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Examining the antecedents of social networking sites use among CEGEP students

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Abstract Investigations in technology acceptance in education has largely overlooked certain unique populations like students from the *Collège d'enseignement général et professionnel* (CEGEP) system. In studies examining CEGEP students' use of technology, the Technology Acceptance Model (TAM) perspective has not been taken into account, nor have modalities of beliefs underlying the TAM framework. Modalities of belief refer to the different way of knowing something, such as certainty, necessity, conditionality/probability, etc. This study explores CEGEP students' use of social networking sites (SNSs) employing the TAM framework proposed by Davis (*MIS Quarterly, 13*(3), 319–340, 1989). The increased role of SNSs like Facebook in the digital experience and lives of college students offers novel venues and presents new opportunities for technology acceptance research. This study examines the determinants of intention and use of SNSs among CEGEP students and includes a new antecedent factor 'need for self-expression', as a modality of belief. Using structural equation modeling, specifically partial least squares (PLS), we test and present the results finding good fit with the data for our extended TAM model for Facebook use. We close by discussing the implications, limitations, and avenues for future research.

Keywords Facebook · Need for self expression · TAM · CEGEP students

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1 Introduction

The present study is motivated by the overwhelming popularity and ubiquity of social media in the lives of the college populace (Dahlstrom et al. 2011; Kalpidou et al. 2011; Selwyn 2009). Our world is unprecedentedly connected, and in recent years, social media has attracted much attention from both practitioners and researchers (Boyd and Ellison 2008). The way we interact has both been facilitated by social media and transformed by our ever-increasing desire for anytime-anywhere communications (Turkle 2011); this is particularly the case for young people, a demographic that tends to be the most avid users of social media (Social Media Update 2014). The way social media changes the way we connect, share, and interact lends itself to an examination of the role of user motives to use such platforms. To better understand how social media shapes social communication and interactions, one key may lie in revealing the factors affecting social media acceptance and use. As social media has been the focus of technology acceptance research in the past decade, the use of social media in education has become a fertile research area fueled by massive uptake of social media by students (Kalpidou et al. 2011; Karvounidis et al. 2014; Rodríguez-Hoyos et al. 2015).

An important thread in the research examining college students' use of social media focuses on effects stemming from the use of such platforms (Greenhow and Askari 2015; Manca and Ranieri 2015; Rodríguez-Hoyos et al. 2015). Indeed, research indicates that use of social media is associated with both positive and negative effects (Turkle 2011; Valenzuela et al. 2009). Thus, a natural question is what drives users to use such platforms. Answering such a question would require understanding the motives for use; the need to understand users' acceptance of social media – or for that matter any technology use – requires examination of the factors that influence acceptance and use (Teo 2009). This driver is the likely explanation for the recent surge in educational technology research concerned with unearthing determinants of technology use. While some research exists which examines the antecedents of use of social media, much of the extant research effort has been trained on the university level and in particular on US undergraduate students (Hew 2011). Yet, social media use among students of the *Collège d'enseignement général et professionnel* (CEGEP) system has hitherto remained understudied (Teo et al., The role of attachment in Facebook usage: a study of Canadian college students, under review). This is somewhat surprising in light of the fact that college students tend to embrace social media more than any other group (Kalpidou et al. 2011; Social Media Update 2014). Far less well-understood are the drivers of social media use among CEGEP students (Teo et al., under review).

The CEGEP college system is unique to the province of Quebec in Canada. Graduates of the secondary school system in Quebec who plan on entering a university in Quebec must first enroll in and complete the *Diploma of College Studies* (DCS) before starting university studies. Increased knowledge of how CEGEP students use social media may assist educators who wish to incorporate social media applications for educational outcomes. This paper attempts to address this gap by examining the factors affecting CEGEP students' social media use. In this paper we focus on a specific form of social media, namely, social networking sites (SNS). Toward that end, we propose and empirically test structural models in order to unearth factors affecting Facebook use.

Capitalizing on the rich literature in technology acceptance in the field of Information Systems, the drivers of SNS use was investigated. The main focus of this

strand of literature is to explicate the main drivers of technology use. The present study draws from the seminal work of Davis (1989), who proposed the technology acceptance model (TAM). In order to examine the factors affecting CEGEP students' use of SNS –Facebook, specifically – we extend the TAM to develop a research model tailored for this context. Through the analysis of the structural model, we attempt to substantively advance the understanding of CEGEP students' use of social media. The remainder of the paper is organized as follows: (1) the first section delineates the background for our work and discusses the relevant literature; (2) the second section outlines the methods and the data; (3) the third section presents the analysis and results of the proposed model; (4) the fourth section discusses the results; and, (5) the final section highlights the results, some limitations of our approach, and recommendations for future research.

1.1 Social media and social networking sites

Social media represents arguably one of the most important progeny of the Internet that has elicited a new interaction paradigm (Boyd and Ellison 2008). The role of technology is embedded in the evolution of human interaction but in the somewhat short history of the web era, transformative tools have altered the landscape of computer-mediated communications. While the definition of social media remains contested, in part because it is "constantly in a state of change" (Tess 2013, p.2), it "is often described by example" (Tess 2013, p. 1). Hence social media is taken to be co-extensive with social networking sites, messengers, media-sharing sites, blogs, etc., as these typify social media. Prominent social media applications like Facebook and Twitter enable and facilitate users in creating, sharing, and interacting online. The social media era essentially began a few years before the bursting of the dot-com bubble, and now permeates many aspects of our lives, transforming the way in which we connect, communicate, and engage with others. The social media world continues to grow and change, and offers an ever-increasing number of products, each of which presents a new set of opportunities and challenges.

SNSs are a form of social media that, according to Boyd and Ellison (2008), allow users to: "(1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site" (p. 211). According to a recent survey by the Pew Research Center, "65% of adults now use social networking sites" (Pew Research Center 2015, p.1).

A gamut of social networking sites exist, such as Edmodo, Ning, LinkedIn, Twitter, Facebook, etc. (Manca and Ranieri 2015). Out of the plethora of social networking sites, Facebook is the most popular social media platform among college students. The significance of such social networking environments is manifested by its sheer user statistics. According to a survey conducted by the Pew Research Center, "90% of young adults now use social networking sites" (Pew Research Center 2015, p.4). Currently, Facebook has over 1.4 billion active monthly users (Newsroom 2016). Among young adults (ages 18–29), Facebook is the most popular platform. 87 % of young adults use Facebook (Update 2014). Notably, college students tend to be active users of the social network (Kalpidou et al. 2011) as they are less tied to traditional

ways of interaction. Large percentages of college students report using Facebook (e.g., Dahlstrom et al. 2011); for example, in the US, college students make up 72% of Facebook users (Duggan 2015). The statistics are a testament to the value that college students find in social networks like Facebook. Given the wide-adoption and popularity of Facebook with college students, the interest in researchers towards this stream of investigation is not surprising (Pempek et al. 2009).

Just as important, Facebook's usage statistics are another indication of the influence of Facebook in the education domain. The literature on the potentials and use of social networking sites in education has been growing (Manca and Ranieri 2015; Wang et al. 2012). Although the educational value of Facebook has still not been fully established, the literature on technology use presents some examples of studies on use of Facebook by college students: for learning English (Kabilan et al. 2010), as a discussion platform in a business planning course (Chang and Lee 2013), as a tool to enhance peer support among students (English and Duncan-Howell 2008), and as an alternative space for student discussion in an introductory organic chemistry lab for non-chemistry majors (Schroeder and Greenbowe 2009).

2 Literature review

In this section, we turn our focus to the technology acceptance literature. How do users' beliefs affect their technology use? This is a question apropos technology acceptance that has been studied by researchers over the last few decades, especially in the field of information systems. Crosscutting all the work on technology acceptance is the observation that user motives affect intentions and technology use (Davis 1989; Davis et al. 1989). A longstanding goal of such research has been to identify the motivational factors that serve as determinants to intentions and use of technology. Technology acceptance has become an important research topic in educational technology as evidenced by the burgeoning documentation of studies (Teo et al. 2008). The present study draws inspiration from this literature.

2.1 TAM model

Users' predisposition toward technology use is a measure of user acceptance, which is central to determining the success or failure of technology (Davis et al. 1989; Swanson 1988). There has been considerable literature on the effects of users' beliefs and attitudes on technology usage behavior (Davis 1989; Taylor and Todd 1995; Venkatesh and Davis 2000). The wide body of work on the behavioral aspects of technology use offers many models for understanding technology acceptance to address why users accept or reject technology (e.g., Davis 1989; Fishbein and Ajzen 1975; Ajzen 1991; Thompson et al. 1991; Rogers 2003; Venkatesh et al. 2003). The TAM is grounded in substantial theoretical and empirical evidence. It has become an influential model and one of the most widely employed models to envisage the factors affecting technology usage behavior, and has been validated in varied contexts (e.g., Chau 1996; Davis 1989; Davis et al. 1989; Lederer et al. 2000; Szajna 1996; Taylor and Todd 1995; Venkatesh and Davis 2000; Venkatesh et al. 2003).

Various meta-analysis of TAM (e.g., King and He 2006) have illustrated the validity and robustness of the TAM. The TAM's origins lie in the Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975; Ajzen and Fishbein 1980), which posits that an individual's intention to perform a behavior is a function of their attitude toward the behavior. The TAM (Fig. 1) is used to explain the behavioral intention and actual behavior of a user's technology use. According to Davis et al. (1989), actual technology use is determined by user's behavioral intention to use a technology. A user's behavioral intention is the most immediate antecedent of use. Further, a user's attitude toward the technology dictates their behavioral intentions. Two fundamental determinants of user acceptance of technology, which exert influence on the attitude toward technology use, are perceived usefulness and perceived ease of use. And TAM assumes that perceived usefulness is influenced by perceived ease of use. Thus, the aforementioned TAM constructs which compose the original TAM are, perceived usefulness, perceived ease of use, attitudes, behavioral intentions, and use.

One of the enduring strengths of the TAM is its parsimonious characteristic (Lee et al. 2003). Yet, it can also be deficient in explaining use behaviors fully (Dishaw and Strong 1999). Indeed, various external factors can indirectly influence the acceptance of a particular technology through the two dominant variables, perceived usefulness and perceived ease of use (Davis et al. 1989; Legris et al. 2003; Szajna 1996; Venkatesh and Davis 1996). Thus, there is a need to widen the lens of investigation beyond the indigenous variables in the TAM. Delineating such a need, Venkatesh and Davis (1996) encourage that "in order to be able to explain user acceptance and use, it is important to understand the antecedents of the key TAM constructs, perceived ease of use and usefulness" (p. 473). Given the extensive scholarship, it appears increasingly likely that even with the addition of external variables which may capture influences of other factors, the model is still incomplete. Technology acceptance investigations around external variables have usually been centered on user traits and belief factors. We posit that such variable additions are not sufficient to provide a holistic understanding of factors affecting use. As such, we go beyond the exercise of beliefs additives, to incorporate modalities of use and usefulness, such as necessity, certainty, and conditionality/possibility, to better reflect motives in specific contexts of use. Such boundary expansions help extend the discussion of technology acceptance to specific contexts

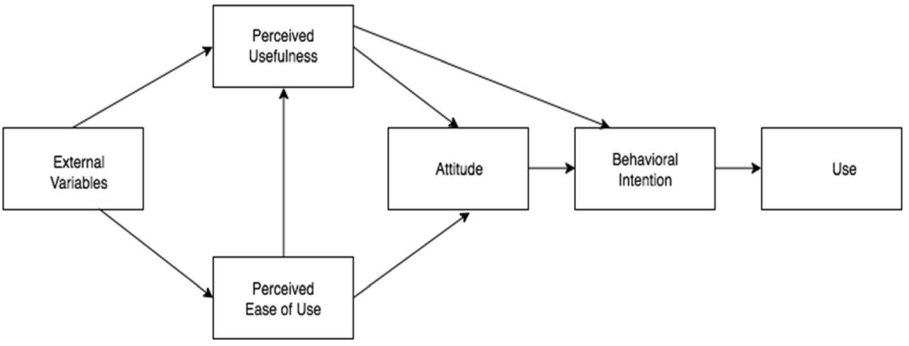

Fig. 1 Technology Acceptance Model (Adapted with permission. Copyright 1989 INFORMS. Davis et al. (1989) User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. Management Science 35(8):982–1003. http://dx.doi.org/10.1287/mnsc.35.8.982, the Institute for Operations Research and the Management Sciences, 5521 Research Park Drive, Suite 200, Catonsville, Maryland 21,228, USA)

through determining the specific intentions and beliefs that reflect the contextual conditions and which impact on perceptions of the perceived necessity, popularity, and/or usefulness of technology.

2.2 Research aims and questions

A key takeaway emanating from the literature is that social media is an integral part of most college students' lives, as social media increasingly becomes not just a preferred, but the expected way of interaction. As has been noted in the literature, the increasing use of social media by college students inevitably raises questions about the effects and affordances of use in learning. For instance, Teo (2014, p.10) argues "social media will take on a greater and more important role across all levels of education". Recent scholarship has recognized and highlighted the importance of social media within the realm of education (Greenhow and Askari 2015; Manca and Ranieri 2015; Karvounidis et al. 2014). Social media sites are seen as potentially useful channels for education purposes. Considering the scale of social media use, the potential for and the problems associated with use, examining the antecedents of social media use could provide valuable insights into technology acceptance and into educational applications. At present little is known about what drives CEGEP students to use social media sites. Likewise, it is less clear why students' use different platforms. Thus, the aim of the present study is to delineate the factors determining the intentions to use and actual use of Facebook, and further to help tease out the salient factors for use. The following research question (RQ1) guided our study: What are the determinants underlying Facebook use?

3 Proposed framework

The theoretical grounding for the present study is the TAM, the choice of which was driven by the fact of the model's extensive use in technology acceptance research. Its flexible and extensible characteristics (easily malleable to capture context-specific enquiries) further recommend it for studying technology acceptance. Both the original and extended versions of TAM have been employed to investigate students' acceptance and use of technology. In studies extending the TAM, researchers have included a number of domain-specific constructs to fit their study context. For example, previous studies on students' Facebook use have extended TAM by adding subjective norm and social capital (Choi and Chung 2013), emotional attachment (Teo 2014), and network externalities (Lin and Lu 2011). However, explications of technology use have mainly been examined in relation to motivations. Generally, researchers have incorporated additional beliefs in extended models (Doleck et al., Examining the antecedents of Facebook use via structural equation modeling: a case of CEGEP students, under review). Yet, one aspect in technology acceptance that has received relatively little attention is perceived necessity. For the present study, we employ an extended TAM by explicitly considering perceived necessity as it may occur in the context of social networks as a "perceived need for self-expression". Thus, this study attempts to further our understanding of technology use and acceptance by considering the modality of beliefs (Garson 2016). "Perceived need for self-expression" as a dimension of perceived necessity was selected because of its relevance in the context of social media, and hence, as a construct

for examining Facebook use. In particular, this study aims at identifying the factors that influence the acceptance and use of Facebook by CEGEP students.

The constructs in the original TAM include: perceived usefulness, perceived ease of use, attitudes, behavioral intentions, and use. In the present study, the hypotheses were kept consistent with the original TAM with the only alteration being the addition of the need for self-expression, which is introduced and described in the following section.

Thus, the causal mechanisms of the conventional relationships validated in numerous studies of the TAM are formulated and enumerated as follows:

H1: Perceived usefulness (PUS) is positively related to behavioral intention (BIN).
H2: Perceived usefulness (PUS) is positively related to attitude toward use (ATT).
H3: Perceived ease of use (PEU) is positively related to attitude toward use (ATT).
H4: Perceived ease of use (PEU) is positively related to perceived usefulness (PUS).
H5: Attitude toward use (ATT) is positively related to behavioral intention (BIN).
H6: Behavioral intention (BIN) is positively related to use (USE).

3.1 Need for self-expression

With this backdrop, we delineate the additional construct "need for self-expression". Investigations on antecedents of technology use often focus on the role of user beliefs while paying little attention to modalities of belief such as the needs of the users. The affordances of social media make it particularly well-suited to (dis)satisfying users' psychological needs. Here, we focus on the need for self-expression, and posit that the incorporation of modalities of belief such as users' needs, or perceived necessity, will provide a more holistic explanation of technology acceptance and use in the specific context of Facebook use. This section deals with the possibility that incorporating user needs might improve the capabilities of the model.

Social networking sites open up varied set of affordances or possibilities. One such affordance derives from their usefulness as a medium to engage in and facilitate self-expression. SNSs provide new spaces and tools offering unique opportunities and pathways for presenting and expressing themselves to others. However, different SNSs offer different levels of affordances for self-expression, which this study attempts to address. If a user believes that a platform serves and fulfills their need for self-expression, we expect that user's perceptions of usefulness, behavioral intentions, and actual use of the platform would be positively affected. This study has the particularity of offering the "need for self-expression" as an added element in the TAM framework for explaining social media use. Along with the baseline formulations, we augment the TAM by considering this additional construct. In this study, we postulate that the need for self-expression as a dimension of necessity as a modality of belief can influence perceived usefulness, attitude toward use, and behavioral intentions. To date, TAM studies which have focused on user beliefs have rarely considered the modalities of the given beliefs. The need for self-expression as a dimension of the perceived necessity of technology appears to us as an important consideration in the appraisal of technology acceptance and use in the context of social networking sites. Perceived necessity of technology, as a modality of beliefs about technology acceptance and use, would appear to be an emergent dimension when a given technology becomes so ubiquitous

it becomes essential in our daily lived experience. For need for self-expression in the extended construct, we would expect the relationships below, formulated in the following three hypotheses:

H7: Need for self-expression (NSE) is positively related to perceived usefulness (PUS).
H8: Need for self-expression (NSE) is positively related to attitude towards use (ATT).
H9: Need for self-expression (NSE) is positively related to behavioral intentions (BIN).

Thus, accounting for the additional construct, we conceptualize a model using a composite of the research hypotheses that captures the factors affecting students' Facebook use, which we hope will provide a new understanding of determinants of technology acceptance and use by illuminating the perceived necessity of technology, as a specific modality of belief about TAM factors. The extended conceptualization of TAM that is embedded with the NSE is presented in Fig. 2.

4 Method

4.1 Study procedure and participant profile

The population of the study consisted of CEGEP students who used Facebook. Participants were volunteers enrolled in pre-university science courses drawn from students at an English CEGEP in Montreal, Quebec. None of the participants received any form of compensation for their participation in the study. The recruitment for this study was conducted by asking for volunteers to complete a survey about their Facebook use. Informed consent was obtained prior to participation in the study, and the participants completed the questionnaire during the class sessions.

One hundred fourty one questionnaires were received. After a check of the questionnaires, 14 questionnaires were excluded because they had invalid responses

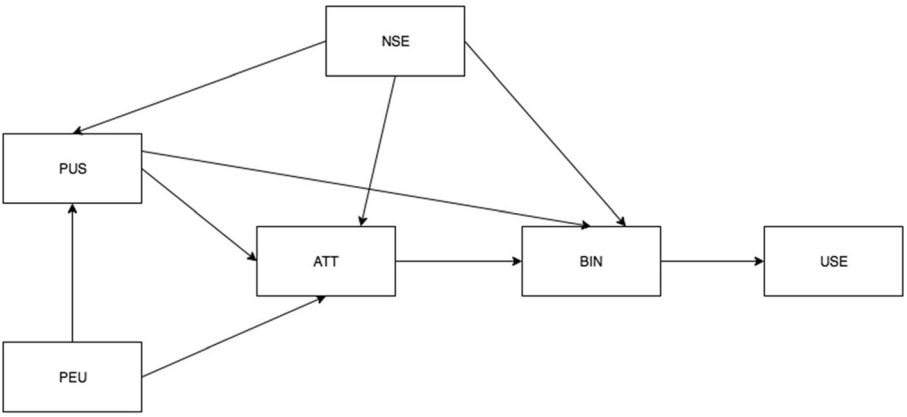

Fig. 2 Research model

(e.g., multiple selections for a single item). A total of 127 usable questionnaires were included in the final analysis. Of the 127 participants, 56.69 % were female ($N = 72$) and 43.31% were male ($N = 55$) with an average age at the time of the data collection of $M = 19.16$.

4.2 Instruments

A survey adapted to the context of Facebook was designed to empirically test the proposed research model. All constructs in the survey were measured using multiple-item perceptual scales. For this study, scales developed and validated by previous studies (Davis et al. 1989; Karahanna et al. 2015; Porter and Donthu 2006; Taylor and Todd 1995) were adapted to fit the study context and purpose. The questionnaire consisted of 23 items to measure the six constructs in the proposed model. The constructs were measured on a seven-point Likert scale (from 1 being "*strongly disagree*," to 7 being "*strongly agree*"). All constructs were operationalized as reflective. The questionnaire also included demographic data including age and gender.

5 Results

5.1 Assumptions and analysis background

To test the proposed model and hypotheses, we employed structural equation modeling (SEM), specifically, a partial least squares (PLS) path modeling approach given the nature of the study goals and data characteristics. Covariance-based SEM and variance-based SEM are two commons SEM techniques. PLS modeling (Wold 1982) belongs to the class of variance-based structural equation modeling techniques. PLS is suitable for analyses that have small sample size and less stringent assumption requirements (Chin 1998; Hulland 1999). Moreover, according to Hair et al. (2011) "if the goal is predicting key target constructs or identifying key 'driver' constructs, select PLS-SEM" (p. 144). Using PLS, the measurement and structural model can be estimated simultaneously. In this study, the WarpPLS software (Kock 2015a) was employed for evaluating the measurement and subsequently the structural model. WarpPLS evaluates both the measurement and the structural model simultaneously. The PLS model was analyzed and interpreted in two stages: the measurement model and the structural model (Henseler et al. 2009).

5.2 Measurement model

Measurement model assessment is required to evaluate the reliability and validity of the measurement model. There is a battery of recommended steps for assessing the measurement model. The adequacy of the measurement model was assessed using factor loadings, internal consistency reliability, convergent validity, and discriminant validity. The reliabilities for items are measured via the factor loadings. It is generally recommended that the factor loadings should exceed the threshold value of 0.70 (Chin 1998); however, others consider a cut-off value of 0.50 to be

sufficient (Hulland 1999). As seen in Table 1, all factor loadings (in bold) were greater than 0.50, with majority of loadings exceeding 0.70, presenting a good indicator of the instrument's reliability.

To verify the construct reliabilities, composite reliability and cronbach's alpha are generally used. While composite reliability is generally considered a better measure of internal consistency (Fornell and Larcker 1981), we report both measures. The composite reliabilities of the different measures ranged from 0.899 to 0.967 (see Table 2); these values are greater than the recommended threshold value 0.70 (Gefen et al. 2000). The Cronbach's alpha of the different measures ranged from 0.799 to 0.949 (see Table 2); these values are greater than the recommended threshold value 0.70 (Churchill 1979). Thus, the recommended thresholds for both Composite reliability and Cronbach's alpha were met leading to the establishment of reliability of the indicators. Composite Convergent validity was assessed through the Average Variance Extracted (AVE) test on the variables. The average variance extracted of the different measures ranged from 0.599 to 0.908 (see Table 2), with all values greater than the recommended threshold value 0.50 (Fornell and Larcker 1981). Thus, the measurement model demonstrated convergent validity.

Table 1 Loadings and cross-loadings of measurement items

	PUS	PEU	ATT	BIN	USE	NSE	P value
PUS1	**0.734**	-0.227	-0.024	0.279	0.063	0.009	<0.001
PUS2	**0.834**	0.286	0.021	-0.020	-0.026	-0.094	<0.001
PUS3	**0.817**	-0.004	-0.222	0.123	0.123	-0.175	<0.001
PUS4	**0.681**	0.334	0.104	-0.065	-0.257	0.088	<0.001
PUS5	**0.731**	-0.137	0.221	-0.354	-0.007	0.113	<0.001
PUS6	**0.833**	-0.235	-0.061	0.017	0.066	0.087	<0.001
PEU1	0.043	**0.901**	0.027	-0.079	0.093	-0.099	<0.001
PEU2	0.070	**0.924**	-0.036	-0.040	0.019	-0.049	<0.001
PEU3	-0.096	**0.911**	0.081	-0.100	0.056	0.045	<0.001
PEU4	0.061	**0.882**	-0.159	0.108	-0.032	0.018	<0.001
PEU5	-0.084	**0.833**	0.090	0.125	-0.149	0.093	<0.001
ATT1	-0.157	0.077	**0.882**	0.104	0.043	0.007	<0.001
ATT2	-0.024	-0.232	**0.839**	-0.068	0.072	0.166	<0.001
ATT3	0.059	0.077	**0.806**	-0.065	-0.117	-0.078	<0.001
ATT4	0.013	0.060	**0.835**	0.040	0.073	-0.184	<0.001
ATT5	0.116	0.018	**0.861**	-0.019	-0.075	0.082	<0.001
BIN1	0.059	-0.221	0.123	**0.913**	0.140	0.037	<0.001
BIN2	-0.059	0.221	-0.123	**0.913**	-0.140	-0.037	<0.001
USE1	-0.009	0.028	-0.045	0.136	**0.943**	-0.055	<0.001
USE2	0.009	-0.028	0.045	-0.136	**0.943**	0.055	<0.001
NSE1	-0.071	-0.099	0.296	-0.077	-0.028	**0.926**	<0.001
NSE2	0.021	0.010	-0.091	0.010	0.043	**0.974**	<0.001
NSE3	0.047	0.085	-0.193	0.064	-0.016	**0.958**	<0.001

Table 2 Measurement scale characteristics

Construct	Composite reliability (CR)	Cronbach's alpha	Average variance extracted (AVE)
PUS	0.899	0.864	0.599
PEU	0.951	0.935	0.794
ATT	0.926	0.900	0.714
BIN	0.909	0.799	0.833
USE	0.941	0.874	0.888
NSE	0.967	0.949	0.908

5.3 Discriminant validity

To complete the construct validation process, the discriminant validity was assessed. To assess discriminant validity, traditionally two approaches have been used: the Fornell-Larcker criterion (Fornell and Larcker 1981) and cross-loadings. According to the Fornell-Larcker criterion, to assess discriminant validity, the square roots of the AVEs for two latent variables must each be greater than the correlations between those two variables (Fornell and Larcker 1981). In Table 3, the square root of the AVEs is highlighted in bold along the diagonal. It can be observed that the Fornell-Larcker criterion is met, i.e., all the diagonal values are greater than the off-diagonal numbers in the corresponding rows and columns (Table 3).

Since all the quality criteria were assessed and found to be satisfactory, we proceeded to test the proposed path model via the generated structural model.

5.4 Structural model

The structural model was used to test the hypotheses by examining the path coefficients (β), path significance (p-value), coefficient of determination values (R^2), effect size (f^2), and predictive relevance (Q^2). The effect sizes of the predictor constructs were evaluated using f^2; values of 0.35, 0.15, and 0.02 are deemed as large, medium, and small, respectively (Cohen 1988). The effect sizes are presented in Table 4. Q^2 was used to assess the predictive relevance associated with each endogenous variable in the model. Q^2 values represents a criterion of the degree to which the exogenous variables predict their endogenous constructs, with Q^2 values greater than zero indicating an

Table 3 Discriminant validity check

	PUS	PEU	ATT	BIN	USE	NSE
PUS	**0.774**	0.620	0.772	0.605	0.516	0.297
PEU	0.620	**0.891**	0.511	0.410	0.383	-0.026
ATT	0.772	0.511	**0.845**	0.681	0.605	0.488
BIN	0.605	0.410	0.681	**0.913**	0.623	0.397
USE	0.516	0.383	0.605	0.623	**0.943**	0.323
NSE	0.297	-0.026	0.488	0.397	0.323	**0.953**

Table 4 Effect size (f^2)

	PUS	PEU	ATT	BIN	USE	NSE
PUS	—	0.405	—	—	—	0.093
PEU	—	—	—	—	—	—
ATT	0.451	0.092	—	—	—	0.153
BIN	0.168	—	0.271	—	—	0.066
USE	—	—	—	0.408	—	—
NSE	—	—	—	—	—	—

acceptable level of predictive relevance. As seen in Table 5, all Q^2 values were found to be greater than zero, indicating that the model had acceptable predictive relevance. The PLS path modeling estimation results are presented in Fig. 3. The global fit indicators (Table 6) for the model were acceptable according to the criterion suggested by Kock (2015b). Thus, the data fit the research model.

Next we turn our attention to the assessment of the paths proposed in our research model. From the results, the following observations can be made:

A). Target endogenous variable variance

- The coefficient of determination, R^2, is 0.41 for USE. Thus, the latent variable, BIN explains 41 % of the variance in USE.
- The coefficient of determination, R^2, is 0.51 for BIN. Thus, the three latent variables (PUS, ATT, and NSE) explain 51 % of the variance in USE.
- The coefficient of determination, R^2, is 0.70 for ATT. Thus, the three latent variables (PUS, PEU, and NSE) explain 70 % of the variance in ATT.
- Finally, the coefficient of determination, R^2, is 0.50 for the PUS. Thus, the latent variable, PEU explains 50 % of variance in PUS.

B). Inner model path coefficients

- H1: the result indicated a positive and significant relationship between PUS and BIN, with a medium effect size (β: 0.27; $p < 0.01$; $f^2 = 0.168$).
- H2: the result indicated a positive and significant relationship between PUS and ATT, with a large effect size (β: 0.58; $p < 0.01$; $f^2 = 0.451$).

Table 5 Predictive relevance (Q^2)

Construct	Predictive relevance (Q^2)
PUS	0.499
PEU	—
ATT	0.696
BIN	0.504
USE	0.406
NSE	—

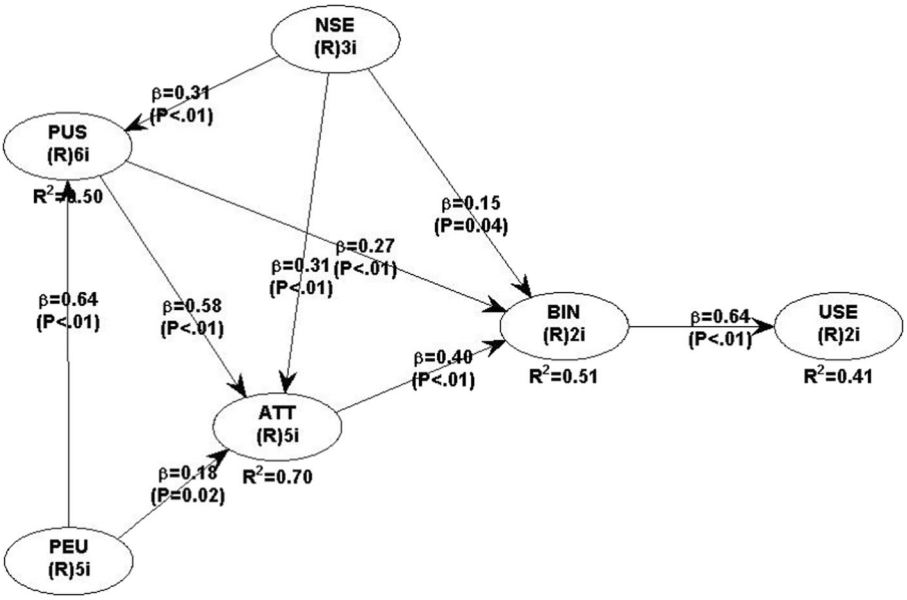

Fig. 3 PLS results

- H3: the result indicated a positive and significant relationship between PEU and ATT, with a small effect size (β: 0.18; $p = 0.02$; $f^2 = 0.092$).
- H4: the result indicated a positive and significant relationship between PEU and PUS, with a large effect size (β: 0.64; $p < 0.01$; $f^2 = 0.405$).
- H5: the result indicated a positive and significant relationship between ATT and BIN, with a medium effect size (β: 0.40; $p < 0.01$; $f^2 = 0.271$).
- H6: the result indicated a positive and significant relationship between BIN and USE, with a large effect size (β: 0.64; $p < 0.01$; $f^2 = 0.408$).
- H7: the result indicated a positive and significant relationship between NSE and PUS, with a small effect size (β: 0.31; $p < 0.01$; $f^2 = 0.093$).
- H8: the result indicated a positive and significant relationship between NSE and ATT, with a medium effect size (β: 0.31; $p < 0.01$; $f^2 = 0.153$).
- H9: the result indicated a positive and significant relationship between NSE and BIN, with a small effect size (β: 0.15; $p = 0.04$; $f^2 = 0.066$).

The results of the hypotheses testing are summarized in Table 7. All of the nine hypotheses were supported by the data.

6 Discussion

It is well acknowledged by now that the TAM is an unstable construct as there is a great deal of variability in correlations reported and antecedents included in the models (King and He 2006; Sun and Zhang 2006). The TAM appears sensitive to moderating factors (Burton-Jones and Hubona 2006; King and He 2006; Schepers and Wetzels 2007; Sun and Zhang 2006) and there are at least ten moderating factors which have been found to

Table 6 Model fit statistics

Measure	Values	Recommended Criterion
Average path coefficient (APC)	0.385, P < 0.001	Acceptable if P < 0.05
Average R-squared (ARS)	0.527, P < 0.001	Acceptable if P < 0.05
Average adjusted R-squared (AARS)	0.519, *P* < 0.001	Acceptable if *P* < 0.05
Average block VIF (AVIF)	1.717	Acceptable if <= 5
Average full collinearity VIF (AFVIF)	2.368	Acceptable if <= 5

influence the core constructs of the TAM (Sun and Zhang 2006) which makes comparing studies somewhat more complicated. Further, it appears increasingly clear that the TAM is contextually determined (Burton-Jones and Hubona 2006; King and He 2006; McFarland and Hamilton 2006; Schepers and Wetzels 2007).

In a previous study of Facebook (Doleck et al., under review), we further found significant direct effects for self-efficacy, relative advantage, trust and risk, and subjective norm on perceived ease of use, perceived usefulness, attitude, and behavioral intention. Our results corroborated the direct relationship at the heart of the TAM between perceived usefulness and behavioral intention but we also found support for a mediating effect of attitude from perceived ease of use to behavioral intention, which was not included in the meta-analyses mentioned above. Given the preceding, it is possible that our divergent findings can be partly explained by the specific context of Facebook use. Facebook's ubiquity means that many users have mitigated feelings about using Facebook ('detoxing' or taking a hiatus from Facebook is increasingly common). They may indeed find Facebook useful and easy to use yet still have negative appraisals of their behavioral intentions to use because they are somehow 'overwhelmed' by overusing the platform.

Thus, the large variability in reported correlations can be partly explained by the contextual specificity of the TAM. In some contexts of technology use, certain variables may be more or less salient. For instance, the organizational context has been shown to influence behavioral intentions to use since the user may have little or no

Table 7 Hypothesis testing

Hypothesis	Path	Path coefficient (β)	*P value*	Result
H1	PUS ➔ BIN	0.27	$p < 0.01$	Supported
H2	PUS ➔ ATT	0.58	$p < 0.01$	Supported
H3	PEU ➔ ATT	0.18	$p = 0.02$	Supported
H4	PEU ➔ PUS	0.64	$p < 0.01$	Supported
H5	ATT ➔ BIN	0.40	$p < 0.01$	Supported
H6	BIN ➔ USE	0.64	$p < 0.01$	Supported
H7	NSE ➔ PUS	0.31	$p < 0.01$	Supported
H8	NSE ➔ ATT	0.31	$p < 0.01$	Supported
H9	NSE ➔ BIN	0.15	$p = 0.04$	Supported

choice in which technology they use (Davis et al. 1992; Sun and Zhang 2006; Venkatesh et al. 2003). Organizational concerns such as these are suggestive of a dimension of moderating factors which has not been fully considered in the TAM literature, which to-date has largely focused on user beliefs. Yet by and large, studies employing TAM have not properly considered the effect of the modality of these beliefs on behavioral intention. Modalities such as certainty, necessity, and conditionality/possibility, have an important influence on behavioral intentions, since we are more likely to use something we are *contextually constrained to use*, whether these constraints be real (as in a job obligation or perceived (as a need for self-expression)). Most constructs so far would appear to be predicated on a mix of belief modalities. For instance, perceived usefulness is related to the enactive dimension; a user will judge the perceived usefulness of a technology on the tools' affordances, and the certainty of task accomplishment with its use. It would thus appear that these constructs conceal interactions of beliefs, and hence that technology acceptance is the result of complex interactions between beliefs and their modalities.

Sun and Zhang (2006) proposed a framework for organizing ten moderating factors on the TAM. They categorize these ten moderating factors into organizational (voluntariness, task/profession), technological (individual/group, purpose, complexity), and individual factors (intellectual capability, cultural background, gender, age, and experience). However we believe a more adequate organizational framework can be derived by organizing situational factors and appraisals as in the matrix presented in Table 8 below.

This matrix is suggestive of how belief appraisals, including modalities, interact with situational factors to determine and moderate TAM relationships in specific contexts of use. If this conjecture holds, then accounting for the interaction between modal and situational factors should provide a flexible model which can be adapted to the unique context of technology acceptance. The addition of belief modality as a dimension provides a way to organize the extant TAM literature and provides a new direction to TAM research by proposing a novel mechanism for incorporating contextual specificity in TAM studies.

Under this matrix, 'need for self-expression' would fall under voluntariness (Moore and Benbasat 1991; Venkatesh et al. 2003), as it is a factor that relates to the social-organizational dimension and is predicated on the necessity of use. In other words, 'need for self-expression' as a form of voluntariness is a 'social-organizational' antecedent factor, which has the modality of belief 'necessity of use'. As a necessity of use belief, need for self-expression is related to individual/group dynamics such as social

Table 8 Organizational matrix of moderating factors in the TAM

	Necessity of use, e.g., need fulfilment, job requirement	Certainty of use, e.g., "failsafe"	Possibility (conditionality/probability) of use, e.g., affordances, innovation
Social-Organizational	Voluntariness	Task requirements	Affordances
Technological	Individual/group	Purpose	Complexity
Individual	Cultural background, gender, age	Profession	Experience

influence, compliance and subjective norm, and cultural background, gender, and age factors (c.f., Karahanna and Straub 1999; Sun and Zhang 2006).

In the technology acceptance literature, the study of beliefs has been limited to the content of appraisals and has only obliquely considered the modalities of such beliefs, often confounding them across levels of analysis, and not distinguishing how appraisals are different from probabilistic beliefs in conditional reasoning or different from entailment beliefs in logical-mathematical reasoning. Ignoring modalities occludes the ways that beliefs interact to inform behaviors and actions. Below we examine the degree that modalities have been included in the models reviewed by Venkatesh et al. (2003) and what it suggests for future study. Our comparison is summarized in Table 9 below.

The modality of belief necessity of use as a dimension differs from subjective norm and attitude toward behavior in the Theory of Reasoned Action (Fishbein and Ajzen 1975) because modalities refer to the way the belief is held; they are not strictly about the content of the belief itself; nor are they strictly subjective appraisals or attitudes since they are influenced by situational constraints and affordances. Further, necessity of use differs from 'perceived behavioral control' at least as defined by Ajzen (1991) as "the perceived ease or difficulty of performing the behavior" (p.188, quoted in Venkatesh et al. 2003, Table I p.428–32). Though, it would appear to share affinities with Taylor and Todd's (1995) definition, who conceive perceived behavioral control in terms of internal and external constraints or in motivational terms, intrinsic and extrinsic motivation (Davis et al. 1992). It would further appear to be related to the Decomposed Theory of Planned Behavior which breaks-down the constructs of attitude, subjective norm, and perceived behavioral control into its 'underlying belief structure' (Venkatesh et al. 2003, p.429) and includes 'voluntariness of use' from Innovation Diffusion Theory (Moore and Benbasat 1991). Yet the above do not separate the modality from the content of the entailment belief in any systematic fashion.

Necessity of use also differs from self-efficacy beliefs (Bandura 1977) – though they are related – because they refer to the extent that a person believes they are capable of successfully engaging in some activity or achieving some goal. Self-efficacy beliefs ought to be classified under the modality of belief 'possibility/ conditionality of use' as they relate to affordances, complexities, and user experiences. Under this modality of belief – in addition to Social Cognitive Theory as conceived by Compeau and Higgins (1995) – we can include perceived ease of use, from the TAM and IDT; job-fit, and long-term consequences from the Model of PC Utilization (Thompson et al. 1991); and relative advantage, ease of use, and image from Innovation Diffusion Theory (Moore and Benbasat 1991), as they all entail probabilistic or conditional reasoning.

The only models that explicitly contain factors which exhibit the modality of belief "certainty of use" are the TAM, as perceived usefulness, and the Model of PC Utilization, as complexity and IDT, as visibility and results demonstrability.

What the above analysis suggests (summarized in Table 9 below) is that not all factors apply equally across all technology acceptance situations. Some models are more suited to organizational level analysis, whereas others are more suited to individual adoption and ignore social/organizational factors completely. Some models only consider necessity of use beliefs, while others also consider conditionality/possibility of use beliefs. It is worth noting how few models actually considered certainty of use

Table 9 Comparison of factors across situational and modal dimensions

	Modality X	Situation	= Category
Theory of reasoned action			
Attitude	Necessity	Individual	Cultural background
Subjective norm	Necessity	Technological	Individual/group
Technology acceptance			
Perceived usefulness	Certainty	Multiple	
Perceived ease of use	Conditionality	Individual	Experience
Subjective norm	Necessity	Technological	Individual/group
Motivational			
Extrinsic	Necessity	Multiple	
Intrinsic	Multiple	Individual	
Theory of planned behavior			
Attitude	Necessity	Individual	Cultural background
Subjective norm	Necessity	Technological	Individual/group
perceived behavioral control	Necessity	Technological	Individual/group
TAM/TPB			
Attitude	Necessity	Individual	Cultural background
Subjective norm	Necessity	Technological	Individual/group
Perceived behavioral control	Necessity	Technological	Individual/group
Perceived usefulness	Certainty	Multiple	
Model of PC			
Job fit	Conditionality	Individual	Profession
Complexity	Certainty	Technological	Complexity
Long-term consequence	Conditionality	Multiple	
Affect	Necessity	Individual	Cultural background
Social factors	Necessity	Individual	Cultural background
Facilitating conditions	Conditionality	Social-organizational	Affordances
Innovation diffusion theory			
Relative advantage	Conditionality	Technological	Complexity
Ease of use	Conditionality	Technological	Complexity
Image	Conditionality	Individual	Experience
Visibility	Certainty	Technological	Purpose
Compatibility	Necessity	Individual	Cultural background
Results demonstrability	Certainty	Social-organizational	Task requirements
Voluntariness	Necessity	Social-organizational	voluntariness
Social cognitive theory			
Outcomes performance	Conditionality	Technological	Complexity
Outcomes personal	Conditionality	Individual	Experience
Self-efficacy	Conditionality	Individual	Experience
Affect	Necessity	Individual	Cultural background
Anxiety	Conditionality	Individual	Experience

*Adapted from Venkatesh et al. 2003, p.428–35

beliefs given users expectations that software 'just work'. Clearly, not all factors apply to all situations equally. The above organizational matrix (Table 8) provides a systematic scheme for understanding the interaction between situational and modal beliefs as determining features of antecedents of technology adoption.

7 Conclusion

Overall, the hypothesized model, assessed to have a good fit, adequately described the salient drivers of Facebook use in the CEGEP sample; the model was able to explain 41 % of the variance in USE. The findings of the study highlighted that the causal linkage flows of the conventional links in the TAM were all supported. Moreover, the augmented aspects of the proposed model were also supported, i.e., all the hypotheses related to the new construct need for self-expression were supported. The present study has a number of limitations; as such the findings should be taken in light of these limitations. Most importantly, we only included one dimension of the perceived necessity of technology use and acceptance in the hypothesized model as need for self-expression appeared especially relevant to the use and acceptance of social networking sites. Perceived necessity manifests in different ways as well, such as job requirement (Sun and Zhang 2006; Venkatesh et al. 2003). However, other modalities of beliefs such as certainty of belief, e.g. the certainty that some software will work when needed or is 'failsafe', ought to be considered as well. As such the contextual determinants of a technology's use and acceptance need to be explored and tested as well. We leave such exercises for the future. As the present study sampled one college and a particular social networking site, another limitation of the study concerns the generalizability of the results to other populations and social networking sites. Similar to most TAM related studies, the present study relies on self-reports of use rather than actual use. Thus, an important task for future work should attempt to gather actual use. It should be noted that the underlying theory used in the present study is the TAM, which while useful as a parsimonious model, can be deficient in fully explaining acceptance. As such, other theories can be integrated with the TAM to better explain the acceptance process and increase the predictive capacity of future research efforts.

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