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The communication role of social media in social marketing: A study of community sustainability knowledge dissemination on LinkedIn and Twitter

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Abstract

This study aims to provide social marketers and researchers with some innovative perspectives on the application of social media in disseminating and promoting new sustainability knowledge to targeted audiences including academics, community sustainability stakeholders, and policymakers. An online survey was used to examine the audiences' attitudes of and motivations for engaging in LinkedIn and Twitter sites that disseminate sustainability knowledge. Also, the fact-base measurements from LinkedIn and Twitter showing the participants' reactions to the contents and formats were analyzed. The results suggest that the infographics message format received the highest engagement and response rates. Participants used Twitter to obtain general sustainability knowledge while engaged in LinkedIn for specific advice on the implementation of community sustainability plans.

Keywords Social media; Knowledge dissemination; Sustainability; Social marketing; LinkedIn; Twitter

Introduction

Owing to the rapid development of technologies, online communication channels such as social media are becoming increasingly popular platforms for communicating sustainability information (Robelia Greenhow, and Burton 2011; Bik and Goldstein 2013). More importantly, audiences' attitudes toward disseminated sustainability knowledge are influencing their subsequent awareness and behaviors (Hungerford 1996). From the marketer's point of view, the understanding of audience attitudes aids in the selection of dissemination strategies (Swani, Brown, and Milne 2014; Kaplan and Haenlein 2010). The purposes of this study are to (1) assess the effectiveness of intermediaries in disseminating sustainability-relevant knowledge, (2) provide insights for developing effective marketing communication strategies for sustainability

stakeholders, and (3) broaden the scope of social marketing by extending its audiences to sustainability practitioners in addition to the traditionally defined consumers. We expect the results of this research will also provide social marketers and researchers with some innovative perspectives on the application of social media in communicating knowledge.

Academic scholars play a vital role in incorporating sustainability knowledge into disseminating strategies for the purposes of fostering a link between knowledge and practice (Sá, Li, and Faubert 2011), obtaining substantial attention from targeted audiences, and better servicing communication platform users (Swani *et al*. 2014; Kaplan and Haenlein 2010). Building on marketing communication theories, this research investigates the role of social media in disseminating and promoting new knowledge related to the implementation of community sustainability plans. Specifically, it aims to help sustainability researchers prioritize online marketing communication channels in order to disseminate their research findings among the target audiences: community sustainability practitioners such as consultants and municipal staff, policy-makers such as municipal councilors, and other academic scholars. This study involves knowledge dissemination through two preselected social networking sites, LinkedIn and Twitter, for the purpose of transferring sustainability knowledge, accelerating collective learning, and providing practical advice.

The remainder of this article is organized as follows: first, we review the related literature, leading to the development of our research questions and hypotheses; and next we explain the methodology followed by the data descriptions. We will then present the results from both an online survey and the measurement indicators from the pre-selected social media sites: LinkedIn and Twitter. The general discussion, managerial implications, and limitations are also included.

Literature review and theoretical background

Knowledge dissemination in social marketing

Knowledge dissemination is a relatively new research area as opposed to product promotion. Marketing strategies employed for new products aim at raising public

awareness and then increasing product sales. From this perspective, new knowledge dissemination is somewhat analogous to new product promotion. Kotler and Zaltman (1971) define social marketing as "the design, implementation, and control of programs calculated to influence the acceptability of social ideas and involving considerations of product planning, pricing, communication, distribution, and marketing research … marketing techniques are the bridging mechanisms between the simple possession of knowledge and *the socially useful implementation of what knowledge allows*" (p. 5). An advantage of this social marketing approach may lie in its refinement of how to communicate research findings effectively and with greater effect (Roger 1995).

According to the diffusion of innovation theory (Estabrooks, Thompson, Lovely, and Hofmeyer 2006), knowledge dissemination is often referred to the process of connecting research findings in academia to broader communities (Sá *et al*. 2011). Gainforth, Latimer-Cheung, Athanasopoulos, and Martin Ginis (2015) define this process as "moving research into the hands of research users" (p. 56). Effective knowledge dissemination and utilization of research promises to enrich and revitalize the research, practice, and community contexts (Herie and Martin 2002). In the current research, we use "knowledge dissemination" as a reference to the practice of transferring academic findings in sustainability to related knowledge users, such as other researchers or scholars, policy-makers and sustainability practitioners (Gagnon 2011) at proper timing (Dell and Grayson 1998).

Community sustainability knowledge

Sustainable community development "is a holistic approach that integrates social, environmental, and economic considerations into the processes and actions undertaken by communities on their path toward sustainability" (Roseland and Spiliotopoulou 2016, p. 2). Sustainability implies social equity and functioning within ecological limits (Goodland 1995). Sustainable development denotes consideration of three interrelated domains: environmental, social, and economic (United Nations 2015). The new global Sustainable Development Goals (SDGs) offer 17 goals as an agenda for the world to achieve by 2030 (United Nations 2015). Sustainable development is the process, while

sustainability is the goal. One of global SDGs specifically sets a goal for inclusive, safe, resilient, and sustainable cities (United Nations 2015).

In order to address problems related to unsustainability, an increasing number of local governments have developed community sustainability plans (CSPs) (MacDonald, Clarke, Huang, Roseland, and Seitanidi 2018). There are over 10,000 CSPs in the world (ICLEI 2012). These CSPs are implemented by local governments, in partnership with other local organizations such as local businesses (MacDonald, Clarke, and Huang 2018; Clarke 2014). Broadcasting ideas and expertise from academia to external audiences accelerates and enhances the understanding of sustainable development (Gagnon 2011). Knowledge dissemination enables new information to be shared among audiences (Murphy and Salomone 2013), in this case, information related to implementing CSPs. Scholars desire to know the drivers of audience engagement in various communication channels, as well as the audience's attitudes toward these channels, so that the most effective methods of sharing sustainability knowledge can be identified.

Social media

Social media are among the most active and popular online communication channels that are primarily designed for networking, which is "a group of Internet-based applications that allow the creation and exchange of user-generated content" (Kaplan and Haenlein 2010). If used effectively and efficiently, social media applications can promote discussion and dialogue (Castronovo and Huang 2012), engage stakeholders (Newell and Dale 2015), facilitate information transfer and understanding (Huang 2010), and improve communication and collaboration in online environments (Murphy and Salomone 2013; Robelia *et al*. 2011). In this research, we are particularly interested in the role of social media websites, LinkedIn and Twitter, in disseminating sustainability knowledge. These online communication platforms can be considered as mechanisms for disseminating knowledge due to the fact that organizations gain and share knowledge through them (Murphy and Salomone 2013).

Twitter

Twitter represents a social networking tool very similar to blogging. As a "micro-blogging" application, Twitter provides all types of users, including individuals, organizations, and researchers, with many opportunities to effectively communicate and disseminate real time message via posts limited to 140 characters which are aimed toward a wide and diverse audience (Castronovo and Huang 2012; Lovejoy, Waters, and Saxton 2012). As one of the most popular social networking sites in North America, Twitter has nearly 300 million active users on a monthly basis (Waters and Jamal 2011), which makes it "the most used social media application in official public relations, advertising, and marketing campaigns" (Stelzner, 2009: p. 313).

LinkedIn

LinkedIn is a professional social networking tool that allows users to post and share information in a professional and online environment (Hennig-Thurau and Walsh 2003). Castronovo and Huang (2012) describe several functions of this social networking application, including the ability to advertise a business on the site, to develop company profiles, and to develop two-way relationships with career professionals and firms. As a communication tool, LinkedIn, like many social networking sites, provides users with many opportunities to disseminate information to particular audiences (Castronovo and Huang 2012).

Twitter is more a means for personal branding whereas LinkedIn is more often used as an online profile (Dessart, Veloutsou, and Morgan-Thomas 2015). Considering that the defined targeted audiences in this research are primarily professionals such as policy-makers and sustainability practitioners, knowledge dissemination platforms need to meet the criterion that the communication channel is generally used for professional purposes and is suitable for disseminating findings from sustainability research. As a result, Twitter and LinkedIn are selected as two representative social media sites for the current research, in that the vast majority of users on LinkedIn and Twitter are professionals, approximately 70% and 50% respectively (Antheunis, Tates, and Nieboer 2013).

Types of messages (posts) on social media

Marketing research has been focusing on the importance of verbal versus visual information in various dimensions. Kim and Lennon (2008) investigate how different product information formats (visual vs. verbal) influence consumer attitudes toward product and purchase intentions in Internet shopping. Spiller and Lohse (1998) find that verbal product descriptions available on the Internet are equivalent to salespeople's service at retail stores.

In a similar way, recognizing the format of knowledge presentation on social media as a potential factor that influences the efficiency and effectiveness of dissemination, we examine a variety of message formats in order to assess the most effective ways of disseminating sustainability research outcomes among the target audiences. Particularly, we examine three message formats used to present the sustainability knowledge on social media: *academic* that represents the original text and language from the research; *public* that focuses on easily accessible, every-day language in order to communicate with a wider audience; and visual language with the use of *infographics* to allow for visual representation of the research data that can easily be accessed and shared (Siricharoen 2013).

Motivations of engaging in social media for disseminating sustainability knowledge

Marketing studies have examined the motivations for acquiring information online, such as obtaining product information and social orientation, reducing purchasing risks, saving search time, and learning about new products (Hennig-Thurau and Walsh 2003). In a similar vein, we argue that acquiring and enhancing valuable sustainability knowledge, together with seeking professional expertise to improve the implementation of CSPs, are the major drivers for the target audiences in this research to engage in various social media networking sites (Dessart *et al*. 2015; Smith and Gallicano 2015).

Huang and Barlas (2009) suggest that shared interests toward the same topics in starting a conversation often initiate word-of-mouth discussion. Conversations are more likely to occur between people who share common interests or have similar backgrounds.

Likewise, knowledge dissemination targets those audiences who share the same interests and needs; and these target groups then proactively receive new knowledge and ideas (Levin 2008). We argue that sustainability practitioners, who look for and/or intend to enhance related knowledge about their practices on social media will engage with scholars with expertise who have social networks with shared interests in the sustainability field (Gershoff, Broniarczyk, and West 2001).

Additionally, previous studies have explored the role of agents promoting buzz, or vanguards. They are defined collectively as a group of people who "have a disproportionate ability to shape public opinion" (Dye 2000, p. 142), and are considered as early practitioners who play a vital role in attracting new adopters (Huang 2010; Castronovo and Huang 2012). These agents can be referred as media for word-of-mouth communication (Huang and Barlas 2009; Gershoff *et al*. 2001). Relating to the current study, we argue that sustainability researchers are important agents serving as an expertise and credible information source for practitioners who are seeking guidance and recommendations to improve their implementation of CSPs.

Measurement of the engagement in social media

Castronovo and Huang (2012) suggest that the techniques used to measure marketing effectiveness depend on specific marketing objectives. Strategies employed for knowledge dissemination are usually determined by knowledge content, targeted audiences, dissemination techniques, and dissemination purposes (Sá *et al*. 2011). The effectiveness of various internet-based tools is measured by audience engagement (Curran and Lennon 2011), such as the viewership of different media as it varies over time (Newell and Dale 2015). Through an understanding of influential factors for knowledge engagement online, we intend to incorporate such factors as attitudes toward environmental issues, adequate knowledge, and intention to apply knowledge and skills (Hungerford 1996) into the information disseminating strategies for the purpose of obtaining substantial attention from the targeted audiences and better servicing communication platform users (Swani *et al*. 2014; Kaplan and Haenlein 2010).

An increasing amount of scientific research has referred to data from Twitter (Golbeck, Grimes, and Rogers 2010) because this application also provides users with many opportunities to engage with stakeholders with four outstanding features to easily communicate, without geographical boundaries, through both public and private messages (Waters and Jamal 2011). The are: 1) user mentions, such as the counts of impressions, link clicks and favorites; 2) replies; 3) retweets; 4) hashtags (Zubiaga, Spina, Martinez, and Fresno 2015). Lovejoy *et al*. (2012) explain that "organizations [or other users] can communicate on Twitter through the use of the "@" symbol" (p. 314). This function connects users in a more direct manner, providing a simple and easy way of searching for other Twitter users. The retweet function is another example of a communication tool on Twitter that allows one user to repost a tweet from another user while giving acknowledgement of the user by adding "RT@[username]" to the beginning of the message" (Lovejoy *et al*., 2012 p. 314). Lastly, hashtag is a popular communication tool that categorizes messages by relevant topics on the social networking site. By the same token, we use the counts of views, likes, comments for each post, shares, and profile clicks on LinkedIn to measure the stakeholders' engagement (Castronovo and Huang 2012).

Research questions

According to the Theory of Reasoned Action, the Theory of Planned Behavior, and the Technology Acceptance Mode (Curran and Lennon 2011), attitude is an important antecedent for both behavioral involvement and psychological immersion (Dessart *et al*. 2015; Smith and Gallicano 2015). On the one hand, different knowledge dissemination sources—referred as social media in this study—have different degrees of impact on audience behaviors. Proper knowledge transfer through appropriate platforms to the focal target audiences is expected to improve sustainability practices. On the other hand, the audiences engage in virtual communities to be connected with other community members (Brodie, Hollebeek, Juric, and Ilic 2011; Dessart *et al*. 2015). In summary, our research questions and the according hypotheses are summarized as follows:

R1: What are the target audiences' attitudes toward disseminating knowledge about implementing CSPs on social media?

> H1: When social media is involved in disseminating sustainability knowledge about CSP implementation, people are more in favor of LinkedIn than Twitter.

R2: What are the drivers that lead the target audiences to engage with knowledge about implementing CSPs disseminated through social media?

> H2: People are more likely to use Twitter than LinkedIn to browse sustainability knowledge; while LinkedIn is more likely to be used when people seek particular advice on CSPs.

R3: What types of knowledge about implementing CSPs, disseminated on social media, do the target audiences pay attention to?

> H3: In terms of various sustainability knowledge topics on social media, people will engage with some topics more than others on social media (LinkedIn and Twitter).

R4: What format of knowledge about implementing CSPs disseminated on social media do the target audiences pay attention to?

> H4: Sustainability knowledge of CSPs presented in infographics with visual language on social media (LinkedIn and Twitter) attracts more attention than using academic or public language.

Methods

To address the research questions R1 and R2, an online survey was used on LinkedIn and Twitter to test the hypotheses 1 and 2. To address the research questions R3 and R4, we use the fact-base measurements based on the participant's reactions to various message contents and formats presented on LinkedIn and Twitter (Mairs, McLeod, Prorok, and Stolee 2013).

Specifically, the message contents refer to a synthesis of academic research findings on sustainability knowledge of implementing CSPs. Such contents were presented in six topics disseminated through both LinkedIn and Twitter:

1. Collaborative strategy process (Clarke and Fuller 2010)
2. Topics in community sustainability plans (Clarke, Huang, Roseland, and Chen 2014)
3. Collaborative strategic management outcome types (Clarke and Fuller 2010)
4. Key structural features for implementing a CSP (Clarke 2011; 2012)
5. Partner outcomes from joining a community sustainability partnership (Clarke and MacDonald 2012; 2019)
6. Partnership versus participation for community sustainability (Clarke and Erfan 2007).

Each topic was completed (i.e., standalone), so the order was not relevant. In addition, the content in each topic was disseminated to the targeted audiences, Twitter followers and LinkedIn connections, using three different formats: academic, public, and infographics. The results of a pretest suggested the significant differences among three content formats for each topic ($F(2, 27) = 7.89$, $p < .05$). Thus, the manipulation of these topic formats was successful. An example of a topic with three content formats is provided in Appendix I.

Survey

A structured survey was offered to those LinkedIn connections who had viewed the content. These participants were asked about their attitudes toward the LinkedIn websites disseminating sustainability knowledge on three items (1 = strongly disagree, 7 = strongly agree):

- *The information about the implementation of sustainable community plans offered on LinkedIn is useful;*

- *The information about the implementation of sustainable community plans offered on LinkedIn is understandable; and*
- *The information about the implementation of sustainable community plans offered on LinkedIn is sufficient.*

The participants were also asked about three motivations for engaging in LinkedIn (1 = strongly disagree, 7 = strongly agree):

- *I browse or participate in the LinkedIn community is to obtain relevant information about sustainable community plans;*
- *I browse or participate in the LinkedIn community is to learn more about sustainable community plans; and*
- *I browse or participate in the LinkedIn community is to seek advice on sustainable community plans.*

The same survey was offered to Twitter followers who had viewed the content. These participants were asked about their attitudes and engagement motivations toward the Twitter websites disseminating sustainability knowledge by using exactly the same items as those used with LinkedIn connections except for replacing "LinkedIn" with "Twitter". The Cronbach's Alpha is .92 for the LinkedIn survey items and .91 for Twitter, which indicate a high reliability of these items on measuring the participant's attitude toward these two pre-selected social media.

In addition to the demographic information, both LinkedIn connections and Twitter followers were asked to provide comments to an open-end question about their impressions and feelings about sustainability-associated knowledge disseminated through these preselected social media accordingly.

In total, 76 completed surveys were collected on LinkedIn and 40 on Twitter.

Sample

The sampling method used in this study was snowball sampling, which is typically used to recruit participants through the referrals or connections of one member of a particular group (Padgett 2012). Specifically, we initially recruited participants from Twitter

followers and LinkedIn connections who shared similar interests in sustainability and then obtained additional participants through their personal, and/or professional online networks (Baltar and Brunet 2012). The final sample included a number of people who were recruited through one of the authors' own Twitter and LinkedIn sites. These participants were sustainability professionals, academics, as well municipal staff and councilors who were interested or involved in work surrounding sustainable communities. There were 243 Twitter followers and 126 LinkedIn connections engaged in the six key topics used for the final analysis.

Procedures and data collection

All six topics were posted through one of the authors' LinkedIn online blog site and Twitter tweets in the same time window for each tween and format. Each topic had the same content in three different post formats: public, academic, and infographics. For each topic, the dissemination schedules consisted of a post on Tuesdays (public format), Wednesdays (academic format), and Thursdays (infographics format) around noon each day. In particular, the dissemination of topics on Twitter and LinkedIn ran from June 2015 to October 2015: Topic 1 was disseminated the week of June 23; Topic 2 was disseminated the week of June 30; Topic 3 the week of July 14; Topic 4 the week of July 21; Topic 5 the week of August 4; and Topic 6 the week of September 29. The time of day was chosen in order to reach the greatest amount of social media traffic on each site (Meidlinger 2015). The participating LinkedIn connections and Twitter followers could express their 'like' for and/or post their comments on these topics.

Analysis and results

To answer the research questions R1 and R2, the aggregated responses from the survey were analyzed. The perceived effectiveness of obtaining sustainability knowledge, providing professional advice, and enhancing learning were the dependent variables. Gender, age, and education were included as the covariates. Furthermore, a content analysis was used to analyze the textual responses to the open-end questions. To answer

the research questions R3 and R4, the number of comments on each topic and other engagement measurements as described in the previous sections were counted for the analysis.

The results from the online survey suggest that the participants had significantly more-positive attitudes toward LinkedIn (M = 5.95, $s.d.$ = 1.14) than Twitter (M = 4.76, $s.d.$ = 0.85, $t(112) = 6.32$, $p < .001$) as the dissemination sources for implementing CSPs knowledge. H1 thus is supported.

In terms of obtaining sustainability knowledge about implementing CSPs, the participants were more likely to use Twitter (M = 4.88, $s.d.$ = 0.93) than LinkedIn (M = 3.97, $s.d.$ = 0.82, $t(112) = 5.43$, $p < .001$). On the contrary, the participants were more likely to use LinkedIn (M = 5.21, $s.d.$ = 0.77) than Twitter (M = 4.35, $s.d.$ = 0.82, $t(112) = 3.99$, $p < .01$) in terms of seeking advice on implementing CSPs. There was no significant difference between these two social media when the participants engaged in learning sustainability knowledge on implementing CSPs ($t(112) = 1.18$, $p = .24$). H2 is then supported.

The results from the content analysis offered further insightful perspectives. These responses were coded by the key words related to the effectiveness and usefulness of social media as communication channels for academic research. As shown in Table 1 the responses were coded into three categories: *useful and effective*, *inappropriate/ineffective*, and *issues with post*. These categories were indicators of the participants' perception of each social media for receiving research. Overall, these responses were consistent with those from the online survey outcomes by indicating that Twitter was a more appropriate and/or effective communication channel for receiving and in turn disseminating sustainability academic research knowledge than LinkedIn. Meanwhile, the results also exhibited a number of issues related to the post itself, thereby impacting the reception of information and perception of LinkedIn and Twitter as channels for receiving research.

Insert Table 1 About Here

The content of each topic was examined to assess how content plays a role in the engagement rates of participants. As shown in Table 2, the number of impressions and

views was provided on each social media application. We then collected these data from LinkedIn and Twitter to compare the engagement rates of each post.

Insert Table 2 About Here.

The results of a chi-square test of goodness-of-fit indicate a very significant difference among the engagement in different topics, χ^2 (5) = 43.06, $p < .001$. In particular, the participants on LinkedIn engaged the most with topics regarding community sustainability plans (Topic 2) and participation versus partnership for community sustainability (Topic 6). Participants can use this information to develop and strengthen their own community sustainability plans. A similar pattern appeared for the participants on Twitter, χ^2 (5) = 7.23, $p < .05$. Specifically, they were more engaged in topics of the CSPs (Topic 2) and the structures of those plans (Topic 4). This information details the most effective ways to structure the collaboration between partners and stakeholders, which is increasingly important for practitioners and organizations as they focus on addressing complex social and ecological problems. As a result, H3 is supported.

Table 3 summarizes the impact of message formats for each topic on LinkedIn and Twitter.

Insert Table 3 About Here.

The results of a chi-square test of goodness-of-fit indicate a very significant difference among the impacts of three message formats, χ^2 (2) = 89.29, $p < .001$, on LinkedIn. That is, the participants engaged the most with the posts disseminated via infographics, followed by the use of academic and public languages. A similar pattern appeared for the participants on Twitter, χ^2 (2) = 7.42, $p < .05$. Therefore, H4 is supported. Although the visual language posts showed the highest engagement and diffusion rates, the rates for the academic posts are higher than those of the public ones. This discrepancy indicates that participants are not consistently responding to communications presented in more accessible language. This could in fact be due to the audience type. The targeted audience for this research study was sustainability practitioners and other academic scholars. This target, however, could not be easily

controlled in social media environments, thus impacting the type of participants and language preferences.

General discussion and conclusion

Academia Contributions

This study is a multidisciplinary research that integrates sustainability, social psychology, communication, and knowledge management into social marketing. The academic contributions of this paper are significant in three ways.

First, the findings enhance the understanding of sustainability knowledge dissemination in enriching and revitalizing the research, practice, and community contexts (Kotler and Zalman 1971; Rogers 1995; Herie and Martin 2002) as well as provide policy-makers with insights for developing marketing communication strategies to achieve important social good. Although previous studies have examined knowledge dissemination through online platforms such as blogs or newsletters, this study has addressed the utilization of social networking sites in disseminating sustainability information in social marketing. Particularly, more than 60% of participants indicated that they browsed the information on Twitter sites but sought advice related to the sustainability knowledge on LinkedIn sites.

Second, although seeking information is considered as the entry level of participation (Smith and Gallicano 2015), our study suggests that the site users engage in Twitter and LinkedIn for different reasons in terms of sustainability knowledge. The results based on the engagement rates present a significant difference among various topics of sustainability knowledge. Some topics more intended to share the latest knowledge (such as the content about sustainability plans), others to further learning (such as the types of outcomes), and still other topics are more advanced advice for application (such as the partnership versus participation approaches content). Therefore, in addition to creating one-way dialogue with disseminated research, encouraging two-way dialogue and conversation will further increase the diffusion and engagement rates on social networking sites.

Finally, this research suggests that from a broad view of social marketing, the sustainability knowledge dissemination process provides a starting point for the sustainability professionals to apply and adapt it in their practices, which has the potential to bridge the gap between research and practice more effectively. Specifically, our study illustrates the effectiveness of visualizing data and information to share knowledge with targeted audiences. Providing participants with visual representations of research, including the use of graphs, charts, and graphics, allowed for easy transmission of knowledge between sender and receiver.

Managerial implications

Previous studies concentrated on knowledge dissemination in the domain of science; whereas our study expands the research domain to social marketing by examining the role of social media, such as LinkedIn and Twitter, in sustainability knowledge dissemination. As one of the few studies in social marketing, we apply social media as a marketing technique for the communication of sustainability research findings to a broad extent. Different from other social marketing studies that focus on individual consumers, we have addressed the target audience to professionals and academia. Particularly, when it comes to knowledge dissemination in social marketing practice for professional audiences, it is undeniable that social networking sites have unique features and functions. In terms of disseminating the knowledge of implementing CSPs, social networking sites is recommended for this purpose if researchers have well-maintained official accounts and sufficient social connections. Additionally, sustainability knowledge dissemination through social networking sites potentially is a cost-effective way to reach a large scale of audiences who are motivated to seek information and advice on sustainable communities (Castronovo and Huang 2012). In this study, obtaining accounts on Twitter and LinkedIn were free of charge, although these two sites provide options of paid service for promoting users' posts as well. Furthermore, visual language, disseminated through infographics, may receive the highest engagement and diffusion rates by online social media users.

Limitations and directions for future research

Accurately analyzing the interactions on social media is a complicated task, which can be impacted by a number of extraneous variables. As this study collected quantitative data from both LinkedIn and Twitter, consequently, it is difficult to control variables that might have impacted the study's results, such as the participant engagement or the diffusion rate of information. As a result, causation cannot be claimed. For instance, it is hard to control for potential confounds, such as political occurrences, world events, conferences, or personal interests, that may lead to the results where a participant chose to like a particular topic or to share a different topic. Therefore, we can only conclude that a correlation does indeed exist. One of the alternatives to address this limitation may be that the engagement of participants on social media sites through two-way dialogue and discussions should be included in future research. Additionally, future research should also incorporate more discussions and conversations among participants (through replies) regarding the disseminated information in order to ensure the effectiveness of knowledge sharing.

Moreover, Twitter and LinkedIn perform similarly in terms of disseminating sustainability knowledge. Further work may incorporate other social networking sites, such as Facebook and blogs, as a way to compare and contrast different social networking sites. Observing more types of online networking channels would help establish a greater degree of accuracy on this matter. More broadly, previous studies regarding knowledge management or dissemination were mostly in the traditional science discipline. More research is needed to determine the best option for sharing knowledge in other fields through social networking sites.

Summary

Recognizing the significance of knowledge dissemination in social marketing, this interdisciplinary study assesses the effectiveness of social media as the communication intermediaries in disseminating sustainability knowledge. As academic institutions play a vital role in knowledge mobilization, efforts can be made to create incentives for fostering a link between knowledge and practice (Sá *et al*. 2011). By understanding

influential factors for knowledge engagement online, academic scholars are able to incorporate these factors into their dissemination strategies for the purpose of obtaining substantial attention from various targeted audiences, and better servicing communication platform users (Swani *et al*. 2014; Kaplan and Haenlein 2010). The results may also be transferable to other perspectives of product or service information.

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Appendix I: The example of a topic presented in three different formats

Topic 1

<u>Infographic message:</u>

What is the best way to tackle social & environmental challenges?

<u>Public message:</u>

What is the best way to tackle social & environmental challenges?

Climate change, environmental degradation, social inequity … there are no quick-fix solutions. These complex problems require the involvement of different sectors. Cross-sector partnerships bring together different actors in order to enable dynamic solutions to social and environmental problems. The collaborative strategic management process involves:

1. Defining the problem and build partner relationships
2. Creating a strategic plan
3. Taking action both as individuals and a collective
4. Realizing the outcomes of these efforts

Revisions at different stages in the process allow for continual improvement.

Derived from: Clarke, A. & Fuller, M. (2010). Collaborative Strategic Management: Strategy formulation and implementation by multi-organizational cross-sector social partnerships. *Journal of Business Ethics,* 94(Supplement 1): 85-101

Academic Message

Collaboration across sectors is essential for sustainable development

Multi-organizational cross-sector social partnerships are becoming an increasingly common means of addressing complex social and ecological problems that are too extensive to be solved by any one organization. Below details a conceptual model of the collaborative strategic management process:

1. The first stage of the collaborative strategic management process is assessing the environmental, social, and economic contexts of the issue and forming the partnership.
2. The second stage of the process is the formulation of the collaborative strategic plan. It is in this phase where partners work together to find a common vision and negotiate a collaborative strategic plan.
3. The third stage of the process involves the implementation of the collaborative strategic plan, through both deliberate and emergent approaches. Some aspects of the implementation will be collectively enacted by the partnership, and some aspects of the implementation will be individually enacted by the partners within their own organizations.
4. The final stage is the realized collaborative strategy implementation outcomes, which are the results of the actions taken by both the partnership and by the individual partner organizations.

Each phase of the development process can be influenced by external factors such as changes in the domain. A series of feedback loops persist allowing for corrective action, overlapping activities, cyclical decision-making and new partners to engage.

Derived from: Clarke, A. & Fuller, M. (2010). Collaborative Strategic Management: Strategy formulation and implementation by multi-organizational cross-sector social partnerships. *Journal of Business Ethics,* 94(Supplement 1): 85-101

Table 1. Coded data from the open-end question in the online survey

Coding categories	Examples
Useful and effective	- Gaining access to a broad range of sustainability and climate change information was the key reasons that I joined Twitter - I think Twitter is a very valuable resource for disseminating info on sustainable community plans - Overall, I'm very supportive of using Twitter - I think that posting research information on LinkedIn will definitely provide you with a very wide & diverse audience. - Until I became aware of your present efforts, I never thought of LinkedIn as a good means of reaching a desired audience in this way, but rather a means to link people with specific training / interests... your efforts bring a greater level of detail to posts.
Inappropriate/ ineffective	- Twitter is the single conduit for disseminating information. - Twitter is more of a dialogue platform - It is more effective to engage the public rather than to learn about trending activities. - Overall, I thought the tweet really didn't share much at all. - Only learned a little bit about what cities' priorities are - Anyway, I find that LinkedIn is one good source of information, but I'm more likely to use it as a source of expertise and knowledge from specific individuals (or for cooperation with those individuals) rather than a source of information in the articles themselves. - I find LinkedIn a problematic website to use at work. I could be doing research for my work, or I could be looking for another job. It looks a bit sketchy so I'm not entirely comfortable using it. - I don't usually find the information I want on LinkedIn but that is because many of my peers do not use it. - Most of my experience on LinkedIn has been following and participating on several discussion groups. I dropped out because it seemed unproductive.
Issues with post	- The tweet didn't show anything about how to implement a sustainable community plan, - Most of these questions had to do with the implementation of sustainable community plans, whereas the infographic only briefly explained what topics are included in several cities' plans, with no mention to how they were implemented. - The infographic is the extent of the information provided in the tweet. - Only issue I encountered is that the information presented in the article given only refers to the content of community sustainability plans, and not to their implementation. - I think the post could have been a bit more detailed. - I do not think the post was about the implementation of sustainable community plans. It was about the content of sustainable community plans. I did not see anything about implementation.

	- I feel the information presented was very general about what topics municipalities include in the their plans -- there was no information at all about how these topics are prioritized in their plans or how they implement the goals/targets set out related to them. - It was not at first clear that I needed to click a link to view the full article. "For more details, click here" is misleading in a bad way, it made me think that there would be details as to how the graphic was generated - in reality, it was a much richer article with much more useful information. - The infographic claimed to show what Canadians think, and what communities are thinking and doing, but it did not identify who constituted "Canadians" or "communities". - This is less about LinkedIn than designing effective visualizations to post on LinkedIn. - The post seemed very short so there doesn't appear to be too much information in it. - I did not spend much time on the website, it started out as sounding too academic. - More detailed information could have been disseminated through this infographic.

Table 2. The dissemination and engagement of each topic on LinkedIn and Twitter sites

Topic	LinkedIn		Twitter		
	View Count	Total Engagement*	Impressions	Retweets	Total Engagement**
1. The collaborative strategy process	182	18	1731	8	41
2. Community sustainability plans	65	33	3072	7	67
3. Collaborative strategic management outcome types	149	10	1596	10	31
4. Key structural features for implementing a sustainable community plan	129	17	3312	12	55
5. Partner outcomes from joining a community sustainability partnership	150	19	1545	7	19
6. Participation versus partnership for community sustainability	111	29	1392	8	30

* the number of likes, comments, shares, and profile clicks
** the number of link clicks, favorites, replies, and hashtag clicks

Table 3. The impact of content formats on LinkedIn and Twitter sites

Topic	Content Format	LinkedIn View Count	LinkedIn Total Engagement*	Twitter Impressions	Twitter Retweets	Twitter Total Engagement**
1	Public	98	8	281	0	2
	Academic	4	0	931	5	29
	Infographic	80	10	519	3	10
2	Public	71	8	473	0	4
	Academic	64	5	898	5	11
	Infographic	470	20	1701	2	52
3	Public	51	3	491	3	6
	Academic	33	3	500	3	7
	Infographic	65	4	605	4	18
4	Public	47	9	634	3	12
	Academic	39	2	399	2	6
	Infographic	43	6	2279	7	37
5	Public	33	4	479	1	5
	Academic	47	3	324	2	5
	Infographic	70	12	742	4	9
6	Public	13	6	379	2	5
	Academic	78	16	195	1	2
	Infographic	20	7	818	5	23

* the number of likes, comments, shares, and profile clicks
** the number of link clicks, favorites, replies, and hashtag clicks