

Student Interactions in Online Discussion Forum: Empirical Research from ‘Media Richness Theory’ Perspective

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Abstract

The present study contributes to the understanding of the effectiveness of online discussion forum in student learning. A conceptual model based on ‘theory of online learning’ and ‘media richness theory’ was proposed and empirically tested. We extend the current understanding of media richness theory to suggest that use of multiple media can enrich the communication context and perceived learning. Hierarchical regression was applied to investigate the relationships between antecedent factors, interaction and perceived learning. The results show that the perceived richness of online discussion forum has significant positive effect on student participation and interaction, and learning, when used along with traditional classroom lecture. Implications of these findings are discussed as they provide important guidelines for management educators.

Introduction

Over the past few years, management education has been experiencing an increased interest in using internet and communication technology tools (ICT). While ICT has been widely used in distance and online mode of education, it is being increasingly used along with the face-to-face lectures to augment and support classroom learning. The use of online discussion forum (ODF) has emerged as a common tool and an effective way of engaging students outside the classroom. ODF is an e-learning platform that allows students to post messages to the discussion threads, interact and receive feedback from other students and instructor, and foster deeper understanding towards the subject under study. In an ODF there is no loss of data as the students’ written messages are stored in the virtual space, and can be retrieved and reviewed anytime. The use of online instructional tools can remove some of the communication impediments associated with the face-to-face lectures providing a forum to address issues through argumentative and collaborative discourse (Karacapilidis and Papadias, 2001). For students, the online environment is less intimidating, less prone to be dominated by a single participant and less bounded by convention (Redmon and Burger, 2004). It also provides

students the flexibility of time and place to reflect on the previous postings to the discussion thread (Anderson and Kanuka, 1997) and thus actively engages them in a meaningful and intellectual experience.

Biggs (1999) had suggested that active teaching methods which involve learning through active experimentation and reflective thinking encourage high-level of student participation in the learning process. This, as opposed to passive teaching approach, like traditional classroom lecture (Ebert-May, Brewer, and Allred, 1997) challenges students to construct knowledge (Struyven *et al.* 2006) leading to higher cognitive outcomes. The various active teaching methods include case studies, panel discussion, simulation games, project studies and problem-based learning (Lantis, Kuzma and Boehrer, 2000; Reichard, 2002; Lamagna and Selim, 2005). Employing these active teaching methods increase the academic performance of the students and generate more positive attitude towards learning (Felder and Silverman, 1998; Struyven *et al.*, 2006). As Thomas (2002) noted, the online discussion forum provides significant opportunities for students to actively engage in their learning process through active participation. Studies investigating the technology-rich classrooms found that the students demonstrated superior attitudes, involvement and engagement with the course content (Dorman and Fraser, 2009). Using technology tools as supportive to lectures can reinforce course information through multiple modes of knowledge representation and comprehension. This improves their learning outcomes by contributing to their intellectual growth and critical thinking (Pena-Shaff and Nicholls, 2004). Other important payoffs of using technology tools include flexibility, convenience and accessibility for students to complete their learning anytime and anyplace.

However, studies have shown that motivating students to actively participate and contribute in online discussions was challenging. Perceived lack of relevance and usefulness seems to hinder student motivation as they assume an 'invisible' online role posting discussions with minimal content (Beaudoin, 2002). Confusion, anxiety, apprehension in writing and difficulty in phrasing, and time constraints are other reasons attributed for student passivity or nonparticipation in ODFs. Another potential problem has been the evaluation of the student's contribution towards the online discussions. Pena-Shaff, Altman and Stephenson (2005) reported some students to have rebelled when discussions are graded, resulting in a negative impact on their participation. Some students found it difficult to interact when the human interface was not present; this was reflected while communicating in ODF environment (Bullen, 1998).

Much of prior research has been done on comparing learning in face-to-face lectures and threaded discussions (Meyer, 2003), the role of instructor in web-based forums (Mazzolini and Maddison, 2007), student interactions in the virtual environment (Pena-Shaff and Nicholls, 2004) and assessment strategies of the discussion content (Gaytan and McEwen, 2007). The area which requires further exploration is the linkage between participation, interaction and learning when ODFs are used as adjunct with traditional classrooms lectures. Furthermore, majority of research studies in the above stream have focused on the qualitative research approach in understanding the students' participation in an online discussion forum (De Wever *et al.*, 2006; Jiang and Ting, 2000). While the findings obtained from this research approach has been valuable, further empirical research is required to identify the important factors that influence interaction and learning in an ODF (Brook and Oliver, 2003). Accordingly, the objective of the present investigation was to study the antecedents and outcomes of using ODFs with traditional classroom lectures.

Theoretical background

This paper deals with using online discussion forums with traditional classroom environment. The conceptual framework is drawn in particular from Anderson's (2004) "Theory of Online Learning" and "Media Richness Theory" (Daft and Lengel, 1986).

The 'Theory of Online Learning' as proposed by Anderson (2004), argues that effective learning environment affords many modalities of interactions between the three macro components namely students, instructors and content (Anderson, 2004). Anderson and Garrison (1998) present the six typologies of interactions namely student-student, student-instructor, student-content, instructor-instructor, instructor-content and content-content interactions that serve as the basis of educational process in online learning environment. These interactions are described as critical to effective learning and take place when the learning environment is learner-centered, knowledge-centered, assessment-centered, and community-centered (Anderson, 2004). Interactivity has been considered as central tenet to the concept of 'online learning theory'. Using online instructional tools provide unique opportunities for the instructor to engage students in various activities and offer a new dimension for interaction – active and higher-order. It changes the way students interact, motivating them to be more attentive and participative, and encourages the process of learning. The role of instructor in facilitating discourse becomes decisive to overcome restrictions due to individual characteristics (e.g. personality traits) and lead to enhanced communications. Additionally, students have to demonstrate strong internet efficacy for active participation and interaction.

Using online resources expand the opportunities for students to reflect upon their thinking and experience the discourse with other students and instructor. It individualizes their learning experience facilitating development of deep level learning and "new knowledge structures" (Anderson, 2004, p. 37). The asynchronous communications facilitate personalization by allowing the students to learn at their own pace and according to their interest, previous knowledge and style. This represents the knowledge-centered view of online learning theory. It is noted by Anderson (2004) that assessment determines if the learning objectives of using online tools had been accomplished. The instructor needs to structure the online discussions to configure with classroom lectures, create experiences leading to outcome, and discuss and use assessment to improve learning. Additionally, feedback is an important part of this assessment-centered learning and influences the approach to learning. The last perspective of online learning theory is the community or social component of online learning. The interactions in the online forum promote a sense of community or social connectivity between the learners and instructors. The level of connectedness among the students results in formation of productive relationships among the class members and in collaborative exploration of the subject matter. Previous research has shown that learning communities exhibit increased student learning, and course satisfaction (Rovai, 2002). As suggested by this theory, it is proposed that learning effectiveness in using ODFs is influenced by the interactions and communication. The level of interaction depends on the learning environment (facilitating discourse, reflective thinking, assessment and feedback, and sense of community), learning process (personalization) and learner characteristics (personality and internet efficacy).

Media Richness Theory (MRT), a widely known theory of media use, posits that communication efficiency will be improved by matching media to the students' task information needs (Daft and Lengel, 1986). The authors argue that media differ in their "richness" or the ability to convey information. This richness depends on media characteristics such as capability to provide immediate feedback, message personalization, available language variety, and

communication and social cues. Critics of Computer-Mediated Communications (CMC) contend that the low richness of the text-based discussion forums and their lack of audio-visual and nonverbal cues, physical appearance and physical environment lead to communication ambiguity and loss of meaning (Ward and Newlands, 1998). Mehrabian's (1971) work suggested that non-verbal cues communicate feelings and attitudes and invoke students' arousal or sensory stimulation leading to more intense interactions. In such case, according to this literature, the lack of cues in ODFs does not support social interaction among the members. However, contrary to the argument, we propose that the lack of cues may unbind the social hierarchy in the online environment resulting in more democratic and equal participation from members. Ruberg, Taylor and Moore (1996) viewed that 'social convention' in the online environment encourages students to overcome the lack of cues and maximizes the interactions between students, instructor and content. When compared to face-to-face medium, CMCs encourage experimentation, provide opportunities to discuss, and facilitate social learning. According to Volery and Lord (2000), a rich medium should support both asynchronous and synchronous communications. Using web-based resources with face-to-face teaching can engage students in communicative exchanges with other participants through multiple mediums and can provide a richer communication context than a traditional lectures approach alone. Dennis and Valacich (1999, p. 9) state that "choosing one single medium for any task may prove less effective than choosing a medium or set of media which the groups uses at different times performing the talks, depending on the current communication process (convey or converge)". With face-to-face lecture being the richest media having multiple channels to communicate information (verbal and non-verbal), adding technology to the process enables more cues exchanged with greater opportunity for feedback. This can lead to a qualitatively different learning experience for the students. Using a combination of technologies can create a spectrum of media richness.

The present study proposes that use of web-based forums with face-to-face lectures can promote rich interaction among students, instructor and content resulting in enhanced subject learning. Figure 1 presents the conceptual framework of the study.

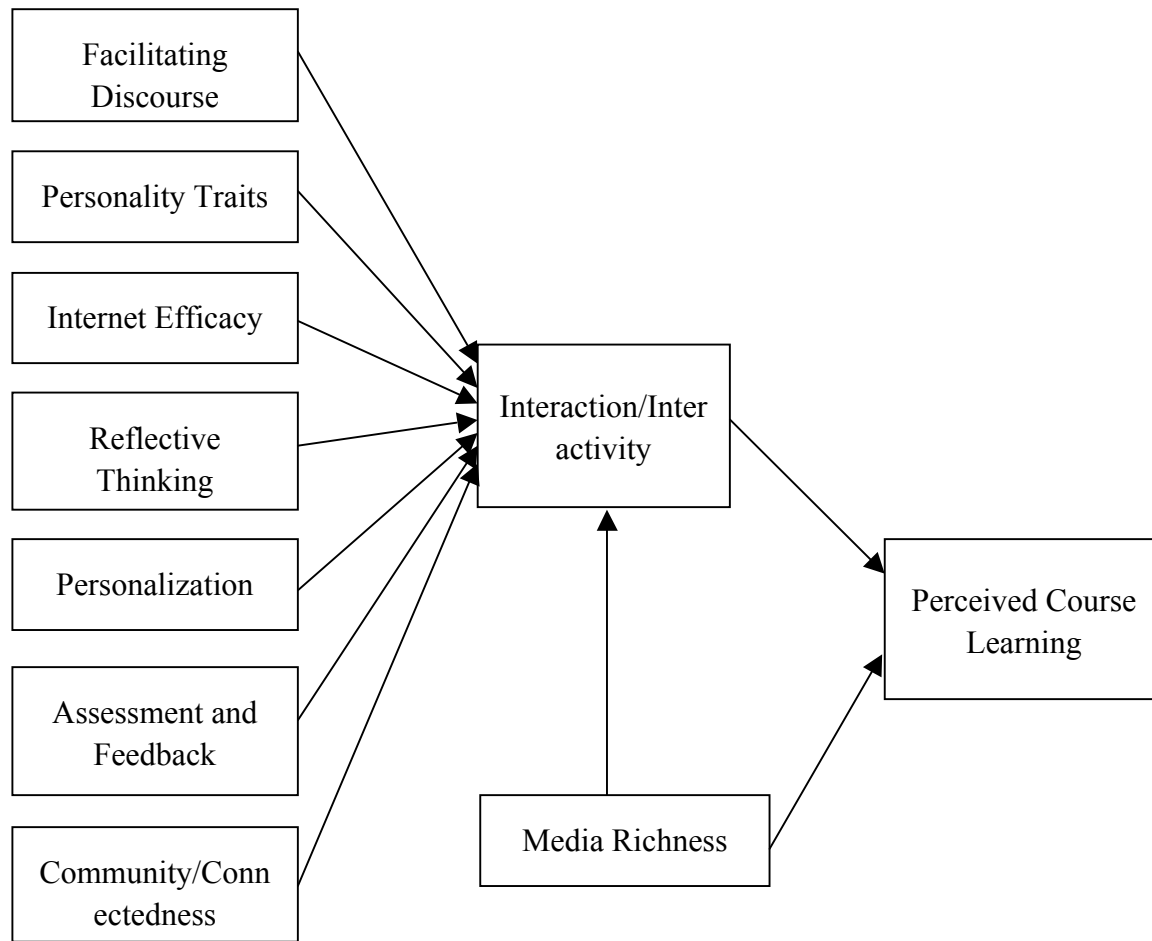


Figure 1. Conceptual framework of the study

ODF: Relevant Findings

Interaction and the quality of interaction among the students and instructor are considered as an essential part of the academic process. The use of ODFs allows students to increasingly interact with other participants, instructor, course materials and resources. Prior studies have shown that students, in general, have a positive attitude towards internet usage and spend more time with online tools (Lee, Hong and Ling, 2001). This implies that they are more likely to be satisfied with their online experiences and become more responsible for their learning process. While critics have questioned the interactivity, Wagner (1997) proffered that the interactions in CMC environments are equally good or better than, the classroom lectures. In another study, Brower (2003) studied interactivity in distance education class and found that the online tools (bulletin board) support quality discussions and collaborative learning. However, Swan (2002), found negative correlation between collaborative learning techniques and perceived learning.

The reasons for the negative associations were not elaborated, but the author does propose asynchronicity and instructor inexperience for the same.

Previous studies report adequate student preparation in using the online discussion forums and easy navigation function of the forum to increase contribution. For example, Tsai (2004) in his study on students' information search strategies found that students with high internet efficacy learned better and performed their online learning tasks more efficiently. Whereas, low internet efficacy users find it challenging in searching for the information to complete online tasks and thus may show lower motivation. Furthermore, the student's personality characteristics can influence their online participation. Studies investigating individual personality and internet behavior have revealed that introverted students to be more able to communicate with others in online environment than face-to-face (Amichai-Hamburger, Wainapel and Fox, 2002). Chen and Caropreso (2004) in their study investigated the effect of three personality traits – extroversion, agreeableness and openness – on online discussion. Contrary to the early findings, the results report that students classified as “low” on these personality dimensions posted messages that were one-way and unrelated or slightly related to the discussion topics. Extroverts, because of their strong need for gratification and higher success rate of interaction are more likely to participate in ODFs.

As many researchers have noted, instructor's role in facilitating appropriate interactions and discussions in online environment supports effective learning. Rohfeld and Hiemstra (1995, p. 91) describe the online instructor's role as “the responsibility of keeping discussions on track, contribute special knowledge and insights, weave together various discussion threads and course components, and maintaining group harmony”. In addition, the instructor posts interesting and relevant topics to seek student involvement and stimulate their critical thinking process. According to Marks, Sibley and Arbaugh (2005), the instructor and his communications are instrumental in creating a positive attitude towards online learning and motivating the students to learn. The instructor designs various online activities, tasks and context that push participative inquiry towards new knowledge construction. McDuffie and Slavitt (2003) suggested that the dialogical nature of online discussions provide a forum for students to share their reflections with other participants. The online activities provide instructor the opportunities to engage students in different levels of reflection of the new knowledge created. Higher levels of reflection require students to critically analyze the new knowledge acquired, integrate with existing knowledge base and apply their understanding to various situations (Moon, 1999). Such critical reflections foster deep levels of learning.

A mechanism that instructors often use to improve learning in online discussions has been linking the student participations with assessment. Students learn faster and more effectively when they are provided with the feedback of their current performance and what might be needed in order to improve. A number of influential studies have confirmed the decisive role of feedback in quality teaching and student learning (Black and William, 1998; Ramsden, 2003). Constant student-faculty interactions and immediate feedback in CMC are suggested to raise the students comfort levels with technology and encourages them to be more proactive. Palloff and Pratt (2005) for example, describe the importance of community for effective learning in online environment. They concluded that a strong sense of community foster connectedness among the participants thereby increasing sharing and discussion of subject matter. Further, it reduces the feeling of isolation, burnout and engage the community members in deep exchange of ideas.

Method

Participants and Procedure

The purpose in the current article is twofold. First, the question of how well the existing theories on online environment, namely ‘Theory of Online Learning’ (Anderson, 2004) and ‘Media Richness Theory’ (Daft and Lengel, 1986) applies to and account for students’ interaction in online discussion forum is investigated. Secondly, the role of such online interaction on perceived learning is examined. More specifically, it is hypothesized that, the use of ODF along with face-to-face lectures provides a richer communication context and facilitates effective student interaction and learning.

To examine the stated objectives, a discussion forum was used to extend the learning activities beyond the class. The sample for the study was taken from the four class sections that were conducted using an electronic bulletin board in the MBA program of a leading private university in India from January 2008 through December 2008. All students were enrolled in the university’s classroom-based MBA program. The four sections followed similar instructional content and discussion questions were posted on a weekly basis. The instructors demonstrated the discussion board and its navigation to the students at the beginning of the course and were informed about their requirements for participation. The instructor first posted a question focused on the course content covered in the ongoing week; the students then were required to post their responses or comments to the instructor and group members’ postings. The discussion questions were taken from the issues that arose in the classroom teaching and from the assigned readings. Students were encouraged to integrate their learning from other students’ entries, classroom learning and assigned readings within their postings. As suggested by Wenger (1999), we viewed ODF as an extension of classroom, where the students make sense of subject under review through collaborative discourse and community of practice. The instructor’s role was confined to moderating the discussions, reply to questions that students could not answer and provide feedback to the students. Feedback was provided on the following four categories namely content, participation, expression, and contribution (adapted from Edelstein and Edwards, 2002). Data collection was completed at the end of the course. The instructor administered the survey questionnaire as part of a course evaluation survey. A total of 227 functional responses were collected for the study.

Measures

A pre-test of the questionnaire incorporating items for the factors identified in the literature review was conducted prior to the actual survey to enable refinement of the measurement scale and to check for any ambiguous or loaded questions. The final survey consists of 43 items that measured ten constructs. The measures are described as below.

Facilitating Discourse - The measures for facilitating discourse was adapted from Anderson and his colleagues’ (2001) work on teaching presence. They describe facilitating discourse as the process of engaging students in online interaction. This requires the instructor to read, comment upon, encourage students to participation, and give clear instruction to move discussions in a desired direction for effective learning. The measurement scale consisted of four Likert-style items that assessed the instructors’ role in facilitate the online discussions. Each item was measured on a seven point Likert scale with points labeled “1” (strongly disagree) and “7” (strongly agree).

Personality Traits – This study included only the extraversion dimension of the Big Five personality traits. Traits frequently associated with extraversion include being sociable, talkative, active, assertive and gregarious. Extraversion was measured using the six-item 7-point Likert scale anchored by “1” (strongly disagree) to “7” (strongly agree) adapted from Big Five Inventory (BFI: John 1990).

Internet Efficacy – The internet efficacy refers to students’ “proficiency and comfort with online environments” (Anderson, 2004, p. 36). The measurement scale was adapted from the Deci and Ryan’s (1985) Intrinsic Motivation Inventory (IMI). Six-Likert scale items that measured the students’ perceived competence was used to measure internet efficacy.

Reflective Thinking – Reflective thinking was measured with the reflective thinking questionnaire (RTQ, Kember *et al.* 2000). According to Kember *et al.* (2000) the reflective thinking is described as the student’s ability to understand, analyze and interpret the situations from various perspectives and come with guiding principles. The scale consists of four items measured on a seven point scale. Items were scored so that higher numbers indicated greater perception of reflective thinking.

Personalization – The personalization scale adapted from Wang’s (2003) study contains four-Likert style items that assess the ability to personalize the learning process in ODF.

Assessment and Feedback – The scale for assessment and feedback contains three items developed for this study from previous literature. These items were measured on a seven-point Likert scale anchored on “1” (strongly disagree) to “7” (strongly agree).

Community – Community or the mutual interdependence and connectedness among the forum participants was measured using three items measured on a seven-point Likert scale adapted from Rovai’s (2003) classroom community scale.

Media Richness – Based on works by Kock, Verville and Garza (2007) and Dennis, Kinney and Hung’s (1999), the six-item media richness scale was constructed as a measure of the extent to which the ODF provides rich communication context. Items ranged from ‘ability to easily explain things’ to ‘communication being ambiguous in the online environment’.

Interaction – The interaction scale consisting of four items was adapted from Marks, Sibley and Arbaugh (2005) study. The scale measured the quality of interactions in the ODFs and was anchored on a seven-point Likert scale. The four items that measured interaction were – ‘quality of discussions was high’, ‘the online discussions were not interactive but were just a series of messages posted’, ‘discussions engaging and participative’ and ‘interaction between instructor and class was high’.

Perceived Learning – The perceived learning scale was adapted from IMI inventory of self-determination theory (Deci and Ryan, 1985). The three items – ‘was of some value to me’, ‘was useful aid for learning’ and ‘stimulated my desire to learn’ – were anchored on seven points of “1” (strongly disagree) to “7” (strongly agree).

Data Analysis

Hierarchical regression analysis was used to test study objectives. To test the first objective of the study, hierarchical regression was used with interactivity as dependant variable. The order of entry of variables was based on logical and theoretical considerations. The most exogenous predictors were entered first and the most endogenous predictors last. Select demographic variables such as gender, semester and instructor was entered on the first step, the online learning variables on the second step, and media richness on the third, and final step.

Consistent with previous research that women find discussion forums highly useful (Guiller and Durndell, 2007), gender was introduced in the analysis. In addition, some sections were taught in the Jan-May semester, while others were taught in the Aug-Dec semester. Instructors also were different for each of these sections. This could possibly result in seasonal effects. While there is not enough variation in the data to control these effects, semester and instructor dummy variables should allow us to capture these effects. Consequently, gender, semester and instructor dummy variables were used for further analysis. To test the second objective, perceived course learning was regressed onto interactivity and media richness.

Results

Of the 227 participants, 124 (54.6%) were female, and the vast majority of the sample were of traditional age. The students had no prior experience with ODFs and about 65 percent were part of the January-May semester. The students posted an average of 4.4 messages during the course.

An exploratory factor analysis was performed on the seven independent constructs and the result of this analysis is presented in Table 1. It can be clearly seen from the exploratory factor analysis that the seven factors separate sufficiently. Most loadings were above 0.70, and all loadings were significant at the $p < 0.01$ level. Further analysis of these constructs was carried out to substantiate the findings. To determine whether the scales used were functioning properly, the reliability for each of the scales included in the study was calculated. Coefficient alpha values for each of the constructs included in the model can be found in table 1 along with composite reliability estimates calculated. The results indicated the measures were internally consistent and reliable. Discriminant validity was assessed based on the Fornell and Larcker (1981) recommendation that square root of average variance extracted estimates should exceed the absolute value of the standardized correlation of the given construct with any other construct in the analysis. Table 2 presents the square root of the average variance extracted measures (in diagonal) and the correlations for each pair of constructs. The results showed that all variances extracted were greater than the correlations; indicating that each construct is empirically distinct. Pearson r correlation coefficients were calculated to identify any noteworthy patterns in the data. The correlations indicate that interaction correlated significantly with personality, facilitating discourse, reflective thinking, personalization, assessment, community and media richness. Perceived learning was highly correlated with both media richness ($r = 0.52$, $p < .01$) and interactivity ($r = 0.58$, $p < .01$). Means and standard deviations of the study variables are also presented in the table 2. To summarize, the psychometric properties of the measures are acceptable.

Table 1

Initial Exploratory Factor Analysis and Reliability of the Main Constructs

Measurement Items	Factor Loading	α	Composite Reliability
Internet Efficacy		0.86	0.89
I think I am pretty good at this activity	0.64		
I think I did pretty well at this activity, compared to other students	0.73		
After working at this activity for a while, I felt pretty competent	0.81		
I am satisfied with my performance at this task	0.81		
I am pretty skilled at this activity	0.77		
This was an activity that I could do very well	0.81		
Personality		0.86	0.90
Talkative	0.76		
Outgoing and social	0.78		
Full of energy	0.77		
Quite	0.81		
Shy and inhibited	0.79		
Assertive	0.69		
Facilitating Discourse		0.87	0.91
The instructor was helpful in guiding the online discussions towards agreement/understanding about course topics.	0.86		
The instructor encouraged students to explore concepts or exploration of new ideas	0.84		

The instructor held me engaged and participating in productive dialog	0.85		
The instructor helped keep the participants on task in a way that assisted me to learn	0.67		
Reflective Thinking		0.84	0.90
It requires us to understand concepts to post messages	0.81		
During the online discussions I discovered faults in what I had previously believed to be right	0.85		
Helped me explore issues, take and discuss positions in an argumentative format	0.82		
I was able to apply the knowledge gained during the course to support my online arguments	0.78		
Personalization		0.78	0.82
Enables me to learn the content I need	0.76		
Enables me to choose what I want to learn	0.78		
Enables me to control my learning process	0.80		
Records my learning process and performance	0.70		
Assessment		0.85	0.91
There is sufficient feedback on activities and assignments posted to ensure that we learn from the work we do	0.84		
The assessment of postings tested our understanding of the key concepts learnt	0.80		
Instructor and peer assessments of my postings were interesting and stimulating	0.86		
Community		0.80	0.88
I felt that I could freely communicate with other students	0.76		
I felt more connected to others	0.75		
The activities helped me feel part of the class	0.79		

A series of independent t-tests was conducted to compare sample means on all variables of interest between the instructors, semester and gender. For instructor, significant difference was found on personalization [$M_{A1} = 4.29$, $M_{A2} = 3.89$, $t(225) = 2.842$, $p = .005$]. In case of gender, significant differences were found on reflective thinking [$t(225) = 1.853$, $p = 0.065$] and personalization [$t(225) = 1.954$, $p = .052$]. No significant difference was observed on the variables for semester the students were taught. Further, analysis of the number of postings did not present significant differences between gender, instructor and semester (Gender: $N_m = 4.77$; $N_f = 4.64$, $F = 1.441$, $p = 0.231$, Instructor: $I_{A1} = 4.68$, $I_{A2} = 4.72$, $F = .005$, $p = 0.941$, Semester: $S_I = 4.67$, $S_{II} = 4.76$, $F = 1.392$, $p = 0.239$). The insignificant findings in gender participation confirm the absence of social status cues such as gender in CMCs resulting in democratisation effects.

To investigate the antecedents of interactions in ODF according to ‘online learning theory’ and ‘media richness theory’, a hierarchical regression was carried out. Table 3 shows a summary of the regression models in which interaction was entered as dependent variable. Equation 1 in the table 3 shows the test of select demographic variables on interactivity. Dummy variables were used to determine any effects by gender (1 – male; 0 – female), instructor (1 – first author; 0 – second author) as well as semester (0 – Jan/May; 1 – Aug/Dec) on interactions in ODF. The control variables - instructor and semester had no significant relationship with interaction in ODFs. The results demonstrate the absence of seasonal effects from the instructional delivery followed by the authors. As proposed earlier, gender was significant; however males perceived interactivity in ODFs as high.

Table 2

Descriptive Statistics: Means, Standard Deviations, Correlations and Discriminant Validity of the constructs

	Mean	Std.Dev	1	2	3	4	5	6	7	8	9	10
Internet Efficacy	5.16	0.92	(0.75)									
Personality	4.95	1.01	0.06	(0.79)								
Facilitating Discourse	4.27	1.21	0.05	0.03	(0.85)							
Reflective Thinking	4.00	1.15	0.01	0.08	-0.07	(0.83)						
Personalization	4.08	1.07	0.06	0.01	0.04	0.32**	(0.74)					
Assessment	4.95	1.34	-0.01	0.07	0.37**	0.15*	0.02	(0.87)				
Community	4.81	1.05	0.08	0.06	0.54**	0.03	0.09	0.44**	(0.85)			
Media Richness	4.17	0.86	0.11	0.26**	0.33**	0.27**	0.10	0.27**	0.28**	(0.73)		
Interactivity	4.26	1.05	0.11	0.17*	0.48**	0.23**	0.15**	0.43**	0.49**	0.62**	(0.72)	
Perceived Learning	4.71	1.35								0.52**	0.58**	(0.76)

Note: ** - Correlation is significant at the 0.01 level (2-tailed); * - Correlation is significant at the 0.05 level (2-tailed)

Values in parenthesis represent square root of average variance extracted

To test the antecedents of interaction in ODF according to ‘online learning theory’, the seven independent constructs were regressed onto interaction. The results revealed that personality, facilitating discourse, assessment and community made significant contributions to predicting the variance in interactions (R Square value = 0.43; Adjusted R Square value = 0.40; $F_{10,216} = 16.15$, $p < 0.01$). As shown in the table 3, personality was significant in predicting interactions in ODFs ($\beta = 0.11$, $p < 0.05$); students high on extroversion personality show increased preference and interactivity in asynchronous threaded discussions. The role of instructor in facilitating discourse was most important among the factors in achieving the learning objective in online environment. In fact, facilitating discourse has the largest path coefficient, .30, of any latent variable. Reflective thinking was significant in contributing to interactions in ODFs. The students get expanded opportunities to reflect upon their thinking when ODFs are used along with traditional classrooms ($\beta = 0.24$, $p < 0.01$). As proposed by earlier studies, assessment had a significant positive effect on interactions ($\beta = 0.19$, $p < 0.05$). The sense of connectedness or community among students greatly influenced the interactivity in ODFs ($\beta = 0.24$, $p < 0.01$). This is similar to the findings of other studies (Rovai, 2002; Woods and Ebersole, 2003). The insignificant effect of internet efficacy on interactivity is consistent with the arguments proposed by Anderson (2004). The students need to demonstrate a strong sense of internet efficacy for effective online learning. Consequently, the upper quartile was recoded as strong internet efficacy and was tested for difference in interactivity, media richness, perceived learning and number of postings. The results from the one sample t-test presented no significant difference between the two groups ($F_{\text{Interactivity}} = .390$, $p = .533$; $F_{\text{mediarichness}} = .002$, $p = .967$; $F_{\text{learning}} = 1.117$, $p = .292$).

Table 3
Results of the Hierarchical Regression Analysis

Independent Variables	Interaction						Perceived Learning	
	1		2		3		4	
	Standardized Coefficients	Std. Error	Standardized Coefficients	Std. Error	Standardized Coefficients	Std. Error	Standardized Coefficients	Std. Error
Gender	0.02	0.14	0.11**	0.11	0.09**	0.10		
Instructor	0.03	0.14	0.01	0.11	0.04	0.10		
Semester	-0.01	0.15	-0.04	0.11	-0.04	0.10		
Internet Efficacy			-0.06	0.06	-0.02	0.05		
Personality			0.11**	0.05	0.02	0.05		
Facilitating Discourse			0.30*	0.05	0.18*	0.05		
Reflective Thinking			0.21*	0.05	0.10**	0.05		
Personalization			0.06	0.05	0.06	0.05		
Assessment			0.19**	0.05	0.15*	0.04		
Community			0.24*	0.06	0.20*	0.06		
Media Richness					0.43*	0.06	0.23*	0.08
Interaction							0.44*	0.06
R ²	.001		0.43		0.56		0.37	
Adjusted R ²	-0.12		0.4		0.54			
Overall F-ratio	.096		16.15*		25.26*		66.23*	
D.f.	3		10		11		2	
R ² change			0.43*		0.13*			

Note: ** - indicates significant at the 0.05 level; * - indicates significant at the 0.01 level.

To test the 'media richness' hypothesis in predicting interactions, the perceived media richness was entered in to the equation (R^2 change = 0.13, $p < .001$). As expected, perceived media richness was significant in predicting participation and interactivity in ODFs ($\beta = 0.43$, $p < 0.00$). However, when perceived media richness was entered in to the equation the personality coefficient became insignificant, while the strength of the other relationships remained partially intact. These results indicate the presence of mediating effects among the variables of study (James and Brett, 1984).

To test the second objective, interactivity and media richness were regressed on perceived learning. The model was significant ($F = 67.719$, $p < 0.00$) with both interaction ($\beta = 0.42$, $p < .00$) and media richness ($\beta = 0.25$, $p < 0.00$) contributing significantly to perceived learning in ODFs. The interaction between the interactivity and media richness on perceived learning was insignificant ($\beta = 0.085$, $p = .254$) suggesting direct influence of the predictor variables. The findings confirm that perceived learning is influenced by both interactivity and media richness of the ODF.

Discussion and Implications

The current empirical study sought to determine the antecedents and outcomes when ODF was used along with face-to-face lectures. The 'Theory of Online Learning' and 'Media Richness Theory' was used to investigate the factors that influence interaction and learning in ODFs. The proposed model is limited to an initial exploratory approach, rather than a definitive one, because of methodological considerations.

This study provides several important findings. First, it is strongly suggested that the role of instructor in facilitating the discussion influences interactions in ODF. This result provides evidence that facilitating discourse has a strong positive effect on the student's interactions, corroborating findings by Menchaca and Bekele (2008) and Dennen, Darabi and Smith (2007) in the distance education and online learning areas. The instructor's role in the online discussion is essential in maintaining the interest and motivation of students to participate in ODFs. In the current study, pedagogical and scaffolding strategies were used to reduce the task ambiguity and improve interest and motivation of the students. Various online activities like web explorations, discussion of assigned readings, field observations and reading reactions were designed for increased online participation. The students reported that detailed instructions provided for completing the activities, regular feedback from the instructor and increased communication among students encouraged greater participation. Further, as proposed by Wu and Hiltz (2004), discussions were kept open for a week for the students to think about the concepts and issues thoroughly. Thus, maintaining an appropriate facilitation can direct student's progress from exploration to the integration and resolution phases and promote a deeper understanding of the course content (Garrison and Arbaugh, 2007).

Second, there is clear evidence from this study to confirm that assessment in online environment significantly influenced the student's interactions. This finding is in line with an earlier study by Gilbert and Dabbagh (2005) who suggested that evaluation rubrics positively influence meaningful discourse and enabled course improvement. While in the current study, timely feedback based on content (understanding of topic, reflection, and knowledge construction), participation (timely, adequate and valuable online presence), expression (clarity in presentation), and contribution (addition to the learning) was given to the students. However, this rubric was used to provide students with feedback and not for formal evaluation. The students often commented that the instructors' feedback have been encouraging and constructive.

In ODFs, the assessment opportunities are more frequent than face-to-face classrooms as students can simultaneously communicate with each other and with the instructor. The ODFs provide a greater opportunity for the instructor to provide faster feedback to the student's work. In addition, students have access to quick feedback from peers. The immediacy of feedback in the online environment thus gives a greater opportunity to communicate with instructor and other students leading to enhanced student interactions.

Third, ODFs provide expanded opportunities for students to share their thinking with each other and the instructor. Consistent with existing research evidence, these results confirm that reflective thinking cultivates meaningful interactions in ODFs. These results are important as Ellis *et al.* (2007) in his study suggests absence of reflection in face-to-face classrooms compared to online discussions. The current findings also indicated that sense of connectedness or community among the students increased the interactions in online environment. The multiple levels of discourse in ODF create ties among the students and promote academic participation. They fulfill an important social network function and build an effective learning community. Previous studies report reciprocity and mutuality as prerequisites to formation of online learning communities (Rovai, 2002). The present findings, in line with the ethnography work by O'Reilly *et al.* (2007) and correlation work by Dawson (2006), support that sense of community or connectedness among the students' influences their forum contributions.

Perhaps the most surprising finding of this study is the non-significant relationship between personalization and interactions. This result is in contrast to the widely accepted view that online environment allows the learner flexibility to access course material and progress through the material at their own pace. The grading process, weekly posting of new discussion questions and volume of student postings could be the possible explanations for this non-significant relationship. Similarly, in this study non-significant relationship was found between internet efficacy and interactions. Two possible explanations could be proposed. First, examination of the data revealed that almost all students had more than two years of internet experience. Second, the instructor's demonstration of the navigation of ODF to the students might have contributed to this non-significant result.

Lastly, the results support findings by Gellevij *et al.* (2002) that suggests that use of multiple medium of instructions lead to better student performance. Using ODFs along with the classroom lectures maximizes the information processing through both verbal and non-verbal communication cues. Media richness theory argues that using appropriate media will improve the task performance. In this paper, the current understanding of 'media richness theory' is extended by proposing that using ODFs with face-to-face classrooms can provide a rich communication context and thus influence interactions and learning.

Conclusion

The present study is significant in its attempts to draw on different theories to investigate the antecedents and outcomes of using ODFs along with classroom lectures. The findings indicate that facilitating discourse, reflective thinking, assessment and connectedness contribute to interactions in ODFs. From the practical perspective, the present study suggests that using multiple medium of instruction enriches the communication context and leads to enhanced learning. Some limitation of this study may warrant further consideration in future research. First, the regression results must be interpreted with caution. It is advisable to use more powerful statistical approaches like structural equation modeling or experimental design to enable the

testing of relationships among the constructs. Second, instructional tools other than ODF could be investigated and compared with classroom lectures for their perceived effectiveness in meeting the learning objectives. Further, qualitative methods, as used in previous research are needed to analyze the content of the postings and make inferences about the level of reflective thinking, and sense of community among the forum members.

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