

Antecedents and Outcomes of Flow Experience of MOOC Users

By: Shrikant Mulik, Manjari Srivastava, Nilay Yajnik, and [Vas Taras](#)

Mulik, S., Srivastava, M., Yajnik, N., & Taras, V. (2019). Antecedents and Outcomes of Flow Experience of MOOC Users. *Journal of International Education in Business*, 13(1), 1-19.
<http://dx.doi.org/10.1108/JIEB-10-2018-0049>

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Abstract:

Purpose: This paper aims to develop and empirically test a model of relationships between antecedents and outcomes of flow experience of users of massive open online courses (MOOC). **Design/methodology/approach:** The researchers surveyed individuals primarily from India, who had enrolled in at least one MOOC offered by MOOC providers such as Coursera, edX and FutureLearn. The data were collected from 310 individuals using an online questionnaire. The partial least squares technique of structural equation modeling (PLS-SEM) was used to test the reliability and validity of the data, and the study's hypothesized relationships. **Findings:** The study found support for identification of telepresence, challenge and skill as antecedents of flow experience. MOOC satisfaction and MOOC usage intention were found to be the outcomes of flow experience, as hypothesized. The study also found the mediating role of MOOC satisfaction in the relationship of flow experience and MOOC usage intention. **Practical implications:** The findings indicate that if the MOOC providers can orchestrate flow experience for MOOC users then that will increase the satisfaction of MOOC users, which will lead to increase in MOOC adoption. **Originality/value:** The study makes the contribution towards better understanding of flow experience in the context of MOOC usage by identifying both antecedents and outcomes of flow experience. Further, it highlights the influencing role of flow experience on MOOC adoption.

Keywords: usage intention | flow experience | massive open online course (MOOC) | MOOC adoption | MOOC satisfaction

Article:

1. Introduction

Massive open online course (MOOC) is a recent phenomenon in education domain. It is an online course, which can be accessed using a computer or a smart phone. It is typically taken by an adult learner and lasts four to six weeks. As MOOCs are designed for massive enrolment, they depend on videos for information delivery, and quizzes and peer-reviewed assignments for

assessment. They offer online discussion forums for interaction among learners and teachers. Majority of MOOCs are offered for free. However, often fees are charged for certification.

MOOC offers many benefits over traditional education model: it can reach a large number of students; provide high-quality course content at low or zero cost; and give unparalleled insights into human learning (Welsh and Dragusin, 2013). Purely from a student perspective, MOOC offers an advantage over traditional lecture-based course due to its greater flexibility, customization, and accessibility, which results into structured self-paced learning (Bruff *et al.*, 2013). In spite of these benefits, MOOC suffers from certain weaknesses, such as difficulty in authoritative assessment of written work utilizing critical thinking skills, reliable authentication for certification of students and inability to provide frequent interaction between faculty and students (Welsh and Dragusin, 2013). MOOCs are also criticized for concentration of their users in the world's most advanced countries and the low completion rates (Reich and Ruipérez-Valiente, 2019).

MOOC received attention when in 2011 one of the early MOOCs, a MOOC on Artificial Intelligence from Stanford University, attracted 160,000 students from across the globe out of which 23,000 finished the course (Waldrop, 2013). MOOC further gained hype when the New York Times declared 2012 as the Year of MOOC (Pappano, 2012). Since those days, numbers of MOOCs and MOOC users have increased significantly. As reported in January 2019 by a MOOC aggregator, Class Central, 101 million students enrolled in 11,400 courses offered by 900+ Universities in 2018. Though there are many MOOC providers, Coursera, and edX, each having more than 10 million registered users, were reported to be top two MOOC providers. While USA tops the list of countries for the number of MOOC users, the number of MOOC users is rising in countries like India, China and Brazil. Edx, for example, has reported 79 per cent of its users from USA, 10 per cent users from India, 14 per cent from Latin America and rest from Africa. The median age of Edx users is 28 and 63 per cent of its users have age more than 25 years. In total, 62 per cent of Edx users are reported to be male (Shah, 2019).

Though the number of MOOC users seems to be large, the potential is even bigger on a global scale. Given that there are more than 3.5 billion internet users, more than 2.2 billion Facebook users, more than 2 billion Android users and more than 1.3 billion YouTube users, one can see the potential for MOOC adoption. In this context, it would be useful to identify the factors that can influence MOOC adoption. Many researchers have taken up this task in last few years. For example, Chang, Hung and Lin (2015) investigated the influence of learning styles on the learners' intentions to use MOOCs. In a later study, Wu and Chen (2017) proposed and tested a unified model integrating the technology acceptance model (TAM), task fit technology (TTF) model, MOOCs features and social motivation to investigate continuance intention to use MOOCs. In another study, Khan *et al.* (2017) applied task- technology fit model, social motivation and self-determination theory to predict the acceptance of MOOCs in a developing country. Similarly, Ma and Lee (2019) used the technology–user–environment (TUE) conceptual framework to identify influential drivers for intention of MOOC adoption in developing country. The present study intends to continue this exploration of factors influencing MOOC acceptance but focuses on the impact of flow experience. Specifically, it proposes and empirically tests a model of relationships between antecedents and outcomes of flow experience of MOOC users wherein MOOC users are viewed as consumers of MOOC platform.

This paper is organized as follows. In Section 2, it will review the literature about flow experience. It will then delve into the development of the research model in Section 3, based on extant literature. It will then describe the methods and data analysis results in Sections 4 and 5. The paper will conclude with a discussion of the results in Sections 6 and 7.

2. Flow experience

The concept of flow experience stems from the studies on motivation in sports and music, particularly that related to external rewards (de Manzano *et al.*, 2010). Csikszentmihalyi (1990) has defined flow as the state in which people are so involved in an activity that nothing else seems to matter; the experience itself is so enjoyable that people will do it even at great cost, for the sheer sake of doing it. The flow experience is also called as “being in the zone” by athletes, “ecstasy” by religious mystics and “aesthetic rapture” by musicians (Csikszentmihalyi, 1990).

Flow experience is characterized by following nine dimensions: challenge-skill balance, merging of action and awareness, clear goals, immediate feedback, high concentration, sense of control, loss of self-consciousness, the transformation of time and autotelic experience (Csikszentmihalyi, 1990). These nine dimensions can be categorized into three stages: antecedents, experiences and outcomes (Chen *et al.*, 1999). The antecedent stage describes the prerequisites for entering the flow state and includes the perceptions of clear goals, immediate feedback and matched skills and challenges. The second stage includes the dimensions that are perceived during the flow state and includes the merger of action and awareness, high concentration and a sense of potential control. The final stage, outcomes describe the person’s inner experiences focusing on the effects after entering the flow states. It comprises a loss of self-consciousness, time distortion and autotelic experience.

There are numerous studies on analyzing the role of flow experience during different types of activities such as chess playing, piano playing, athletic sports and learning. When the relationship between subjective flow reports and psycho-physiological measures were analyzed by using piano playing as a flow-inducing behavior, significant relation was found between flow and psycho-physiological measures such as heart period, blood pressure, heart rate variability, activity of the zygomaticus major muscle, and respiratory depth (de Manzano *et al.*, 2010). In another study, out of 35 students of a sixth-form college in the West Midlands, UK, those who experienced flow as optimal experience were found to score significantly higher on measures of psychological well-being than those who did not experience flow as highly enjoyable (Clarke and Haworth, 1994). In a similar study but in the school context, the motivation and quality of experience of demographically matched students from Montessori and traditional middle school programs were compared. This study found that the Montessori students reported greater affect, potency, intrinsic motivation, flow experience and undivided interest while engaged in academic activities at school, as compared to traditional middle school students (Rathunde and Csikszentmihalyi, 2005). Guo and Ro (2008) found that undergraduate students in an American University experienced flow during classroom lectures. In this study, feedback, goal clarity, interest and balance of challenge and skill lead to flow experience which further lead to concentration, control and enjoyment. In another study, Fu *et al.* (2009) argued that e-learning

games can be developed for achieving learning objectives via the creation of a flow effect and developed a scale called eGameFlow to measure learners' enjoyment of e-learning games. When Hamari *et al.* (2016) conducted field survey among 134 high school students and 40 undergraduate students from USA, they too found that flow impacts learning in the game-based learning environment.

In a study conducted to examine the mediating role of flow on user behavior, perceived task challenge and sense of being in control were found to be the key determinants of the state of enjoyment and intense concentration called optimal flow (Ghani and Deshpande, 1994). In this study, the flow was linked to exploratory user behavior which in turn was linked to the extent of computer use.

In their conceptual paper, Hoffman and Novak (1996) examined the role of flow in a web environment. They defined flow on the web as a cognitive state experienced during online navigation that is determined by high levels of skill and control; high levels of challenge and arousal and focused attention and is enhanced by interactivity and telepresence. Based on the empirical study, this theoretical model was revised in which skill, challenge, telepresence and interactive speed were identified as antecedents for flow experience (Novak *et al.*, 2000). The same set of antecedents along with their scale was used to examine the role of flow experience in e-retailing (Rose *et al.*, 2012). This study further identified online shopping satisfaction and trust in online shopping as outcomes of flow experience. In both these studies, the flow experience was itself measured with a three-item scale following a narrative description of flow.

When Rossin *et al.* (2009) examined the effects of flow on learning outcomes in an online information management course taken by 45 MBA students in an American University; they found that flow impacts students' perceived learning of the subject matter, students' perceived skill development, and student satisfaction. They however, did not find support for relationship between flow and learning performance. It is interesting to note that the authors found the similar results when they conducted similar studies for classroom based courses (Klein *et al.*, 2010).

The relationship between flow experience and satisfaction was also found in a study involving 462 e-learners in South Korea (Joo *et al.*, 2013). Cheng (2014) too found that flow experience leads to satisfaction in a study involving 378 Taiwanese nurses using blended e-learning system. This study also found that both flow experience and satisfaction lead to intention to continue to use blended e-learning system.

In a related study, the effect of flow experience on user adoption of mobile TV was examined (Zhou, 2013a). Similar to Koufaris (2002), this study considered three dimensions of flow, namely, perceived enjoyment, perceived control and attention focus. It found that flow experience is one of the determinants of usage intention. In a similar study, the effect of flow on user adoption of mobile games was examined wherein it was found that flow is positively related to usage intention (Zhou, 2013b).

3. Model development

Figure 1 presents our conceptual model of flow experience of MOOC users. This model is comprised of three blocks of variables: antecedent variables, core variable and outcome variables. Each block is reviewed in detail below.

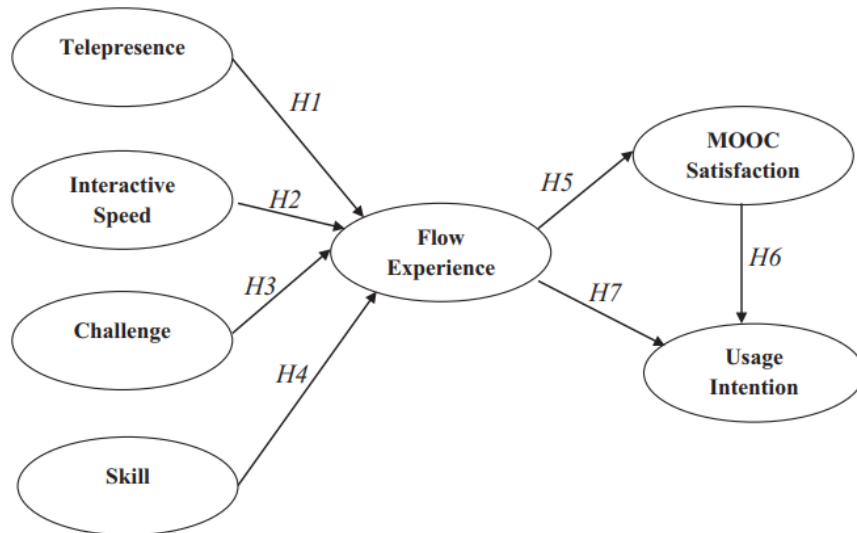


Figure 1. Proposed research model

3.1 Antecedent variables

The antecedent block includes four variables: Telepresence, Interactive Speed, Challenge and Skills affect core variable of Flow Experience, which in turn influences two outcome variables, namely, MOOC satisfaction and usage intention. Hoffman and Novak's (1996) conceptual model proposed five antecedent variables for flow experience, namely, telepresence, interactive speed, challenge, skills and focused attention. However, in a quantitative study based on this model, no support was found for the focused attention as the antecedent of flow experience (Novak *et al.*, 2000). Hence, this study includes remaining four antecedent variables in the proposed model.

Telepresence, or the mediated perception of the environment, can be defined as the perception that the virtual environment with which one is interacting is more real or dominant than the actual physical environment. Hoffman and Novak (1996) introduced this antecedent of flow and it was later supported in a follow-up study (Novak *et al.*, 2000). Telepresence was also found to be an antecedent of flow experience in (Guo *et al.*, 2012, 2016; Rose *et al.*, 2012). Similarly, Faiola *et al.* (2013) found a correlation between telepresence and flow experience.

Interactivity is defined as the extent to which users can participate in modifying the form and content of a mediated environment in real time. Steuer (1992) has identified three factors viz. speed, range and mapping, that contribute to interactivity. Speed refers to the rate at which input can be assimilated into the mediated environment. Range refers to the number of possibilities for action at any given time. Mapping refers to the ability of a system to map its controls to changes in the mediated environment in a natural and predictable manner. Interactivity was defined to be an antecedent of flow experience in original Hoffman and Novak's conceptual model (Hoffman and Novak, 1996). This relationship was validated in (Huang, 2003; Choi *et al.*, 2007). When

measuring this construct, Novak and colleagues (2000) developed a scale for only speed aspect of interactivity. Hence the construct was named as Interactive Speed. In the present context, interactive speed is being defined as the rate at which user can interact with MOOC site.

One of the key dimensions of flow experience is challenge-skill balance (Csikszentmihalyi, 1990). Using MOOC would involve challenges that require appropriate skills to tackle. If there are inadequate skills as compared to the challenges, then the user would become anxious. On the other hand, if skills exceed what is needed for the challenges then the user would get bored. Only when the skills meet the requirements for the challenges, the flow could happen. Hoffman and Novak (1996) identified challenge and skill as two separate antecedents of flow experience. Later Novak and colleagues (2000) measured these constructs using a series of pretests and pilots. Rose *et al.* (2012) considered both these constructs as antecedents of flow experience in e-retailing context. A study examining challenge and skill as antecedents of flow experience in distance learning environment has found support for the same in (Liao, 2006). Similarly, challenge and skill were found to be antecedent of flow experience in mobile game application (Su *et al.*, 2016). In the present context, challenge specifies the opportunities available to the user for action while using MOOC, whereas skill refers to the capacity of the user for action while using MOOC.

Based on this support from literature, following four hypotheses identifying four antecedent variables for flow experience are proposed:

H1. Telepresence positively affects flow experience during use of MOOC.

H2. Interactive speed positively affects flow experience during use of MOOC.

H3. Challenge positively affects flow experience during use of MOOC.

H4. Skill positively affects flow experience during use of MOOC.

3.2 Outcome variables

In this model, MOOC satisfaction and usage intention are identified as two outcomes of flow experience. Similar to Khalifa and Liu (2007), who have identified three types of online shopping satisfaction, namely, pre-purchase, at-purchase and post-purchase satisfaction, this model identifies three types of MOOC satisfaction, namely, satisfaction in using content, satisfaction in getting assessed and satisfaction in interacting with peers and teachers. In MOOC, using content involves watching videos and reading online articles. Assessment in MOOC happens through online quizzes (typically auto-gradable multiple-choice questions) and peer-reviewed assignments. Learners can interact with one another and with teachers or teaching assistants using online forums or in some cases, by means of video conferencing sessions using tools such as Google Hangout or Microsoft Skype.

Usage intention is identified as the other outcome of flow experience. Technology Acceptance Model (TAM) and related models have established usage intention or behavioral intention as a predictor of behavior i.e. usage (Davis, Bagozzi and Warshaw, 1989; Lee, Kozar and Larsen,

2003; Venkatesh *et al.*, 2003). Usage intention in the present context is defined as the degree to which a person has formulated conscious plans to use MOOC.

Flow experience is found to have an impact on satisfaction (Ding, Hu and Wardell, 2010; Hsu, Chang and Chen, 2012; Rose *et al.*, 2012; Choi *et al.*, 2016). It is also found to have impact on intention to use distance learning system (Liao, 2006), world wide web (Agarwal and Karahanna, 2000), mobile TV (Zhou, 2013a), instant messaging (Lu, Zhou and Wang, 2009), mobile banking (Zhou, 2012) and mobile games (Zhou, 2013b). Satisfaction is also found to lead to usage intention (Khalifa and Liu, 2007; Ranaweera, Bansal and McDougall, 2008; Martin, Mortimer and Andrews, 2015). Based on this support from literature, following three hypotheses are proposed:

H5. Flow experience positively affects MOOC satisfaction.

H6. MOOC satisfaction positively affects usage intention.

H7. Flow experience positively affects usage intention.

4. Method

To test the proposed model, the survey research technique was used. As the respondents should have experienced at least one MOOC to answer the questions regarding their flow experience, the survey questionnaire was needed to be circulated to only those individuals who would have used at least one MOOC. Respondents would have not been able to answer the questions regarding flow experience unless they would have used at least one MOOC. Hence purposive sampling method was used to collect the data. An online questionnaire was sent to individuals from the professional network of authors, primarily from India, who would have used MOOC. Email and social media tools, namely, Facebook, LinkedIn and WhatsApp were used to circulate this online questionnaire. To ensure that only MOOC users respond to the questionnaire, the questionnaire clearly mentioned that one should respond to the questions only if he/she has enrolled in at least one MOOC. No incentive was offered for responding to the questionnaire. After cleansing, a total 310 usable responses were obtained.

The sample had 73 per cent of respondents of age more than 25 years. It had 73 per cent male respondents. Full-time college students constituted 24 per cent of sample, while rest of sample consisted of working professionals. Around 60 per cent of respondents had education beyond graduation. Though all respondents had enrolled in at least one MOOC, 25 per cent per cent of them didn't complete even one MOOC. Majority of respondents (around 85 per cent) had enrolled in less than six MOOCs. While 75 per cent of respondents completed at least one MOOC, only 7 per cent of respondents completed more than five MOOCs. Table I shows the demographic details of the sample profile.

A questionnaire was created by referring to scale items from extant literature. All items were measured on a five-point Likert scale. Scales for antecedent variables were adapted from Novak *et al.* (2000). Consistent to studies by Novak *et al.* (2000) and Rose *et al.* (2012), flow experience was measured with a three-item scale following a narrative

description of flow. The narration of around 200 words explained the concept of flow experience so that the respondent can answer questions regarding their flow experience while using MOOC. The scale items for usage intention were adapted from the scale given in (Venkatesh *et al.*, 2003). The scale items were adapted for wording, wherever found necessary. Table II mentions these scale items.

Table I. Sample profile

Demographic	Category	No.	(%)
Gender	Male	226	72.90
	Female	84	27.10
Age	18-25	83	26.77
	26-40	107	34.52
	41-60	116	37.42
	60+	4	1.29
	Occupation	Student	74
	Professional	236	76.13
Education	Diploma	4	1.29
	Graduation	96	30.97
	Post-graduation	185	59.68
	Doctoral	25	8.06
No. of MOOCs enrolled	Zero	0	0
	1-2	186	60
	3-5	76	24.52
	6-10	27	8.71
	More than 10	21	6.77
No. of MOOCs completed	Zero	77	24.84
	1-2	167	53.87
	3-5	43	13.87
	6-10	10	3.23
	More than 10	13	4.19

Table II. Results of exploratory factor analysis

Theoretical construct	Item	1	2	3	4	5	6
Challenge	Using MOOC sites challenges me due to the difficulties involved in using them						0.584
	Using MOOC sites challenges me to perform to the best of my ability						0.684
	I find that using MOOC sites stretches my capabilities to my limits	0.460					0.497
	Using MOOC sites provides a good test of my skills	0.569					
Flow experience	Do you think you have ever experienced flow?				0.646		
	In general, how frequently would you say you have experienced “flow” when you use MOOC?				0.754		
	Most of the time that I have used the MOOC, I feel that I am in flow				0.764		
Interactive Speed	Content on MOOC sites usually load quickly					0.676	
	Interacting with MOOC sites is fast	0.513					0.464

Theoretical construct	Item	1	2	3	4	5	6
Usage Intention	When I use MOOC sites there is no waiting time between my actions and the response of MOOC sites	0.633					
	I intend to use MOOCs in future		0.805				
	I foresee that I would use MOOCs in near future		0.737				
Skill	I plan to use MOOCs in six months	0.572	0.406				
	I consider myself knowledgeable about finding right MOOC for me					0.747	
	I am extremely skilled at learning online		0.337			0.397	
Telepresence	I know how to find what I am looking for when using MOOC	0.444				0.436	
	I know somewhat more than most users about using MOOC	0.498		0.353			
	Using MOOC sites creates a new world for me, and this world suddenly disappears when I stop browsing			0.651			
	I forget about my immediate surroundings when I use MOOC sites			0.768			
	Using MOOC often makes me forget where I am			0.827			
MOOC Satisfaction	After using MOOC I feel like I come back to the “real world” after a journey			0.654			
	I am satisfied with my experience of using educational content (videos, readings, etc.) in the MOOC		0.622				
	I am satisfied with my experience of doing assignments/exercises in the MOOC		0.577				
	I am satisfied with my experience of online discussions/interactions in the MOOC	0.589	0.317				

Except for MOOC Satisfaction, all scale items were modeled as reflective items. Similar to how it was done by Khalifa and Liu (2007), different activities of MOOC use (i.e. using content, getting assessed and interacting with peers and teachers) were distinguished hence MOOC satisfaction was operationalized as a formative, emergent construct formed with items based on these activities. Table III mentions these scale items.

The analysis of data was performed using Partial Least Square Structural Equation Modeling (PLS-SEM) method. SEM could be done using either Covariance Based SEM or PLS-SEM. PLS-SEM was chosen over CB-SEM as it readily incorporates formative as well as reflective constructs (Hair, Ringle and Sarstedt, 2011; F. Hair *et al.*, 2014; Lowry and Gaskin, 2014). SmartPLS 2.0 M3 software was used for data analysis.

In PLS-SEM, the minimum sample size requirement is determined either by the ten-times rule (Barclay, Higgins and Thompson, 1995) or by a more differentiated rule of thumb provided by (Cohen, 1992). The ten-times rule indicates the minimum sample size to be ten times of the larger of (1) the indicators on the most complex formative construct and (2) the largest number of antecedent constructs leading to an endogenous construct as predictors. In the proposed research model, the indicators on the most complex formative construct are three, while the largest number of antecedent constructs leading to an endogenous construct is four. Hence the minimum sample size requirement is 40 as per the ten-times rule. On the other hand, the table for

sample size recommendation in PLS-SEM for a statistical power of 80 per cent given in (Hair *et al.*, 2014), which is based on (Cohen, 1992), indicates the minimum sample size requirement to be 65 for detecting minimum R^2 value of 0.25 for significance level of 5 per cent. The same table provides minimum size requirement of 191 for detecting the minimum R^2 value of 0.10 for a significance level of 1 per cent. The size of the sample used in this study is 310, which is more than either of these minimum sample size requirements.

Table III. Results of reliability and validity tests for reflective measurement model

Construct	Item	Loadings
Telepresence AVE = 0.6231 CR = 0.8681	Using MOOC sites creates a new world for me, and this world suddenly disappears when I stop browsing	0.714
	I forget about my immediate surroundings when I use MOOC sites	0.834
	Using MOOC often makes me forget where I am	0.853
	After using MOOC I feel like I come back to the “real world” after a journey	0.749
Interactive speed AVE = 0.6431 CR = 0.8438	Content on MOOC sites usually load quickly	0.776
	Interacting with MOOC sites is fast	0.828
	When I use MOOC sites there is no waiting time between my actions and the response of MOOC sites	0.802
Challenge AVE = 0.6292 CR = 0.8350	Using MOOC sites challenges me to perform to the best of my ability	0.742
	I find that using MOOC sites stretches my capabilities to my limits	0.874
	Using MOOC sites provides a good test of my skills	0.757
Skill AVE = 0.5533 CR = 0.7856	I consider myself knowledgeable about finding right MOOC for me	0.740
	I am extremely skilled at learning online	0.631
	I know how to find what I am looking for when using MOOC	0.846
Flow experience AVE = 0.6505 CR = 0.8431	Do you think you have ever experienced flow?	0.571
	In general, how frequently would you say you have experienced “flow” when you use MOOC?	0.904
	Most of the time that I have used the MOOC, I feel that I am in flow	0.899
Usage intention AVE = 0.6325 CR = 0.8366	I intend to use MOOCs in future	0.831
	I foresee that I would use MOOCs in near future	0.858
	I plan to use MOOCs in six months	0.688

5. Results

As the data was collected using a single (common) method (i.e. online questionnaire), it could have introduced systematic response bias that would either inflate or deflate responses. Hence Harman’s single factor test (Podsakoff *et al.*, 2003) was conducted to see if the majority of the variance can be explained by a single factor. IBM SPSS was used to do factor analysis, in which the number of factors extracted was restricted to just one (rather than extracting via eigen values). If common method bias would have been an issue then a single factor would account for the majority of the variance in the model. However, only 29.42 per cent variance could be explained with single factor as against 58.96 per cent variance explained by six factors with eigen values greater than 1. Hence it was concluded that common method bias is absent in the study. The rotated component matrix resulted from the exploratory factor analysis using principal component analysis (PCA) with rotation method of Varimax with Kaiser normalization is shown in Table II. The coefficients having absolute value less than 0.3 are not shown to enhance readability of the results.

As a next step, the reflective measurement model was tested for reliability and validity. Two indicators were dropped due to their poor loading. The results of reliability and validity tests are shown in Table III. Composite Reliability (CR) values above the threshold value of 0.708 for all constructs indicated internal consistency reliability. Similarly, AVE values for all constructs were found to be above the threshold value of 0.50, thus indicating convergent validity.

To test discriminant validity, outer loadings of all indicators on the associated construct were examined. They were found to be greater than all of their loadings on other constructs (i.e. the cross-loadings), thus establishing discriminant validity. Testing for Fornell–Larcker criterion (Fornell and Larcker, 1981), which is considered to be a more conservative approach to assessing discriminant validity (Hair *et al.*, 2014) was also performed. When tested, the square root of the AVE of each construct was found to be higher than its highest correlation with any other construct, thus indicating discriminant validity.

Next, formative measurement model was assessed for collinearity issues. To do so, Multiple Regression Analysis was performed using IBM SPSS to generate VIF and tolerance values. VIF values of all three indicators for MOOC Satisfaction were found to be lower than 5 and their Tolerance values were found to be higher than 0.2, indicating lack of any collinearity issues. As the last step in assessing the formative measurement mode, values and significance of outer weights (relative importance) and those of outer loading (absolute importance) were examined. The results are shown in Table IV. As the outer weight values of all three indicators were found to be significant, there was an empirical support to retain these three indicators.

Table IV. Formative measurement model

Formative indicator	Tolerance (VIF)	Outer weight	t-value for outer weight	Significance of outer weight	Outer loading	t-value for outer loading
I am satisfied with my experience of using educational content (videos, readings, etc.) in the MOOC	0.822 (1.217)	0.559	7.774	Significant at 1% level	0.822	19.196
I am satisfied with my experience of doing assignments/exercises in the MOOC	0.780 (1.281)	0.327	4.006	Significant at 1% level	0.698	11.192
I am satisfied with my experience of online discussions/interactions in the MOOC	0.789 (1.268)	0.419	5.255	Significant at 1% level	0.746	12.124

After evaluating reflective and formative measurement model, the structural model was analyzed. The first step in doing so was to assess a structural model for collinearity issues. To do so, latent variable scores produced by SmartPLS were used as input for collinearity assessment in IBM SPSS. Multiple regression analysis was then performed for all predictors of Flow Experience and for all predictors of usage intention. VIF values were found to be below the threshold value of 5, thus indicating that collinearity among the predictor constructs is not an issue in the structural model.

Table V shows the results after running PLS algorithm, bootstrapping procedure and blindfolding procedure in SmartPLS software. The antecedents of flow experience could predict 33.2 per cent variance in flow experience. On the other hand, 36 per cent variance in usage intention could be explained by MOOC satisfaction and flow experience. The path coefficients are significant for all relationships except for the relationship between Interactive Speed and Flow Experience. Among other three antecedents, path coefficient of skill is found to be lower in

value as compared to path coefficients of telepresence and challenge, indicating higher impact of telepresence and challenge on flow experience. The f^2 effect size values of 0.02, 0.15 and 0.35 indicate an exogenous construct's small, medium, or large contribution, respectively, on the endogenous construct's R^2 value (F. Hair *et al.*, 2014). The f^2 effect size values associated with the antecedents of flow experience indicate somewhat medium contribution of telepresence and small contribution of other antecedents of flow experience to the R^2 value of flow experience. The f^2 effect size values of MOOC satisfaction and flow experience indicate their large and small contribution to the R^2 value of usage intention respectively.

Table V. Summary of results

	Path coefficient	f^2 Effect size	q^2 Effect size
<i>Flow Experience ($R^2 = 0.332$ and $Q^2 = 0.217$)</i>			
Telepresence	0.284***	0.096	0.052
Interactive Speed	0.063NS	0.004	0.002
Challenge	0.261***	0.063	0.051
Skill	0.139**	0.018	0.013
<i>Usage Intention ($R^2 = 0.360$ and $Q^2 = 0.226$)</i>			
MOOC Satisfaction	0.546***	0.388	0.200
Flow Experience	0.112*	0.008	0.010

Notes: ** $p < 0.5$; *** $p < 0.01$; NS = Not significant

The Q^2 values for flow experience and for usage intention were found to be 0.2169 and 0.2256 respectively. These Q^2 values larger than zero indicate that the predictor constructs have predictive relevance on the respective endogenous constructs. The q^2 effect size values of 0.02, 0.15 and 0.35 respectively indicate that an exogenous construct has a small, medium, or large predictive relevance for a certain endogenous construct (F. Hair Jr *et al.*, 2014). The q^2 effect size values for the antecedents of flow experience indicate that they have small predictive relevance for flow experience. On the other hand, MOOC satisfaction and flow experience are found to have their medium and small predictive relevance for usage intention respectively.

Based on these results, results of hypothesis testing are displayed in Table VI and the resultant model is shown in Figure 2.

Table VI. Results of hypothesis testing

Hypothesis	Results
<i>H1:</i> Telepresence positively affects flow experience	Supported
<i>H2:</i> Interactive Speed positively affects flow experience	Not supported
<i>H3:</i> Challenge positively affects flow experience	Supported
<i>H4:</i> Skill positively affects flow experience	Supported
<i>H5:</i> Flow experience positively affects MOOC satisfaction	Supported
<i>H6:</i> MOOC positively satisfaction affects usage intention	Supported
<i>H7:</i> Flow experience positively affects usage intention	Supported

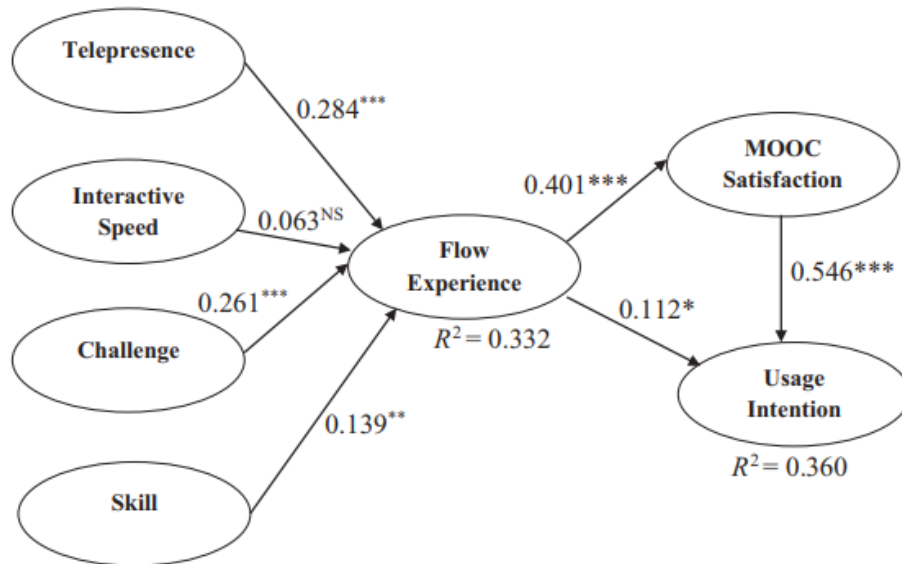


Figure 2. Resultant research model

As seen in Figure 2, MOOC Satisfaction mediates the relationship between Flow Experience and Usage Intention. To examine the mediating effect, as advised in (F. Hair Jr *et al.*, 2014), the approach given in (Preacher and Hayes, 2004, 2008) was used. The first step involved the assessment of the significance of the direct effect of flow experience on usage intention in the absence of the mediator. The significance test was conducted using the bootstrapping method. The relationship was found to be significant ($p < 0.01$) with a path coefficient of 0.3354 with corresponding t -values of 5.8480.

As a next step, the mediator was included in the model and the significance of the indirect effect was assessed. A necessary (but not sufficient) condition was the significance of the relationship between flow experience and MOOC satisfaction as well as between MOOC satisfaction and usage intention. As both these relationships were found to be significant, the indirect effect was calculated to be $0.4085 \times 0.5459 = 0.2230$. To test its significance, bootstrapping procedure was executed in SmartPLS software with following settings: 310 observations per subsample, 5,000 subsamples and no sign changes. In a spreadsheet, indirect effect via the mediator was calculated as the product of direct effects between flow experience and MOOC satisfaction as well as between MOOC satisfaction and Usage Intention, for each of the 5,000 subsamples. The standard deviation (which equals the standard error in bootstrapping) of 5,000 indirect effect values was found to be 0.0357. The empirical t -values of 6.2382 was arrived after dividing the original value (0.2230) by the bootstrapping standard error (0.0357). Hence we could conclude that this relationship via the MOOC satisfaction mediator was significant ($p < 0.01$).

In the final step, the Variance Accounted For (VAF) was calculated. VAF determines the size of the indirect effect in relation to the total effect. The direct effect of flow experience on usage intention had a value of 0.1115 while the indirect effect via MOOC satisfaction had a value of 0.2230. Thus the total effect had a value of $0.1115 + 0.2230 = 0.3345$. The VAF equals the direct effect divided by the total effect and had a value of $0.1115/0.3345 = 0.3333$. That means 33.33 per cent of the effect of flow experience on usage intention was explained via the MOOC

satisfaction mediator. As the VAF is larger than 20 per cent but smaller than 80 per cent, this situation can be characterized as partial mediation.

6. Discussion

The purpose of this study was to develop and empirically test a model of relationships between antecedents and outcomes of flow experience of MOOC users. The model was developed by drawing on extensive literature in e-learning and e-retailing and was tested by analyzing data collected from MOOC users. The findings of this study and its contribution to theory and practice are now discussed below.

6.1 Interpretation of findings

The study had formulated the first four hypotheses for examining telepresence, interactive speed, challenge, and skill as the antecedents of flow experience. Telepresence has been found to be an antecedent of flow experience in (Novak *et al.*, 2000; Rose *et al.*, 2012; Faiola *et al.*, 2013; Guo *et al.*, 2016). With support for *H1* (*H1*), telepresence has been found to be an antecedent of flow experience in the MOOC context also. As MOOC attempts to replace a classroom-like experience with video lectures, online quizzes, peer-assessed assignments and online discussions, this finding is very important. It indicates that if learners can perceive the online course to be more real than their surroundings then they can experience flow thus increasing their intention to use MOOC. Use of technologies such as virtual reality or augmented reality can boost telepresence and hence could be considered for their use in MOOC offerings.

The second hypothesis (*H2*) did not receive support as the study didn't support the relationship of interactive speed with flow experience, similar to what was found in (Rose *et al.*, 2012). As discussed by Rose *et al.* (2012), this lack of support is perhaps due to the consistent superiority of internet speed. As compared to the late 1990s, high internet speed has now become quite consistent and hence interactive speed could have ceased to have any impact on variation in flow experience. It is possible that other studies testing this model in regions having low internet speed may get a different result.

H3 and *H4* received the empirical support thus establishing the challenge and skill as antecedents of flow experience. This is in line with what was observed in the context of online shopping (Novak *et al.*, 2000), distance learning environment (Liao, 2006), and mobile game application (Su *et al.*, 2016). Designing MOOC, which will challenge users but will not exceed their skills, would be a balancing act for MOOC providers. The flexibility in pursuing the desired learning goal and convenient learning path in MOOC could help cultivate the challenge and skill balance necessary for flow experience.

The next set of hypotheses (*H5–H7*) examined the relationships among flow experience and its outcomes. The study has found support for the identification of both MOOC satisfaction and usage intention as outcomes of flow experience. The study supported *H5* about the relationship between flow experience and MOOC satisfaction. It means if MOOC users experience flow while using MOOC, then that would lead to their satisfaction. The same phenomenon is observed in related contexts such as realistic performing art, online financial services, online shopping,

and e-learning (Ding *et al.*, 2010; Hsu *et al.*, 2012; Rose *et al.*, 2012; Choi *et al.*, 2016). With support for this phenomenon in the MOOC context, this finding makes a contribution to the body of knowledge about flow experience.

H6 indicating the relationship between MOOC satisfaction and usage intention, has received support. Consistent to (Khalifa and Liu, 2007; Ranaweera *et al.*, 2008; Martin *et al.*, 2015), this study has found that satisfaction leads to usage intention. The present study has also found that MOOC satisfaction performs a mediating role in the relationship between flow experience and usage intention. With VAF value of 0.33, this is the case of partial mediation. It indicates that when users experience flow in using MOOC then it impacts their intention to use MOOC, partly because of their satisfaction in using MOOC. This is in line with the findings in (Cheng, 2014).

H7 has also got supported thus indicating the relationship between flow experience and intention to use MOOC. The study found that the users, who experience flow while using MOOC, are more likely to use MOOC in near future. This is an important finding as it indicates that flow experience would have an influencing role in the adoption of MOOC. The influencing role of flow experience on adoption of the distance learning system, world wide web, mobile TV, instant messaging, mobile banking and mobile games was reported in the literature (Agarwal and Karahanna, 2000; Liao, 2006; Lu *et al.*, 2009; Zhou, 2012, 2013b, 2013a). Thus, the finding of this study recognizing the influencing role of flow experience on MOOC adoption makes a contribution to the body of knowledge about flow experience and technology adoption.

6.2 Research limitations

This study suffers from certain limitations. One limitation arises due to lack of random sampling. Use of large finite sampling frame such as registered users of major MOOC providers would help future studies provide more credibility to the results. Also the sample was largely drawn from India, which is the second largest country in terms of MOOC users. A more diversified sample would have been more representative of global MOOC population. Another limitation arises as flow experience was assessed using a survey questionnaire. Csikszentmihalyi (1997) had used experience sampling method (ESM) to assess flow experience. A digital version of this method was used by Chen (2000) to assess flow experience of Web users. Survey questionnaire may not yield a good quality of data as compared to ESM for assessing flow experience but was used due to its feasibility for data collection. Future studies may choose to use online ESM instead of an online questionnaire to assess flow experience.

This study chose to view MOOC users as consumers of MOOC platform hence did not include the assessment of either perceived or actual learning outcomes for the MOOC users. This is another limitation of the study. The future studies can extend the research model to examine whether learning, either perceived or objectively measured or both, be the outcomes of the flow experience.

This study did not distinguish among MOOCs from different subject areas such as social science, computer programming and personal development. Different results might be possible based on the subject area of the MOOCs as one may argue that users of MOOC from say, personal development subject area tend to experience higher flow experience as compared to flow

experienced while using MOOC from say computer programming subject area. Similarly, differentiation among MOOC based on the level of complexity (e.g. basic, intermediate and advanced) was not accounted in the present study.

Finally, this study limited itself to examining the relationship between flow experience and MOOC acceptance and did not consider MOOC completion as an outcome of flow experience. Future studies can make use of longitudinal study design to establish a relationship between flow experience and MOOC completion. Future studies may also examine the moderating effect of age and gender on key relationships in the model.

6.3 Practical implications

This study has identified the mediating role of MOOC satisfaction between flow experience and usage intention. This is an important finding for MOOC providers as it indicates that MOOC providers should give attention to provide flow experience to MOOC learners, which can lead to satisfaction of MOOC users thereby increasing MOOC adoption.

What will lead to flow experience of learners? This study has found telepresence, challenge and skill as antecedents of flow experience. Learners would experience flow when they will find MOOC to be more real than their surroundings and when there will be a balance between challenge and skill. While it would not be easy for MOOC providers to fulfill these conditions, achieving the same, will ensure flow experience of learners thereby increasing MOOC acceptance of learners.

To induce flow experience, MOOC providers can consider use of technologies such as virtual reality and augmented reality that can enhance telepresence. Similarly, use of personalization techniques such as adaptive quizzing, flexible navigation of content and chat bots for quick clarification of doubts of learners can help manage the challenge-skill balance needed for flow experience.

7. Conclusion

The study proposed and tested the model of relationships between antecedents and outcomes of flow experience of MOOC users. It found support for telepresence, skill and challenge as antecedents of flow experience. It also found support for MOOC satisfaction and usage intention as outcomes of flow experience. Additionally, it recognized the role of MOOC satisfaction as a mediating variable between flow experience and MOOC usage intention. Thus it has highlighted the impact of flow experience on MOOC adoption. As MOOC is gaining more importance as a viable alternative to traditional University course, the study of this nature would help understand how MOOC enrolment can be increased by providing flow experience to MOOC users.

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