71			6.12
BI:				0.93	0.81	
BI1	6.03	1.21	0.88			23.09
BI2	6.07	1.21	0.92			30.17
BI3	6.18	1.13	0.88			34.19
AU:				0.91	0.77	
AU1	5.40	1.41	0.92			49.44
AU2	3.83	1.73	0.88			40.72
AU3	5.46	1.45	0.83			9.61

* PEOU1 did not load significantly and hence removed.

The discriminant validity was checked by Fornell and Larcker test (Fornell & Larcker, 1981). The method requires that the square root of the AVE for each construct should exceed the correlation shared between the construct and other constructs in the model. Table 3 shows that all constructs pass the test, as the square of the AVE (on the diagonal) is larger than the cross-correlations with other constructs. Thus all constructs in our model demonstrate a good degree of validity and reliability.

Testing of hypotheses

Figure 2 summarises the PLS findings for hypotheses results (H1-H4) using bootstrap procedure with 200 re-samples. The path coefficient values are represented along each path as shown in Figure 2, all in the positive direction. We found a direct positive effect of perceived media richness on both perceived usefulness and perceived ease of use of SL. This supports hypotheses H1a and H1b. We also found a direct positive effect of perceived usefulness on behavioural intention, supporting hypothesis H2. Perceived ease of use also had a direct positive effect on perceived usefulness (supporting H3a) but no significant effect on the behavioural intention, thus rejecting H3b (represented by dotted line in Figure 2).

Table 3: Discriminant validity of the constructs

	PMR	PU	PEOU	BI	AU
PMR	**0.79**				
PU	0.57	**0.76**			
PEOU	0.39	0.43	**0.74**		
BI	0.45	0.39	0.14	**0.90**	
AU	0.33	0.29	0.17	0.43	**0.88**

We also found a direct positive effect of behavioural intention on the actual usage of SL, supporting hypothesis H4. Thus all hypothesised relationships are supported by our data except H3b. In addition, the perceived usefulness explained 37.3% of the variance in our model; perceived ease of use explained 15.1% of the variance; while behavioural intention and actual usage explained only 15.2% and 18.5% of the variance respectively.

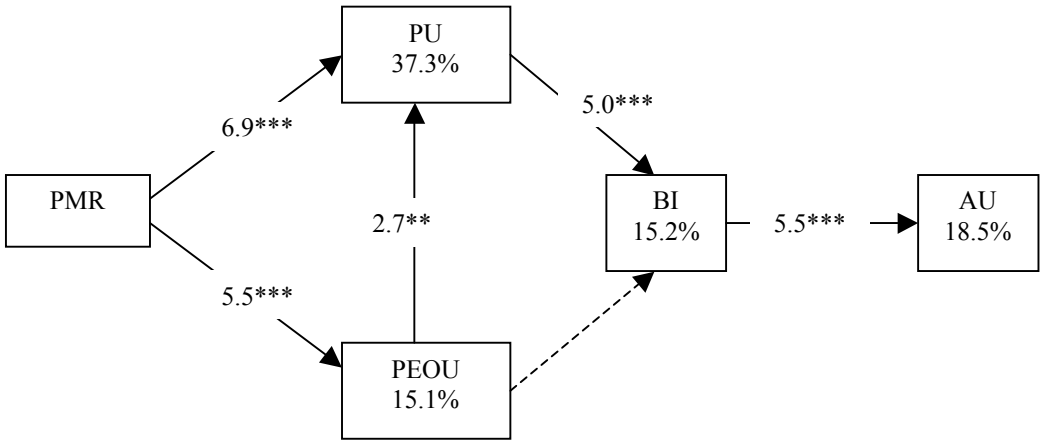

Figure 2: PLS results
The critical ratios determined by the bootstrap method are: 1.645 is significant at the 0.5 (*) level, 2.326 is significant at the 0.01 (**) level and 3.090 is significant at the 0.001 (***) level.

Discussion and limitations

Our study attempts to examine the media richness of *Second Life* using media richness theory. It also attempts to examine the impact of media richness on user acceptance of *Second Life* using technology acceptance model. A research model has been proposed and empirically tested with PLS.

The study reports highly significant relationships among media richness and perceived usefulness and ease of use, which in turn leads to the actual usage of SL. The direct positive effects of media richness on perceived usefulness and ease of use imply that the more the medium is rich, the more useful users perceive it and finally use it. In Table 2, the t-statistic values for all four items of perceived media richness (PMR1-PMR4) construct appear highly significant, which suggests that SL is a very rich medium in its capacity to provide immediate feedback, to have a personal focus, to transfer multiple cues, and to offer language variety. Among these four items, PMR3 (capacity to transmit multiple cues) and PMR4 (ability to offer language variety) are the most significant, which suggests that SL's ability to transmit multiple cues (graphics, voice, text, gestures) and the ability to offer language variety (natural language communication) have the greatest impact on user acceptance of SL. Because of its ability to transmit and process sufficient and rich information, SL should be able to reduce uncertainty (lack of information) and equivocality (negotiating meanings for ambiguous situations), which implies that SL has the capacity to increase effective communication frequency among its users as suggested by (Sun & Cheng, 2007). These results have implications for educators and researchers; they can use SL to design interactive academic activities for students while collaborative research activities among colleagues because SL provides a variety of communication channels and supports effective communication.

Our study results also confirm the relationship between perceived ease of use and perceived usefulness, as suggested by (Davis, 1989). In accordance with several other studies measuring acceptance of new technology (Chau & Hu, 2002; Gao, 2005; Selim, 2003; Szajna, 1996; Wu & Wang, 2005), we found no direct effect of perceived ease of use on behavioural intention or actual usage of SL. Davis also observed that when users learn to effectively use the system, the direct effect of ease of use on the system use disappears (Davis, 1989), our study confirms this behaviour. (Raaij & Schepers, 2008) also suggest that the actual use of the system can be influenced more by the perceived usefulness than by perceived ease of use, as users are willing to overcome usability hurdles of system's environment in favour of the prospect of better academic outcomes.

A limitation of our study is the use of self-reported usage data, which is often measured using log files. As our respondents were picked from SL mailing lists, it was beyond our control to maintain their usage log files. In addition, since our study is restricted to *Second Life* only, the results can not be generalised for media richness and user acceptance of other 3-D virtual environments. However, similar future studies involving other 3-D virtual tools would help to compare and rank the media richness of various virtual environments. It would also help to compare the user acceptance of various virtual environments and choose which tool suits best for educational context. Another limitation of our study is the lower variance explained by the dependant variable, i.e., actual use (AU) of SL. Figure 2 shows that AU explains only 18.5% of the variance in the model, which is relatively lower when compared with similar studies of technology acceptance mentioned earlier in the paper. This suggests a need to look into other determinants of SL usage.

Conclusion and future research

This study is a first of its kind measuring media richness and user acceptance of *Second Life*. Based on the study results, *Second Life* emerges as a highly rich medium when examined with media richness theory. The positive effect of media richness on user acceptance of *Second Life* also appears to be a significant finding of our study. These results further suggest that *Second Life* can be used as an effective communication medium for teaching and learning. In our future studies, we would like to compare the media richness of SL with other 3-D virtual environments (such as Active World, CyWorld, There) or communication media (such as blogs, wikis, podcasts), used in distance and on-campus education.

Our study also confirms that technology acceptance model holds true for *Second Life*. However, other key determinants of perceived ease of use and perceived usefulness should be investigated in order to better understand user acceptance of this emerging 3-D virtual environment. Moreover, since *Second Life* is largely considered as an entertainment-oriented technology, conventional technology acceptance models like TAM may not work very well, as suggested by some previous studies (Holsapple & Wu, 2007; Hsu & Lu, 2004; Koufaris, 2002). In our future studies, we would like to investigate other behavioural factors like imagination or emotional responses, user / system involvement or motivation, and learning /cognitive styles; that may affect the user acceptance of *Second Life* within educational domain.

Endnote

[1] A complete list of institutions is available at SL education grid pages: http://simteach.com/wiki/index.php?title=Second_Life_Education_Wiki#Institutions_and_Organizations_in_SL/

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Appendix A

Perceived Media Richness (PMR):
PMR1: *SECOND LIFE* allows me to give and receive timely feedback.
PMR2: *SECOND LIFE* allows me to tailor interaction according to my personal requirements.
PMR3: *SECOND LIFE* allows me to communicate a variety of different cues (such as emotional tone, attitude, or formality) during communication.
PMR-4: *SECOND LIFE* allows me to use rich and varied language during communication.

Perceived Ease of Use (PEOU):
PEOU1: Learning to use *SECOND LIFE* is easy for me.
PEOU2: I find it not difficult to get *SECOND LIFE* to do what I want it to do.
PEOU3: I find *SECOND LIFE* to be flexible to interact with.
PEOU4: It is easy for me to become skilful at using *SECOND LIFE*.

Perceived Usefulness (PU):
PU1: Using *SECOND LIFE* enables me to accomplish my tasks more quickly.
PU2: Using *SECOND LIFE* improves my class or work performance.
PU3: Using *SECOND LIFE* increases my productivity.
PU4: Using *SECOND LIFE* makes it easier for me to understand lecture.
PU5: Using *SECOND LIFE* makes it easier for me to communicate with lecturer/friends.
PU6: Overall, I find *SECOND LIFE* useful in my study/work

Behavioural Intention (BI):
BI1: Assuming I had access to *SECOND LIFE*, I intend to play it.
BI2: Given that I had access to *SECOND LIFE*, I predict that I would play it.
BI3: I will play *SECOND LIFE* frequently in the future.

Actual Use (AU):
AU1: How many times do you use *SECOND LIFE* during a week?

☐ ☐ ☐ ☐ ☐ ☐ ☐

Not at all Less than About once 2 or 3 times Several times About once Several times

once a week a week a week a day each day

AU2: How many hours do you use *SECOND LIFE* every week?

☐ ☐ ☐ ☐ ☐ ☐ ☐

>1 h 1-5 h 6-10 h 11-15 h 16-20 h 21-25 h <25 h

AU3: How frequently do you use *SECOND LIFE*?

Infrequent ☐ ☐ ☐ ☐ ☐ ☐ ☐ Frequent

Extremely Quite Slight Neither Slight Quite Extremely