


Article

Sustainability of the Benefits of Social Media on Socializing and Learning: An Empirical Case of Facebook

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Abstract: Social network sites (SNSs) provide new avenues for self-expression and connectivity, and they have considerable potential to strengthen social capital and psychological well-being. SNSs have consequently become deeply rooted in people's daily lives. During the COVID-19 pandemic, e-learning has become a dominant learning modality to maintain social distancing. Because of the excellent connectivity provided by Internet platforms, SNSs can be leveraged as collaborative learning tools to enhance learning performance. However, conflicts may emerge when extending the socializing function to learning; thus, this topic merits in-depth investigation. One potential reason for the conflicts is the various types of overload caused by the system features, information, communication, and social aspects that users experience, leading to negative emotional responses, such as social network fatigue. Although SNS overloads have been extensively studied, most of these studies were conducted from the perspective of SNSs as platforms for socializing, and the overloads were treated as linear and independent. We apply multi-criteria decision-making tools to bridge the research gaps. Specifically, we recruited 15 active Facebook learning community members as an expert panel under the saturation principle. After extensive pairwise comparisons between the primary constructs and further matrix calculations, our significant research findings include antecedents to social network fatigue and their causal effects, representing a valuable complement to conventional structural equation modeling approaches. We also discuss the theoretical and practical implications of the study.

Keywords: overload; social network fatigue; regret; information system discontinuance; DANP



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1. Introduction

In conjunction with the rapid development of information and communication technology (ICT), social network sites (SNSs) have emerged and enabled users to interact with the world without time and space constraints. SNS users share their personal experiences on these sites, and research has highlighted the tremendous value of SNS. For instance, SNSs provide new avenues for self-expression and connectivity [1,2]. By leveraging the connectivity possible through SNSs, users can establish and enhance their social capital [3]. Moreover, SNSs can strengthen users' psychological well-being through improvements in self-esteem and quality of life [4]. Consequently, SNSs have become increasingly ingrained in people's daily lives [5], and the sustainability of their benefits has been a significant concern.

During the COVID-19 pandemic, e-learning has become a dominant learning modality to maintain social distancing. This teaching approach helps enhance the interaction and collaboration between teachers and students and increases student engagement. Moreover, because the asynchronous nature of e-learning relies on both self-directed and cooperative learning, the ubiquity of SNSs presents a unique opportunity for applying them as collaborative learning tools. The shifting of conventional face-to-face learning communities to online alternatives creates avenues to leverage the versatility, flexibility, and convenience that SNSs offer.

Alongside these benefits, some dark sides of SNSs also emerge. For example, the negative effect of SNS-related overload on users [6]. The pervasiveness of SNS has prompted people to be connected and continuously involved; for some people, this has resulted in overload, which refers to a mismatch between environmental requirements and an individual's ability to cope [7]. For example, learners must pay attention to learning materials and other activities, such as familiarizing themselves with increasingly complex SNS system features, responding to demanding social support from friends, confronting the distractive advertising, etc. These overloads lead to negative emotional responses such as stress, frustration, and anxiety, which also occur in learning communities. When individuals feel threatened by the physical and psychological strain generated by SNSs, they have to prevent or reduce the adverse outcomes and restore emotional stability [8,9], thus threatening the sustainability of SNS's massive benefits for people.

Although numerous studies have investigated topics related to overloads as stressors [6,8,10,11], some significant research gaps motivate us to conduct in-depth exploration. First, most SNS-related studies have employed structural equation modeling (SEM), which may not capture the dynamic and multidirectional interactions among essential constructs [6,8,11]. Thus, a pertinent research question involves considering the complicated relationship among various overloads instead of merely treating them as distinct elements (i.e., direct, linear, and independent). Second, most studies have discussed general SNS concerns, disregarding that SNSs are now multipurpose platforms that include socializing, marketing, learning, and so on. Therefore, these studies have frequently obtained mixed results and potentially lack definite and practical considerations. This study adopts multi-criteria decision-making (MCDM) techniques and focuses on Facebook learning communities to address the two questions mentioned above. Specifically, the decision-making trial and evaluation laboratory (DEMATEL)-based analytic network process (ANP) is applied to clarify the causal relationships and influential weights of both the dimensions and criteria of the decision model.

The primary purposes of this study are as follows: (1) exploring the causal relationships among SNS overload, internal psychological process, and discontinuous intention, (2) examining the causal relationship among essential factors under these dimensions, (3) identifying the influencing weights of these factors from the system point of view, (4) clarifying possible conflicts between socializing and learning in SNSs, and (5) suggesting practical strategies for overcoming conflicts to sustain the benefits of SNSs.

2. Literature Review

In this section, the theoretical background is introduced as the first step for establishing the research models. Similar to the system concept, which consists of input–process–output components, the stressor–strain–outcome framework has been applied in technostress research [12,13]. In this framework, stressors refers to factors that produce stress; strain represents the psychological outcomes of individual stressors, and the outcome is the behavioral result in stressful situations. This study identifies overload as the stressor; social network fatigue, disconfirmation, and dissatisfaction as the strain; and regret and discontinuance intention as the outcome. These constructs are described in the subsequent sections.

2.1. Overload as the Stressor

Studies related to overload have approached the topic either objectively, for example, by considering the time factor, amount of information, and characteristics of information [14–18]; or subjectively, for example, by considering the feelings of stress, confusion, pressure, anxiety, or low motivation [19,20]. This study focuses on overload in SNSs and consequently employs a subjective perspective. Thus, in this paper, overload refers to subjective evaluations and perceptions of individuals who face situations or people beyond their management ability [21].

When confronted with rapidly developing technology, people often encounter technostress. According to Brod [22], technostress is a common disease of adaptation due to an

individual's inability to cope with new computer technology healthily. It describes a state of mental stress generally concerning technology use and with both physical and biological manifestations, such as stress or frustration.

Technostress refers to the phenomenon where more information technology does not necessarily produce higher productivity [23]. Karr-Wisniewski and Lu [23] identify system feature overload, information overload, and communication overload as the three major technology overload dimensions and as the primary technostressors.

With social relationships increasingly embedded in social media, people have encountered a relatively recent phenomenon known as "social overload," which occurs when individuals have insufficient capacity to deal with requests for interaction on social networks. Therefore, users face a predicament: to enhance their social capital, they may develop feelings of losing control over social situations. This study adopts and examines the following facets of technostress in social media: system feature overload, information overload, communication overload, and social overload, described in the subsequent sections.

2.1.1. System Feature Overload

Karr-Wisniewski and Lu [23] define system feature overload as a situation where the technology is too complicated for a given task or where the addition of new features is not worthwhile in terms of the resources spent to obtain the possible benefits. For instance, because individuals use Facebook for multiple purposes, socializing features (e.g., notifications) might interfere with learning situations.

2.1.2. Information Overload

Information overload occurs when an individual's capacity to accommodate or process information is exceeded [24]. When heavy information loads challenge individuals' limited information processing capabilities, they may feel as if they are losing control and are more likely to be confused and regret decisions they have made. Following the study of Jacoby, Speller, and Kohn [25], this study adopts the definition of information overload as the condition created when users have insufficient capacity to deal with large amounts of information generated on SNSs.

2.1.3. Communication Overload

In an ever-connected environment and as social networks expand, frequent communication can lead to an imbalance between communication needs and human cognitive capabilities. Communication overload occurs when the communication requirements on an SNS exceed the state of personal communication capabilities [26]. Thus, this study's communication overload is defined as the conditions caused by frequent communication on SNSs that exceed an individual's capacity.

2.1.4. Social Overload

Social overload originated as a sociological concept proposed by McCarthy and Saegert [21] to describe the adverse effects of overcrowding. According to their example, tenants in more crowded buildings are likely to encounter others in the public spaces; such frequent interaction might exceed their capacity or ability to process relevant incoming social stimuli, leading to social overload. This situation leads to mental and psychological suffering for residents. This phenomenon also occurs on SNSs. Maier, Laumer, Eckhardt, and Weitzel [27] define social overload on SNSs as a feeling that individuals experience when they must cater to the excessive social support needs of connections they have made. LaRose, Connolly, Lee, Li, and Hales [28] also identify this overload and its impact on people's lives. The current study defines social overload as the perception of online crowding and its impact on users' sense of excessive social demand. In such a scenario, users must invest an ever-increasing amount of time and effort to maintain and manage online social connections.

2.2. Social Network Fatigue, Disconfirmation, and Dissatisfaction as the Strain

2.2.1. Social Network Fatigue

One primary symptom of technostress is fatigue, which has been defined and investigated in various disciplines, including psychology, health care, and occupational domains. Two types of fatigue can be identified: physical fatigue and psychological fatigue. Physical fatigue affects physiological ability, leading to imbalances in the individual's physical state, such as muscle fatigue or eye strain [29]. Psychological fatigue refers to negative cognitive states that result in pathologies such as tiredness, exhaustion, stress, boredom, and anxiety [30]. Because this study's context is learning communities, focusing on the psychological fatigue dimension is more relevant.

According to Ravindran et al. [10], social network fatigue is a subjective, multidimensional user experience that includes negative emotional responses, such as tiredness, annoyance, anger, disappointment, guardedness, loss of interest, or reduced need or motivation as a result of various aspects of social network use and interaction. From this perspective, social network fatigue is a repulsive and unconscious psychological reaction to stressful situations [27].

2.2.2. The Expectation–Confirmation Model of Information System Continuance

Expectation–confirmation theory (ECT) is widely applied in studies of consumer satisfaction and post-purchase behavior [31–33]. The predictive power of this theory has been validated in various product repurchase and service continuance contexts [32–35].

In this framework, the process by which consumers establish continuance intention can be described as follows: First, consumers form a prior expectation of the product or service. Second, they form perceptions regarding its performance after a period of consumption. Third, they compare the perceived performance with their initial expectation and determine the degree to which their expectation was confirmed. Fourth, they perceive a satisfaction level based on the degree of confirmation they received. Finally, satisfied consumers form a repurchase or continuance intention, whereas dissatisfied users do not.

Bhattacharjee [36] applies ECT in information system (IS) continuance contexts and proposes the post-acceptance model of information system continuance (PAM-ISC). The major features of the PAM-ISC can be described as follows: First, PAM-ISC only focuses on post-acceptance constructs because the effects of any pre-acceptance variables are reflected in the confirmation and satisfaction constructs. Second, PAM-ISC modifies ECT to include a post-acceptance expectation. Third, the post-acceptance expectation in PAM-ISC is manifested through the perceived usefulness. Both the ECT and PAM-ISC emphasize that consumer satisfaction and confirmation are crucial in determining the intention to repurchase [31,32,37].

The PAM-ISC postulates that two constructs determine user satisfaction: the IS's expectation and confirmation of expectation after actual use. Expectation serves as the baseline level for users to assess their confirmation's validity and then determine their response and satisfaction level. In an IS usage context, confirmation relates positively to satisfaction because it implies the realization of expected benefits.

2.3. Regret and Discontinuance Intention as the Outcome

2.3.1. Regret

According to ECT, satisfaction is an affective response to the comparison between expectation and actual performance. When the evaluation of the actual performance is more favorable than the expectation, confirmation and satisfaction occur, whereas when the assessment is poorer than the expectation, disconfirmation and dissatisfaction occur [38]. Indeed, the comparison between expectation and actual performance is essential to consumer continuance intention. However, to further explore individual psychological processes, another comparison is required. Kang et al. [39] propose that users may regret their decision to use SNSs if a previous alternative service is perceived to be more beneficial.

Cao and Sun [6] claim that, compared with satisfaction, regret more accurately reflects the individual psychological process. In social media, even when people are dissatisfied with the service, they are likely to continue using it if they have poor self-regulation. By contrast, even if people are satisfied with a service, if they spend a considerable amount of time and energy on activities they later perceive as meaningless, they will likely experience regret. Therefore, regret is a critical trigger factor for discontinuous behavior in social media.

2.3.2. Discontinuance Intention

When exposed to stressful and regretful situations, rational SNS users attempt to reduce adverse outcomes from technostress and restore emotional stability. This concept reflects SNS users' intention to modify and discontinue existing behavioral patterns [27,40].

In terms of discontinuance intention or behavior in the SNS context, Ravindran et al. [10] classify three types of discontinuous behavior: taking short breaks, controlling activities, and suspending behavior. Thus, discontinuance intention in the SNS context could be defined as an individual's intention to decrease SNS use intensity, stop SNS use temporarily or permanently, or switch to other alternatives [10,27,40].

3. Research Model

This study develops its conceptual research framework (Figure 1) on the basis of the relevant literature, mainly the PAM-ISC [36]. Although the PAM-ISC focuses on the positive (continuous) aspect of IS, Bhattacharjee [36] claims the link's negative element also holds. Because the current study focuses on the negative responses generated by social network usage, the links from disconfirmation to perceived usefulness and dissatisfaction are first established. This study then replaces the perceived usefulness construct with social network fatigue because perceived usefulness is an opposite emotional response. Next, overload is added as an external variable to increase the explanatory power of the model. Finally, in a voluntary social network context, regret triggers the final discontinuous intention and behavior.

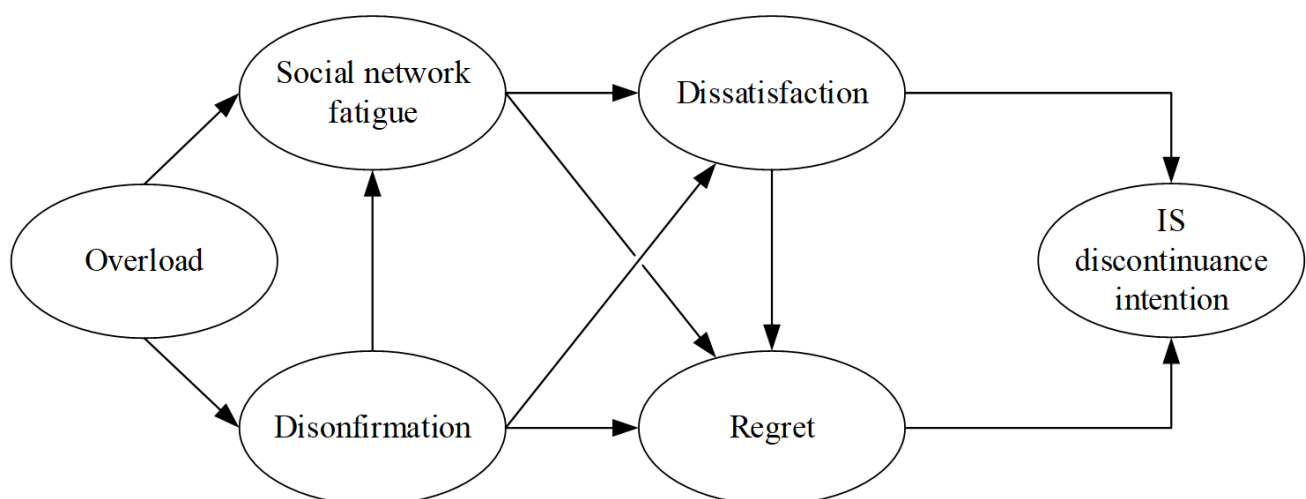


Figure 1. Conceptual Research Framework.

3.1. Impact of Overload

3.1.1. Impact of Overload on Social Network Fatigue

Alongside the rapid development of ICT, the system features of SNS have also developed rapidly. For users, the benefits of new system features may reach a limit. For example, frequent changes in system features or functions that are highly complex may result in adverse effects. When SNS users believe that the cost of learning and using system features

outweigh the benefits, they will become tired of SNS usage and experience social network fatigue [8].

The effects of information overload have been widely examined and validated, with a proven negative impact on decision quality and effectiveness [16,25]. Zhang et al. [11] also confirm that when the information provided by social networks overloads users, those users experience lower perceived system usefulness. Lee et al. [8] posit that information overload may negatively affect human feelings, behavior, and health, resulting in social network fatigue.

Accidental and excessive communication disrupt users, causing distractions and additional cognitive burdens. Such interruptions negatively influence work productivity regarding accuracy, efficiency, and performance [41,42]. Communication overload can result in users feeling fatigued, leading to more serious mental or physical illness [43,44].

Dunbar's [45] famous number, 150, is based on the rationale of a cognitive limit concerning the number of individuals with which one can maintain stable social relationships. Although the number limit might be different in an SNS context, beyond a certain number additional friends are associated with decreasing subjective well-being [46]. According to Zhang et al. [11], the possible reasons for this phenomenon are as follows: First, excessive communication needs may interrupt and distract individuals from their daily work and cause a sense of interference and frustration [23]. Second, people might become weary of the pressure to comply with social norms, such as offering social support to SNS friends [47]. Third, an individual's lack of reaction to social needs or indulgence in SNSs is recognized as indirectly causing harmful effects and stress [28].

3.1.2. Impact of Overload on Disconfirmation

SNS system features have both benefits and costs. Even if social networks enable people to accumulate social capital efficiently and effectively, when users experience overload, their evaluation of actual performance will be lower than prior expectations, leading to disconfirmation.

3.2. Impact of Disconfirmation

3.2.1. Impact of Disconfirmation on Social Network Fatigue

In the IS continuance context, confirmation and perceived usefulness are related [36]. This relationship implies a negative side of the PAM-ISC model, represented by disconfirmation and social network fatigue. SNS users may have a high initial usefulness perception, but this perception is adjusted according to their disconfirmation experience. Cognitive dissonance theory [48] posits that users may experience cognitive dissonance (or psychological tension) if their usefulness perceptions are disconfirmed during use. Rational users attempt to reduce this discomfort by modifying their perceptions; subsequently, they become more susceptible to feelings of social network fatigue. Therefore, the extent of users' disconfirmation is expected to be positively associated with their social network fatigue.

3.2.2. Impact of Disconfirmation on Dissatisfaction and Regret

Expectation provides a comparison base for users to assess the extent of confirmation and determine their evaluative response in terms of satisfaction. The confirmation–satisfaction link represents a realization of system benefits through actual use and has been validated by ECT studies and PAM-ISC studies. The disconfirmation–dissatisfaction link, which indicates a perceived performance lag or failure to meet expectations, is also supported by Selwyn [49] and Sliwa and Collett [50]. Because regret represents the consideration of expectation and the sacrifice of alternatives, disconfirmation–dissatisfaction can be expected to extend to regret.

3.3. Impact of Social Network Fatigue

3.3.1. Social Network Fatigue, Dissatisfaction, and Regret

Tiesinga et al. [51] define fatigue as a negative perception caused by the dissonance between reality and an individual's ability to manage it. SNS users typically expect to gain positive results, such as connectedness and social support. If users experience adverse outcomes (e.g., fatigue), a disconfirmation effect arises. In terms of ECT, this disconfirmation results in dissatisfaction [39]. Empirical studies have supported that SNS users who experience adverse outcomes might exhibit dissatisfaction with SNSs [27,40].

When users perceive the unpleasant effects of social network fatigue, which are inconsistent with their original expectations, regrets occur because of the alternatives they may have sacrificed. According to social cognitive theory [52], the regret mechanism regulates behavior, which may help people overcome problems associated with SNSs.

3.3.2. Social Network Fatigue and Discontinuance Intention

According to cognitive dissonance theory [48], when individuals are under mental stress, they modify their behavior or emotional reaction strategies to avoid such unpleasant feelings. Psychological studies have proven that psychological fatigue generates low performance and hurts participation or continuance activities [53–55]. A definition of social network fatigue by Ravindran et al. [10] mentions a state of “reduced need/motivation produced from various aspects of social network use and interactions”; thus, social network fatigue is expected to be associated with discontinuous intention. Empirical studies have supported this viewpoint [10,27,40].

3.4. Impact of Dissatisfaction and Regret

3.4.1. Dissatisfaction on Regret

Fishbein and Ajzen [56] argue that a correspondence principle, to accurately predict behavioral intention, beliefs, and attitudes, must be specified in a manner consistent with time, target, and context. Wixom and Todd [57] apply this principle to describe the power of behavioral beliefs over object-based attitudes. Similarly, this study supposes regret to be a more advanced internal psychological process than dissatisfaction and to represent the last impetus to the final discontinuance intention and behavior. Thus, dissatisfaction is expected to lead to regret.

3.4.2. Dissatisfaction on the Discontinuance Intention

Satisfaction and dissatisfaction reflect the affective response to an individual's total experience with a product or service; in contrast to satisfaction, dissatisfaction describes negative emotions, such as frustration and bitterness [58]. In SNS contexts, many studies have confirmed the satisfaction–continuous intention link [59,60]. Similarly, research on the dissatisfaction–discontinuance intention link has revealed that negative emotions cause avoidance behavior or a shift to alternatives [61,62]. Therefore, dissatisfaction is likely to result in discontinuance intentions.

3.4.3. Regret on the Discontinuance Intention

If people regret not achieving a more favorable experience, they change their behavior to protect themselves from negative emotions. Because social network fatigue leads to several adverse outcomes, such as addiction, depression, and anxiety, which further strengthen the sense of regret, these unpleasant experiences remind people of problems and promote corrective action [63]. Hence, users who experience regret in SNS environments become aware of their problematic behavior and attempt to discontinue usage.

After extensively examining tentative relationships of major constructs, this study establishes an MCDM framework (Figure 2) for further analysis. In this framework, all constructs are categorized in the stressor–strain–outcome model. Notably, all links in this research framework are double-arrowed because of the absence of prior assumptions concerning the cause-effects between elements.

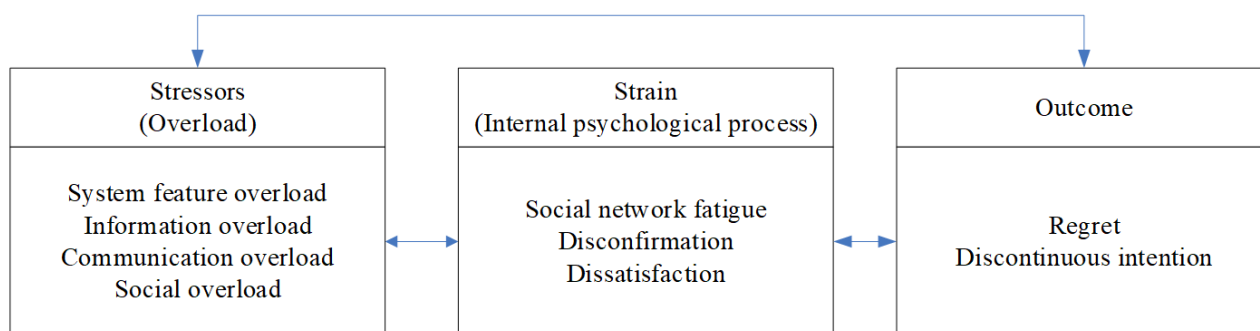


Figure 2. MCDM Research Framework.

4. Methodology

4.1. The DANP Method

In response to our first research question, the proposed MCDM research framework is analyzed using the DANP method. A major feature of this methodology is that all judgments are inferred from the consensus opinion of active members in SNS learning communities through extensive pairwise comparisons and further matrix calculations of decision elements (i.e., dimensions and criteria) without any prior hypotheses regarding their relationships. In this manner, this study provides a valuable complement to existing research findings and provides further insight into the stressor effects of SNSs.

The DANP procedure, as illustrated in Figure 3, can identify the interdependence among decision elements by DEMATEL, and their relative weights by ANP. This article focuses on the implications of findings; for the technical details of the procedure, please refer to Chuang et al. [64].

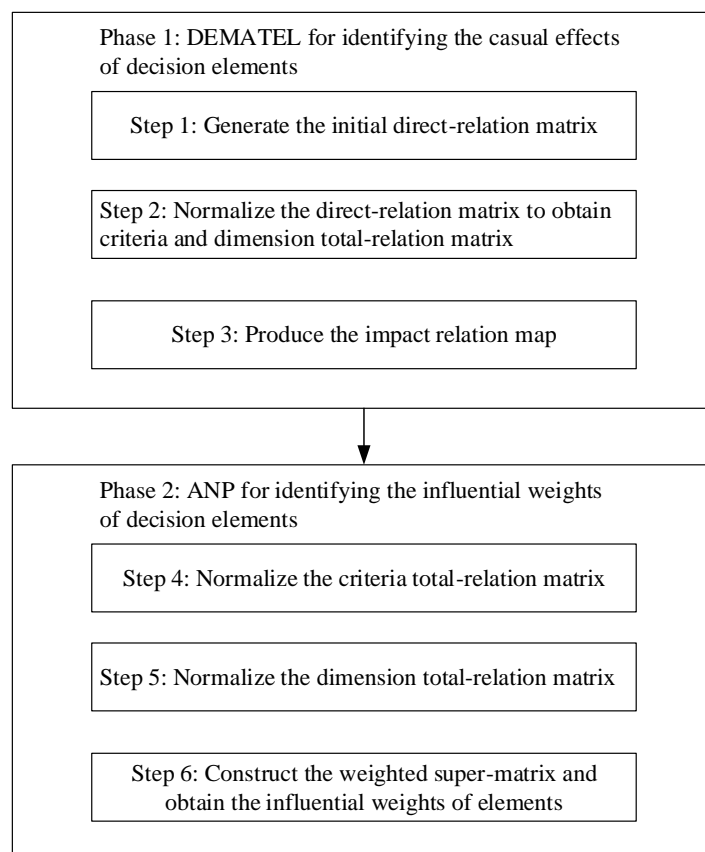


Figure 3. DANP Procedure.

4.2. Measurement

To conduct the DANP analysis, a survey questionnaire was designed with three parts. The first part involves collecting the respondent's basic data. The second part introduces the primary constructs of the study. The third part is a comprehensive pairwise comparison of research constructs. Table 1 is an example of the third part. To complete this part, the first step is to confirm the relationship between the constructs; the second step is to indicate the degree of influence on a scale from 0 to 4: 0 = no impact, 1 = low impact, 2 = medium impact, 3 = high impact, and 4 = very high impact. The questionnaire was completed during face-to-face meetings to ensure that respondents understood the exact meaning of each element. The survey has an approximate duration of 30 min.

Table 1. Questionnaire Response Example.

X Construct	Y Construct	Relationship of the Constructs				→ Degree of Influence				← Degree of Influence			
X1	Y1	×	→	←	↔	1	2	3	4	1	2	3	4
	Y2	×	→	←	↔	1	2	3	4	1	2	3	4

The questionnaire indicated that X1 is affected by Y1, and the degree of influence is 2; X1 and Y2 affect each other, X1 affects Y2 with degree 3, and X1 is affected by Y2 with degree 4.

To help respondents clearly understand essential constructs, the respondents were provided with explanatory items, which were devised on the basis of an extensive literature review (Table 2).

Table 2. Survey Constructs.

Construct (Source)	Explanatory Items
a1. System feature overload [23]	1. I am often distracted by features that are included in FB but are not related to my main purpose in using FB. 2. I find that most features of FB contain too many poor sub-features instead of too few very good sub-features. 3. FB tends to try to be too helpful by adding features, which makes the social performance even harder. 4. The features of FB I use are often more complex than the tasks I have to complete using these features.
a2. Information overload [23,65]	1. I am often distracted by the excessive amount of information on social media. 2. I am overwhelmed by the amount of information that I process daily from social media. 3. I feel some problems with too much information on social media to synthesize instead of not having enough information. 4. There is too much information about my friends on FB, so I find it a burden to handle. 5. I find that only a small part of the information on FB is relevant to my needs
a3. Communication overload [26,66]	1. I receive too many messages from friends through social media. 2. I feel like I have to send more messages to friends through social media than I want to send. 3. I feel that I generally receive too many notifications on new postings, push messages, and news feeds, among others, from social media as I perform other tasks. 4. I often feel overloaded with social media communication. 5. I receive more communication messages and news from friends on social media than I can process.
a4. Social overload [27]	1. I take too much care of my friends' well-being on FB. 2. I deal too much with my friends' problems on FB. 3. I am too often caring for my friends on FB. 4. I pay too much attention to my friends' posts on FB.
b1. Social network fatigue [67,68]	1. Sometimes, I feel tired when using FB. 2. Sometimes, I feel bored when using FB. 3. Sometimes, I feel drained from using FB. 4. Sometimes, I feel worn out from using FB. 5. I feel disinterested in whether new things are happening on FB. 6. I feel indifferent about the reminders or alerts of new stuff from FB.

Table 2. Survey Constructs.

Construct (Source)	Explanatory Items
b2. Disconfirmation [36]	<ol style="list-style-type: none"> 1. My experience with using FB was better than what I expected. 2. The service level provided by FB was better than what I expected. 3. Overall, most of my expectations from using FB were confirmed.
b3. Dissatisfaction [69]	<ol style="list-style-type: none"> 1. I feel dissatisfied with my overall experience using FB. 2. I feel displeased about my overall experience using FB. 3. I feel disgruntled about my overall experience using FB. 4. I am not delighted about my overall experience using FB.
c1. Regret [39]	<ol style="list-style-type: none"> 1. I feel sorry for using FB frequently. 2. I regret using FB excessively. 3. I should have spent less time on FB.
c2. Discontinuous intention [10,27]	<ol style="list-style-type: none"> 1. In the future, I will use FB far less than today. 2. In the future, I will use another social network service. 3. I will sometimes take a short break from FB and return later. 4. If I could, I would discontinue the use of FB.

4.3. Sample

In response to the second research question, this study concentrates on the context of SNS learning communities. Because the DANP questionnaire is expert-oriented, this study considered qualitative and quantitative requirements for an appropriate research sample.

4.3.1. Sample Qualitative Requirements

Northcutt and McCoy [70] suggest certain desirable characteristics of members to ensure a focus group has a suitable composition in terms of sample quality. First, members should be knowledgeable and have experience regarding the research topic. Second, they should be able to ponder the question and express their thoughts adequately. Third, they should have the motivation and time to participate in the study. Fourth, they should be homogeneous concerning critical dimensions of distance and power. Finally, members should have excellent team spirit and should be neither overpowering nor too timid to speak.

Based on these suggestions, this study recruited a research sample of 15 master's degree students majoring in Management Information Systems at a university in Central Taiwan and taking courses that require collaborative learning highly, such as team presentations and reports. These students have expert-level familiarity with Facebook and participate actively and spontaneously in learning communities on that platform.

4.3.2. Sample Quantitative Requirements

Regarding sample size, this study considered whether to collect more data by following the principle of saturation in qualitative research. Thus, when no new or relevant data emerges for a category, the category is regarded as well-developed, and the linkages between categories are also well-established [71–73]. Because each expert's opinions are obtained through pairwise comparisons of element i and j for n criteria and then represented by a direct-relation, the theoretical saturation of this study can be evaluated by the “errors of gap ratio” (EGR; [74]).

5. Results

The recruitment of a qualified sample, its group consensus, and the DANP analysis results in terms of causal effects, influential weights, and their synthesis concerning essential constructs are delineated in the subsequent sections.

5.1. Group Consensus

In this stage, EGR is applied to determine the appropriate sample size. Because the EGR of the 15 respondents is 4.31%, the group consensus has a confidence level of 95.69%, which is higher than the 95% level used to test for significance. Therefore, the sample size of this study is 15. The demographic characteristics of this sample are summarized in Table 3.

Table 3. Respondents' Demographic Characteristics.

Category	Classification	Frequency	Percentage
Gender	Male	8	53%
	Female	7	47%
Education	First-year master's student	12	80%
	Second-year master's student	3	20%
Age	23–24	12	80%
	25–26	3	20%
Most frequently used social media	Facebook	10	67%
	Line	4	27%
	Instagram	1	6%
Duration of everyday use	Less than 30 min	0	0%
	30 min to less than 1 h	3	20%
	1 h to less than 2 h	3	20%
	2 h and more	9	60%
Top 3 subjects of the learning community	Management Theory and Practice	5	33%
	Foundation of Computer Science	4	27%
	Research Method	3	20%

5.2. Clarifying the Causal Effects of Dimensions and Criteria

The DEMATEL technique is used to model causal relationships among dimensions and criteria based on the proposed research framework. Two essential results of the analysis are the criteria total-relation matrix and dimension total-criteria matrix listed as follows.

In the total-relation matrix, r_i denotes the sum of the i th row, representing direct and indirect effects given by i to the other elements; s_j denotes the sum of the j th column, representing direct and indirect effects on element j by the other elements.

Then the IRM can be constructed by mapping $(r_i + s_j, r_i - s_j)$. The horizontal axis vector $(r_i + s_j)$ represented the prominence of element i . Similarly, the vertical axis vector $(r_i - s_j)$ represented the relation of element i ; a positive value indicates a cause factor and a negative value an effect factor [75,76]. For main matrix results are summarized in Tables 4 and 5.

Table 4. Total Criteria Relation Matrix T_c .

Criteria	a1	a2	a3	a4	b1	b2	b3	c1	c2	r_i
a1	0.046	0.134	0.125	0.071	0.255	0.262	0.295	0.204	0.328	0.376
a2	0.136	0.062	0.176	0.106	0.336	0.296	0.322	0.231	0.342	0.480
a3	0.097	0.192	0.071	0.146	0.321	0.284	0.282	0.235	0.312	0.507
a4	0.077	0.152	0.191	0.046	0.310	0.263	0.246	0.207	0.271	0.466
b1	0.050	0.047	0.046	0.048	0.098	0.267	0.248	0.181	0.258	0.614
b2	0.054	0.020	0.035	0.018	0.168	0.092	0.247	0.218	0.257	0.508
b3	0.064	0.035	0.034	0.020	0.185	0.198	0.097	0.208	0.259	0.480
c1	0.009	0.008	0.025	0.006	0.060	0.078	0.082	0.036	0.178	0.214
c2	0.006	0.006	0.021	0.005	0.052	0.055	0.045	0.050	0.032	0.082
s_j	0.357	0.541	0.562	0.369	0.451	0.558	0.593	0.086	0.210	–

Based on the value of $r_i - s_j$ in Table 6, the causal effects of dimensions and criteria can be summarized as shown in Table 7. Table 7 provides decision-makers with a clear picture concerning the influential relationships among criteria and dimensions and identifies areas

for improvement. For example, if the influential relationship reveals that dimension A affects dimension B and C ($A \rightarrow \{B, C\}$) and dimension B affects dimension C ($B \rightarrow \{C\}$), then to alleviate the users' discontinuous intent (C), the SNS host should first reduce users' overload (A) to improve their internal psychological processes (B).

Table 5. Total Dimensional Relation Matrix T_d .

Dimensions	A	B	C	r_i
A	0.114	0.289	0.266	0.670
B	0.039	0.178	0.230	0.447
C	0.011	0.062	0.074	0.147
s_j	0.164	0.529	0.570	–

Table 6. Sum of Influences on Dimensions and Criteria.

Dimensions/Criteria	r_i	s_j	$r_i + s_j$	$r_i - s_j$
Overload (A)	0.670	0.164	0.834	0.505
System feature overload (a1)	0.376	0.357	0.733	0.019
Information overload (a2)	0.480	0.541	1.021	−0.060
Communication overload (a3)	0.507	0.562	1.069	−0.056
Social overload (a4)	0.466	0.369	0.835	0.097
Internal psychological processes (B)	0.447	0.529	0.976	−0.082
Social network fatigue (b1)	0.614	0.451	1.065	0.163
Disconfirmation (b2)	0.508	0.558	1.065	−0.050
Dissatisfaction (b3)	0.480	0.593	1.073	−0.113
Outcome (C)	0.147	0.570	0.717	−0.423
Regret (c1)	0.214	0.086	0.300	0.128
Discontinuous intention (c2)	0.082	0.210	0.293	−0.128

Table 7. Causal Effects Summary.

Dimensions	Criteria
Overload (A) \rightarrow {Internal psychological processes (B), Discontinuous intention (C)}	Social overload (a4) \rightarrow {System feature overload (a1); Communication overload (a3), Information overload (a2)}
Internal psychological processes (B) \rightarrow {Discontinuous intention (C)}	System feature overload (a1) \rightarrow {Communication overload (a3), Information overload (a2)}
	Communication overload (a3) \rightarrow {Information overload (a2)}
	Social network fatigue (b1) \rightarrow {Disconfirmation (b2), Dissatisfaction (b3)}
	Disconfirmation (b2) \rightarrow {Dissatisfaction (b3)}
	Regret (c1) \rightarrow {Discontinuous intention (c2)}

IRMs can be drawn to demonstrate the causal effects visually. However, because of complex and interacting personal phenomena, the original diagram that contains all links between elements may be cluttered in nature (see the left-hand side of Figure 4). Cluttered diagrams may be comprehensive and rich in meaning, but they are challenging to interpret intuitively. Such representations may lead to observers noting the details rather than the whole picture. One method to obtain a more suitable balance between richness and parsimony is to produce a second diagram without the redundant links [70]. The main idea behind this treatment is illustrated in Figure 4 and described in the next section.

The cluttered diagram represents an individual's perception that A influences B and C, and B influences C. We can simplify this system by removing the link from A to C. This link is redundant because it can be explained by the link from A to B plus the link from B to C. A may indeed influence C directly and significantly, but without B explaining this

link is difficult. Thus, by removing links that skip over mediating elements, we create a simpler, more meaningful mental model. Based on this principle, this paper produces the IRMs (Figures 5–8).

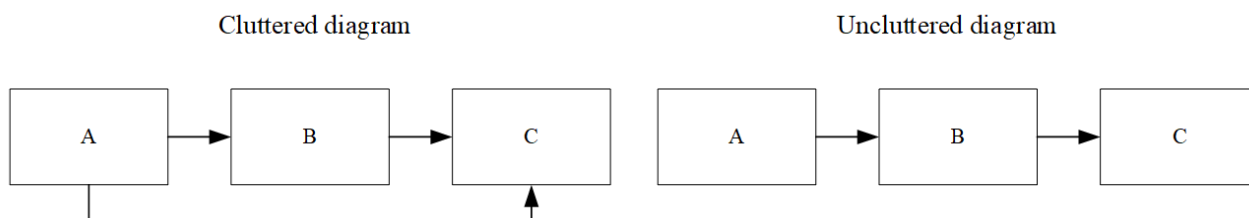


Figure 4. Cluttered and Uncluttered Diagram.

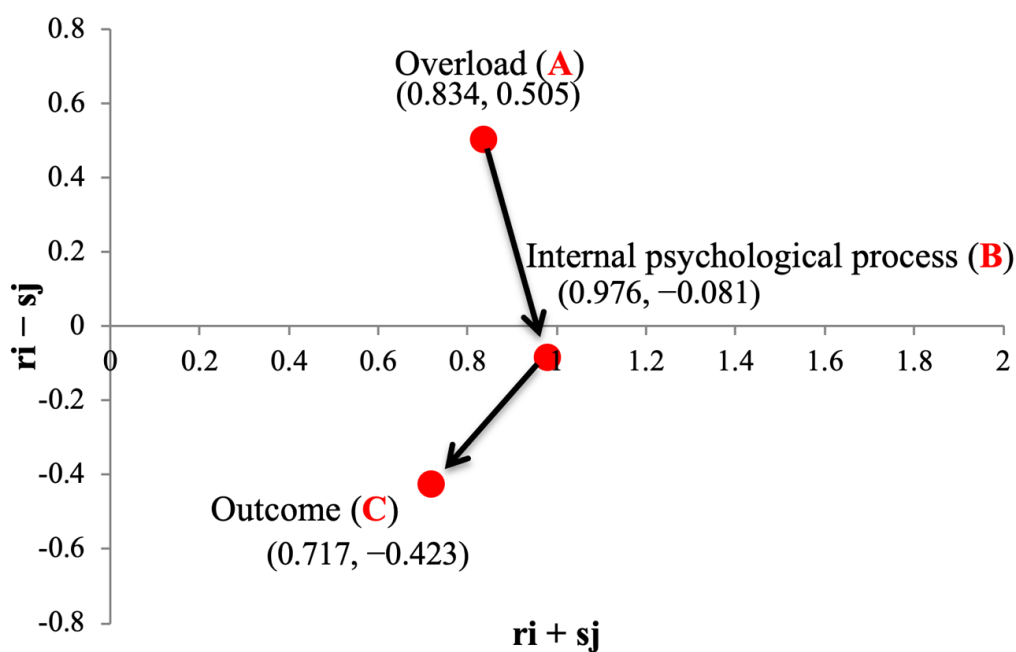


Figure 5. IRM of Dimensions.

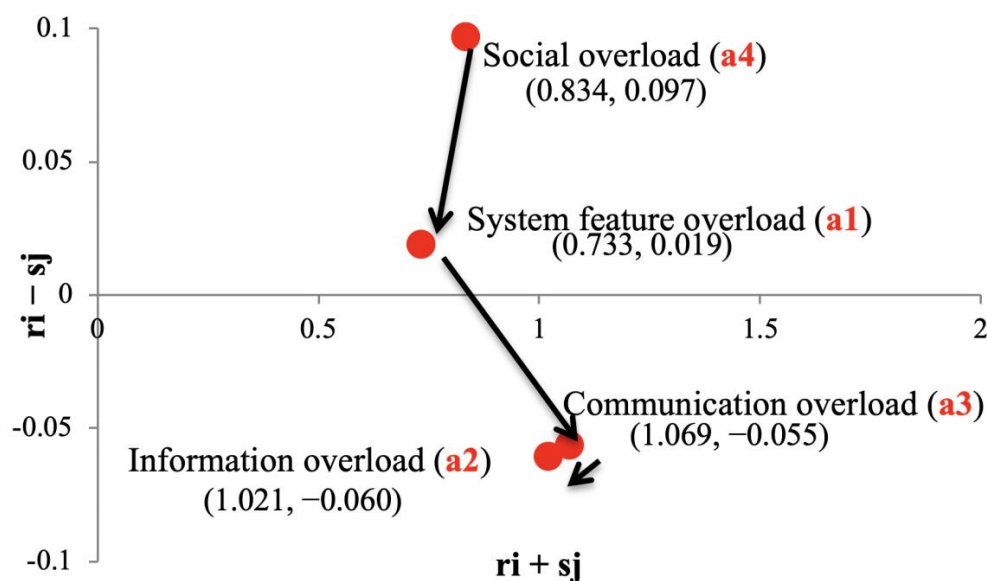


Figure 6. IRM of Overload.

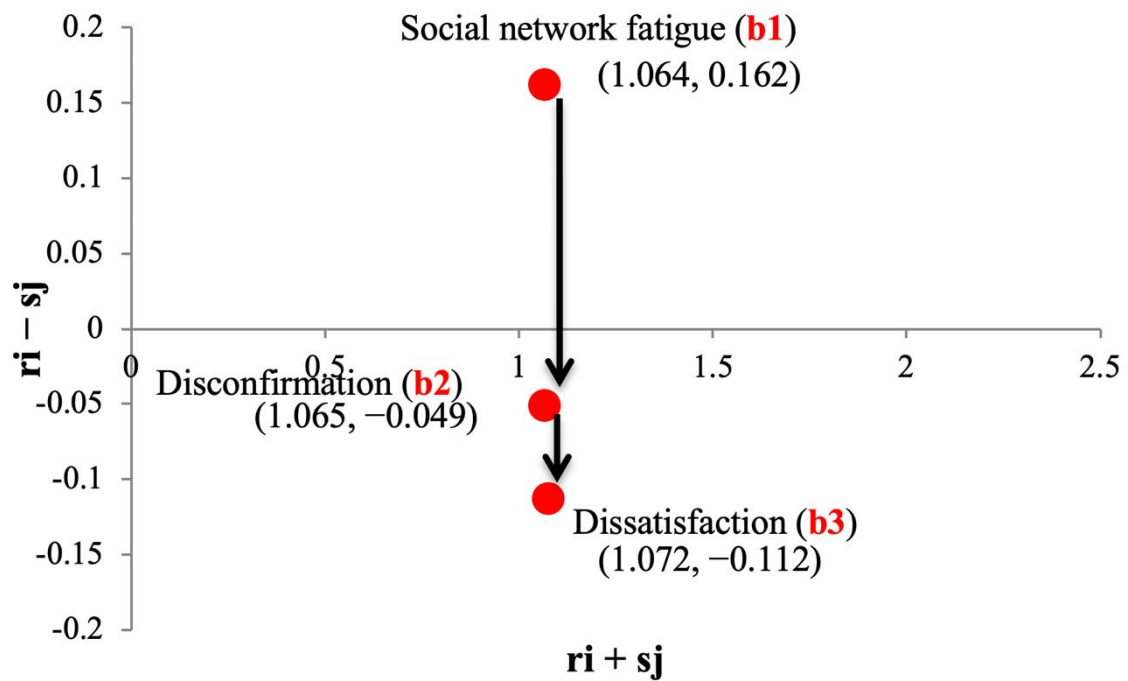


Figure 7. IRM of the Internal Psychological Processes.

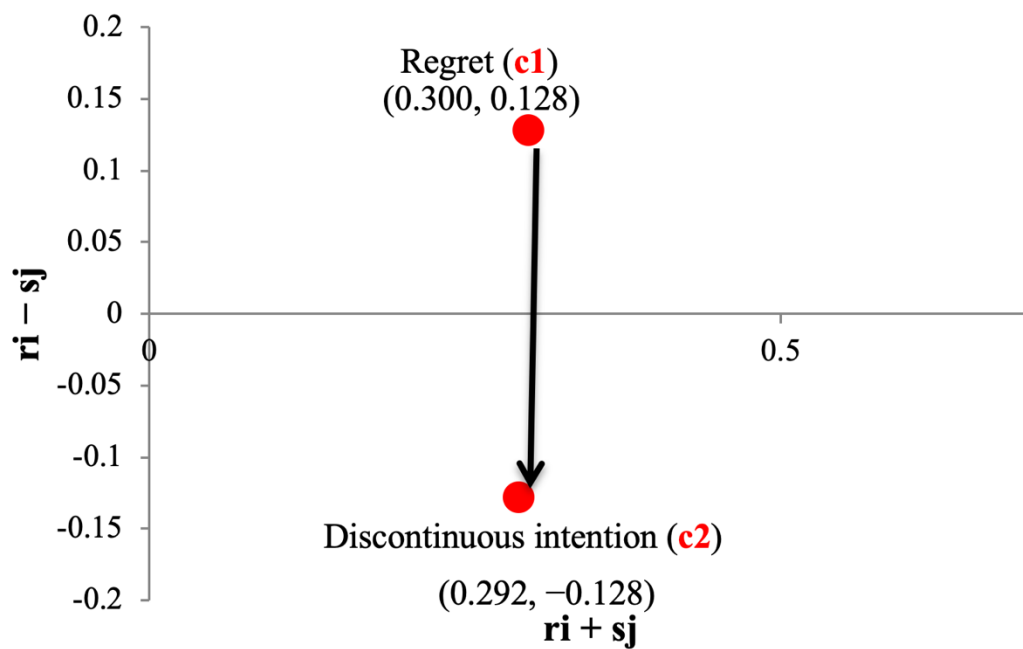


Figure 8. IRM of Outcome.

On the basis of these identified causal effects, the results of the MCDM analysis can be obtained, as illustrated in Figure 9.

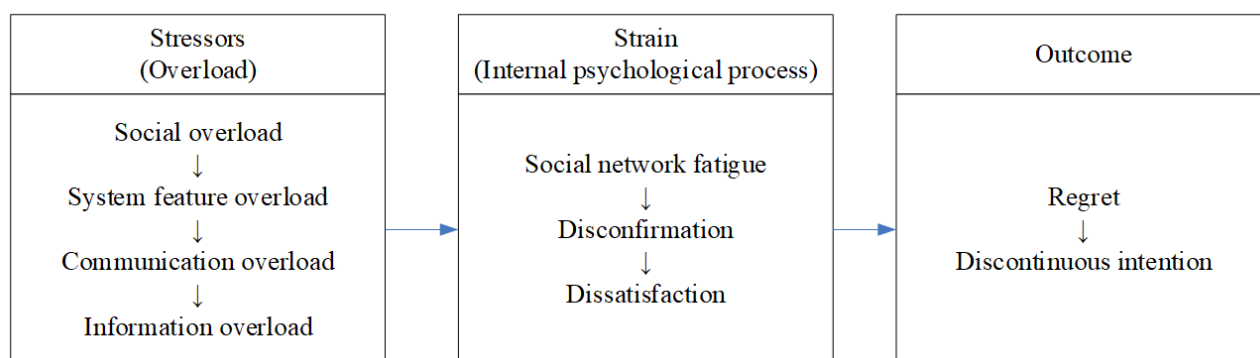


Figure 9. Results of the MCDM analysis.

5.3. Identifying the Influential Weights of Criteria

After determining the causal relationships of dimensions and criteria, the DANP method is applied to obtain the influential weights of the criteria. Initially, the criteria total-relation matrix T_c and the dimension total-relation matrix are normalized and produce the original weighted super-matrix S , subsequently transposed to S^* . The influential weights of the DANP are obtained by limiting the power of the weighted super-matrix S^* until it reaches a steady-state (Table 8), where the column values represent the influential weights of the related criteria.

Table 8. Limit of the Weighted Super-Matrix S^* .

Criteria	a1	a2	a3	a4	b1	b2	b3	c1	c2
a1	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
a2	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
a3	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
a4	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
b1	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147
b2	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164
b3	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164	0.164
c1	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163
c2	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217	0.217

5.4. Synthesizing the Results of Causal Effects and Influential Weights

In the final stage of the DANP, the results of the causal effects and influential weights can be combined to obtain further insight into the relationship among all criteria of the decision system. This study draws the influential weights on the X-axis and causal effects on the Y-axis. Because the influential weights lie between 0 and 1, with a maximum total of 1, for a fair comparison, this study first rescales the values of $r_i - s_j$ by using the range provided by Equation (1) and normalizes them to have a total equal to 1.

$$X_{\text{rescale}} = (X - X_{\min}) / (X_{\max} - X_{\min}) \quad (1)$$

The coordinate map in Figure 10 reveals that social network fatigue and regret are two primary driving factors; disconfirmation, dissatisfaction, and discontinuance intention are three primary received factors; social overload and system feature overload are two secondary driving factors; communication overload and information overload are two secondary received factors (Table 9).

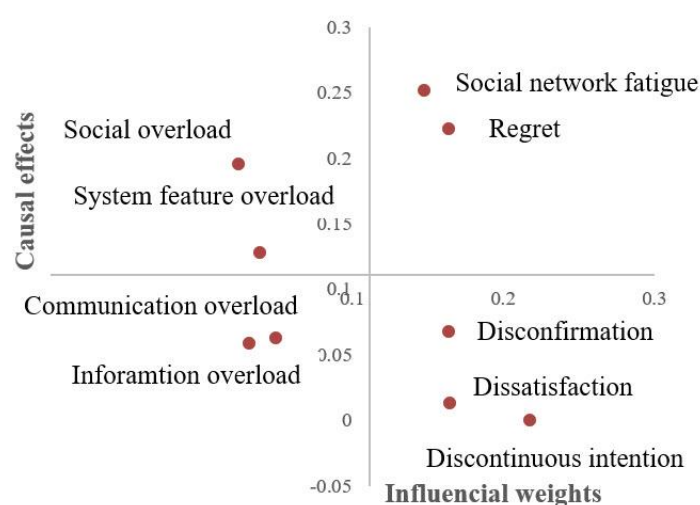


Figure 10. Synthesis of Causal Effects and Influential Weights.

Table 9. Summary of Driving and Received Factors.

	Secondary	Primary
Driving	Social overload System feature overload	Social network fatigue Regret
Received	Communication overload Information overload	Disconfirmation Dissatisfaction Discontinuous intention

6. Discussion

SNSs were originally designed for social purposes; nevertheless, because of their popularity and connection to people's lives, SNSs have been applied in other contexts, such as learning communities. This phenomenon has made the relationship between socializing and learning a fascinating and worthwhile research topic. In this section, we reference our major research findings (Tables 8 and 9 and Figure 9) to elaborate theoretical and managerial implications and conclude with suggestions for future studies.

6.1. Theoretical Implications

This study provides several substantial theoretical contributions.

First, it has implications for the application of SNSs in learning communities. This study focuses on the application of SNSs in learning communities. It adopts a system perspective and identifies overload as the input (or stressor), internal psychological processes as the process (or strain), and discontinuance intention as the output (or outcome). The DEMATEL questionnaire surveys of active members of Facebook learning communities and the results of their consensus revealed the following causal effects: Overload \rightarrow {Internal psychological processes, Discontinuance intention} and Internal psychological processes \rightarrow {Discontinuance intention}, which supports the stressor–strain–outcome framework.

Second, researchers have differing opinions regarding the types of overload. For instance, Karr-Wisniewski and Lu [23] identify three prominent technology overload dimensions, in agreement with Lee et al. [8], namely system feature overload, information overload, and communication overload. Zhang et al. [11] adopt this framework but claim that in the case of SNSs the main aim of communication is socializing; therefore, they change communication overload to social overload. In a similar study, Cao and Sun [6] also follow the perspective of Karr-Wisniewski and Lu [23] but skip the system feature overload, as they believe it is unlikely to happen in a mobile social media context. They agree with the emphasis of Maier et al. [27,40] on social overload and add it as a third dimension of overload. System feature overload is common on SNSs such as Facebook,

and communication overload refers to excessive communication requirements on various media [11], which is different from the excessive social support requirements of social overload [27,40]; consequently, this study recognizes system feature overload, information overload, communication overload, and social overload as four critical types of overload.

Here, other than treating each type of overload independently, by using DEMATEL, their causal effects could be identified by the following relationships: Social overload \rightarrow {System feature overload, Communication overload, Information overload}, System feature overload \rightarrow {Communication overload, Information overload}, and Communication overload \rightarrow {Information overload}. These relationships reveal that social overload is the primary driving factor for system feature overload, communication overload, and information overload, in that order. This finding is reasonable because SNSs were first designed for socializing. The demanding requirements of frequent and stressful system feature updates result in considerable communication overloads and information overloads. Given this background, socializing platforms are likely to conflict with other productivity purposes, such as learning.

The causal effects of internal psychological processes, identified by DEMATEL, included the following: Social network fatigue \rightarrow {Disconfirmation, Dissatisfaction} and Disconfirmation \rightarrow {Dissatisfaction}. These results further verify the propositions of the ECT and PAM-ISC.

The discontinuance intention criteria identified by DEMATEL were Regret \rightarrow {Discontinuance intention}. Previous studies have indicated that overload influenced users' dissatisfaction [11]. This finding supports Cao and Sun's [6] proposition that regret is more applicable to individual psychological processes. The current study also identifies the link between dissatisfaction–regret–discontinuance intention, demonstrating that regret is the critical mediator between dissatisfaction and discontinuance intention.

Finally, in terms of the research methodology, this study applies the DANP approach to social network fatigue, which complements the conventional SEM approach. Although DANP has been used in different domains, this study refines it by using the saturation principle in qualitative research [71–73] to assure appropriate sample sizes and group consensus. Moreover, following Northcutt and McCoy's [70] study, the current study creates an uncluttered IRM and obtains an improved mental model. The influential weights as the final result of the DANP technique are widely used for further analysis; for example, VIKOR [74,77]; by using appropriate data rescaling, the current study demonstrated that influential weights can be synthesized with causal effects to provide a clear picture of the interrelationships of crucial multi-criteria decisions.

6.2. Managerial Implications

This study identifies a significant conflict between socializing and learning in SNSs. The benefits of establishing learning communities on SNS center on the initial convenience and efficiency; however, on the dark side, participants are readily exposed to distraction majorly from social overload that pushes learners to discontinuance intention. To sustain the benefits of SNSs, this study, based on the research findings, suggests having active moderators in SNS learning communities responsible for planning and implementing discussion agendas to redirect participants' attention to focused, organized, and constructive learning.

The benefits of active moderators in SNSs are multifaceted. First, as Kim and Kankanhalli [78] suggested, individual usage behavior is a critical determinant of whether overload occurs. For instance, adverse outcomes of SNSs, such as social network fatigue and discontinuance intention, are more dependent on individual usage behavior than on the nature of SNSs. More precisely, users with solid self-regulation can adjust their SNS use to avoid experiencing overload. Nevertheless, moderators of SNS learning communities can support those with poor self-regulation and suffering different types of overload to focus on learning instead of socializing.

Second, because regret plays a critical role in harming the sustainability of SNS benefits, even if participants are satisfied with participating with SNSs, they may still experience regret and discontinue their use if they spend an extended period engaging in unconstructive activities. Consequently, the moderators of SNS learning communities should attempt to motivate strong rapport and value co-creation behaviors on the part of participants to enhance their learning performance, commitment, and contribution to the host community.

Although this study provides some valuable insights, some limitations should be noted. First, this study's target sample is a group of master's students majoring in Management Information Systems; thus, this study's generalizability may be limited. Future studies may consider different industry segments to improve the robustness of our conclusions. Second, this study identifies social network fatigue and regret as two major driving factors for SNS discontinuance intention. However, because of the complexity of people's psychological processes, future research may examine the impact of other factors, such as technology attitudes and technology anxiety, on discontinuance intention. Third, although a DANP-based expert consensus is suitable for this study, the proposed research framework would still benefit from a quantitative large-sample survey for comparison. Finally, this study is cross-sectional; thus, future research may consider a longitudinal investigation.

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