Reducing problems of sociability in online communities: Integrating online communication with offline interaction*

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Abstract

Social network researchers claim that relations offline affect relations online. However, it is unclear which characteristics of online interaction are affected by the existence of offline relations. This paper attempts to answer the question of whether a mixture of virtual and 'real-life' interaction between at least some members of knowledge-sharing online communities -in contrast to 'purely virtual' interaction- reduces the prevalence of the problems that the whole community faces. Typical problems of sociability that increase the risk of failure in knowledge sharing are: 1) a lack of trust between members, 2) free rider behavior, and 3) a lack of stable membership. This analysis uses survey data from 26 online communities that are part of a virtual organization that hosts communities for teachers. The findings provide evidence for the existence of more trust and less free riding in 'mixed' communities, but not for greater membership stability. Results lead to the conclusion that offline networks have beneficial effects on online knowledge sharing and contribute to our knowledge of how offline networks influence online relations. Moreover, they modify earlier claims about the integration of online communication with offline interaction by showing that a complete integration is unnecessary.

Key words: sociability, trust, free riding, embeddedness, social networks, e-learning, blended communities, online community

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Introduction: Barriers to online knowledge exchange reaching full potential

Online communities are frequently used for knowledge exchange and learning. Some are linked to 'communities of practice', groups of professionals with similar task responsibilities who share their experiences (Wick 2000). While communities of practice do not necessarily contain an online component, online communities (OLCs) of practice, by definition, do (Johnson, 2001). Research into the effects of OLCs for companies indicates that such communities have the capacity to stimulate exchange of knowledge (Ardichvili, Page, & Wentling, 2003), but a high number of communities do not fulfill these expectations. Members are often not sufficiently motivated to share their knowledge actively (Johnson, 2001; Stoddart, 2001; Gal 2004). Some OLCs of practice have been built for the professional development of teachers, and a few teachers claim to have benefited from their use. However, in general, researchers have once more come to the conclusion that the OLCs for teachers that have been studied do not yet meet their ambitious aspirations (Kling & Courtright, 2003; Yang & Liu, 2004; Barab, MaKinster, & Scheckler, 2003). This paper contributes to identifying the typical barriers that affect successful sharing of knowledge in OLCs and how these barriers can be reduced. It focuses on the problems of sociability (Preece, 2000), which are problems related to social interaction in groups that are important barriers to knowledge exchange (Barab, 2003). Technological characteristics of online communities have been shown to be important for high usability (Chen, 2007), but other problems receive much less attention (Schlager & Fusco, 2003). This paper draws attention to a particular social characteristic of an online community, namely its embeddedness in social networks in the offline world and how that affects sociability.

This study extends two streams of research. First, social network analysts claim that offline relations affect online interaction (Wellman & Gulia, 1999; Wellman, 2001). However, *how* that might happen is left open. This paper contributes to answering this question. Second, community researchers argue that it would be useful to build OLCs around pre-existing offline communities (Kling & Courtright, 2003; Barab, MaKinster, & Scheckler, 2003), thereby suggesting a *complete* integration of online with offline activities. I agree with these authors that integration of online and offline activities is beneficial. However, I argue that a mixture of virtual and 'real-life' interaction between *some* members is enough to reduce problems of sociability faced by the *whole* community, making a complete integration unnecessary.

The paper is structured as follows. First, a distinction is made between three important problems of sociability. Then, after describing how offline and online interaction in communities are related to each other, the paper proceeds by specifying mechanisms that show how embeddedness in offline networks reduces problems of sociability, leading to three

hypotheses. The design of the study and its measurements are introduced next, followed by tests of the hypotheses using survey data collected from 26 online communities of teachers in the Netherlands. The implications of the findings for the design and management of online communities are discussed, and conclusions for further research are drawn.

Typical problems of sociability

Successful interaction in online communities not only depends on a high usability, but also on efforts that support the members' social interaction as a group. This is called solving problems of sociability (Preece, 2000). Three problems of sociability are distinguished.

First, a *lack of trust* can develop during exchange of information between members. If one member, ego, provides information to another member, alter, then ego can hope that these roles may be reversed in the future. Alter may be willing to provide information to ego because he wants to reward ego for his past help and to ensure that they stay engaged in mutually advantageous exchanges. However, ego's initial provision of information is risky for him. Alter may not reciprocate or may choose to use the received information in ways that are harmful to ego. This may happen, for instance, when teachers help others by sharing their teaching material. They take risks by putting teaching examples online. In the traditional classroom setting teachers keep their teaching activities private after closing the classroom door. This is different in an online community of teachers. Members do not know where their materials will travel if they put them on the Internet (Barab, MaKinster, & Scheckler, 2003). If problems of trust between members are too severe, they hesitate to share their information and the OLC fails (Ridings, Gefen, & Arinze, 2002; Jarvenpaa & Leidner, 2000; Kling & Courtright, 2003).

A useful online discussion is a collective good for the whole OLC. Every member profits from the discussion (independent of his own contribution intensity) because the discussion 'consumption' is non-excludable (Kollock, 1999). A useful contribution to a discussion or a common database is costly. At the very least, it takes time and effort. While the contribution costs are restricted to active members, the discussion benefits are distributed among all active and passive members. Without selective incentives for individuals to become active, rational individuals will decide not to incur the costs, but profit from other members' contributions nevertheless (Dawes, 1980). *Free riding* is the tendency of members to withhold information and let others incur contribution costs; this is another sociability problem (McLure Wasko, & Faraj, 2000; Thorn & Connolly, 1987; Cress, 2004). If the tendency to free ride is too high, the collective good is not produced and members do not gain enough benefits.

Finally, it is often assumed that OLCs will suffer from *insufficient membership stability* (Johnson, 2001; Butler, 2002; Dannecker & Lechner, 2007; Chen, 2007). Komito (1998) argues that many OLCs can be left at will, limiting the amount of social control, and thereby reducing the members' motivation for longer-lasting investments. Insufficient membership stability therefore could make the development of trust more difficult and may reduce the motivation to participate actively in knowledge sharing. In the end, a member could anticipate that one's contribution to an ongoing discussion might not be returned if those who profit leave the community quickly after they have found what they sought.

Social embeddedness of online communities in offline networks

Online interaction is often embedded in offline networks. It can lead to new contacts that are transferred to the offline world in unplanned ways. Users can maintain existing offline contacts via online communication, some online communities are naturally affiliated with offline communities, and some community managers and members intentionally create opportunities for offline meetings among members.

A number of studies have shown that Internet use comes with new or pre-existing offline contacts (Hampton & Wellman, 2003; Hlebec, Lozar-Manfreda, & Vehovar, 2006; Wellman, Boase, & Chen, 2002; Franzen, 2002). Online group communication, in particular, can lead to new offline contacts (Zhao, 2006; Parks, 1996; Parks & Roberts, 1998; Utz, 2000; Matzat 2004). For instance, Heintz (2000), in a study of Swiss intensive users of newsgroups and chat groups, found many personal contacts between users. Sixty-seven percent of the online contacts met face-to-face. Matzat (2009) found that many academic emailing lists were affiliated with well-integrated academic communities that met regularly offline. In a study of online health care communities, Dannecker and Lechner (2007) showed that managers and members actively created opportunities for offline interaction. Ishii and Ogasahara (2007), in a study of a stratified random sample of adult inhabitants of Seoul and Tokyo, suggest that the degree of embeddedness in offline networks may depend on cultural factors. Online communities used by Koreans were more often embedded in offline networks than those used by the Japanese (48% versus 33%). While offline interaction can be planned, natural circumstances also play a role. Yuan, Gay, and Hembrooke (2006) demonstrate that in online learning communities, students who belong to the same university had a higher likelihood of face-to-face meetings.

Consequences of embeddedness in offline networks

There is only limited empirical evidence showing how embeddedness affects online interaction. According to social network analysts, embeddedness should change online

relations (Wellman & Gulia, 1999). Unfortunately, it is not clear how this happens. The literature on knowledge sharing groups discusses the relevance of face-to-face relationships between members (Wenger, 1998; Brown & Duguid, 1991). However, it does not clarify how characteristics of the whole network might affect online interaction. Also, online community researchers have wondered whether face-to-face meetings are necessary (e.g., Johnson, 2001). Some argue that the greatest potential for online communities of practice is to function as a supplement to already existing local offline communities (Schlager & Fusco, 2003; Kling & Courtright, 2003); Barab et al. (2003) describe face-to-face interaction as an *essential* supplement to online interaction. I agree with these authors that online communities of practice have the potential to support pre-existing local communities. However, I argue that online communities of practice have potential beyond this support. The authors neglect the fact that offline interaction of some members may change the situational constraints not only for those members who know each other, but also for the whole group. Understood in this sense, the perspective that is presented here implies that face-to-face (or offline) interaction is not an essential pre-condition for a member changing his behavior. It is enough for some other members interact offline. Therefore, OLCs can include individuals who are not members of a pre-existing local community as long as other members interact face-to-face.

Experimental research on computer-mediated communication in small groups shows that communication between members increases trust, and preceding communication between members increases the contribution rate, reducing free rider problems (Riegelsberger, Sasse, & McCarthy, 2003). Much less field research has been conducted on the effects of communication between members of large or longer-lasting online groups. The situation in large online groups is different from interaction in small laboratory groups for two reasons. First, one cannot expect all members in large groups to communicate with each other outside the group. In large OLCs, it might well be that members who do not know each other and who do not know any other member wish to share their knowledge. Second, in longer-lasting OLCs, the consequences of communication even among those members who have communicated with each other might be weaker because the time lag between the preceding communication and the subsequent online interaction can be very large. The limited empirical evidence from field studies is briefly presented below.

Field studies of small or medium-sized groups suggest that preceding face-to-face meetings among students in online learning courses might increase the rate of contribution to subsequent online discussions (Bluemink & Järvelä, 2004; Kleine Staarman, 2003). Haythornthwaite (2000; 2001) examined an online class consisting of 14 students in a 15-week course. After periods with face-to-face meetings, online socializing activities and emotional exchange took place much more frequently. She argues that face-to-face

interaction had a catalytic effect. However, OLCs are much larger, and the interaction period is much longer. It is unclear whether these findings can be generalized to such communities. The crucial question for field research is whether those who do not interact outside the group with other members will nevertheless, in the long run, be affected by the common offline interaction of other members. Therefore, I next focus on mechanisms that reveal how embeddedness in offline networks changes the situation for the whole group and thereby influences sociability problems in large OLCs.

Coleman (1988; 1990) argues that dense networks diminish problems of cooperation in groups in a number of ways. Cheating is more disadvantageous because individuals who do so damage their reputations. Information about cheating behavior can spread more easily in a higher density network (see also Raub & Weesie, 1990). Moreover, cooperative norms and expectations of trust are easier to establish because norm violators face a higher likelihood of being sanctioned through other members' coordinated action, which is facilitated by the dense network. These and related arguments by Granovetter (1985) stimulated a large body of research exemplifying how dense networks (or, in the terminology of Granovetter (1985), the embeddedness of action in social networks) facilitate solutions to problems of collaboration in the offline world.

Field research on large online groups provides evidence for two effects of embeddedness in offline networks. First, Matzat (2009) found that in academic emailing lists embeddedness provides incentives for researchers to gain reputation within their scientific community by contributing actively to the online discussion. Second, under a high degree of embeddedness, group norms that prescribe helping others are more likely to emerge (Matzat 2004b). Therefore, embeddedness affects the quantity of the online discussion contributions because it provides selective incentives (namely opportunities to gain or lose reputation), thus reducing *free rider problems*. Furthermore, Matzat (2009b) argues that there are other reasons to expect embeddedness to affect sociability. Even if some members do not have any offline contacts, they recognize over time that the informal network among members is dense; they realize that information about misbehavior spreads quickly and that strong forms of misbehavior may be sanctioned by collective action (e.g., coordinated public complaints) facilitated by dense informal relationships. Under such conditions, members are more dependent on each other to gain reputation and avoid disapproval. If members are more interdependent, then they are more likely to develop an interest in maintaining a satisfying relationship with each other.

The point is that for members it is much harder to leave an OLC that has maintenance of relationships between members as a goal than to leave an OLC that focuses only on information interests. Leaving an OLC with additional relational interests is much more

disadvantageous for the member. If members step out of such a community they clearly indicate a lack of relational interests. This may offend some other members' feelings who had different expectations about how one has to behave. Even if members who leave may not care much about other members' feelings, it is not in their own interest to offend them because that prevents access to information that they might need in the future. Coming back to the community later once more and asking for information is then no longer a valid option. In addition, the maintenance of the relationships is likely to become a pleasant experience in and of itself. In extreme cases, members will not leave at all because the maintenance of relationships with specific individuals is important. So there will be less membership fluctuation in embedded communities than in purely virtual communities.

Finally, under conditions of high social embeddedness and therefore relational interests between members, problems of trust are diminished. The abuse of placed trust would be a clear signal of a lack of relational interest. Just like explained above, in OLCs with relational interests signaling a lack of relational interests is self-damaging for a member. Therefore, under a high degree of embeddedness and relational interests, trust is less likely to be abused and members are more likely to behave cooperatively. Members in OLCs with high embeddedness anticipate the higher likelihood of cooperative behavior from others. Therefore, it is more likely that they will place their trust in members of the OLC (Matzat, 2009b). Hence, there will be fewer problems of trust.

This leads to the following hypotheses about effects of embeddedness in offline networks.

H1: In online communities of practice, there will be fewer instances of free riding under a high degree of embeddedness than under a low degree of embeddedness.

H2: In online communities of practice, there will be fewer problems of trust (or higher rates of placement of trust) under a high degree of embeddedness than under a low degree of embeddedness.

H3: In online communities of practice, there will be greater membership stability under a high degree of embeddedness than under a low degree of embeddedness.

Study design and measurements

The hypotheses were tested with questionnaire data that was collected between November 2005 and February 2006 from 33 online communities of practice in a large Dutch virtual organization for teachers of secondary education.[1] A random sample of members received an email invitation for a web survey (n=1259, 37% response rate) The OLCs work in the same

technological environment, including discussion fora, an electronic newsletter, and opportunities for uploading and downloading teaching material.

Dependent variables

The hypotheses make predictions about the effects of embeddedness on three problems of sociability, namely free riding, a lack of trust, and membership fluctuation. These were measured in three ways.

1.) The perceived intensity of all three problems was measured through experienced members' assessments of how serious the different problems are for the functioning of the community. This leads to three dependent variables.
2.) The intensity of the problems of free riding and trust were measured by members' self-reported willingness to participate in a number of common activities. These activities would contribute to the production of collective goods for the community or demand the placement of trust in other members. In the case of the free rider problem the activities differed with respect to the amount of time they asked for. In the case of trust problems the activities were risky in the sense that they included the possibility that, to some extent, they might be self-damaging because trust placement might be abused. These activities were presented as hypothetical, but realistic scenarios. The following measures were taken to increase the validity of the members' answers in the scenarios. The virtual organization regularly publishes an electronic journal that is sent to all members; the intention to increase the active participation of teachers in the OLCs was explicitly announced in the journal shortly before the start of the data collection. It was also announced that the virtual organization would take specific measures to increase participation. The questionnaire referred to this initiative, and the scenarios were presented in such a way that members were to assume that the management might use the information provided by the members in the near future to take certain actions (as indeed it might). In the scenarios it was stressed that the member's answers would be of crucial importance for the further development of his/her own community. Additionally, the survey included items that form a 'social desirability scale', so that it is possible to control for a general tendency to answer in socially desirable ways. The scenario answers lead to two dependent variables measuring the willingness to contribute to collective goods and to place trust.
3.) For the problem of free riding, the members' self-reported behavior was taken as an indicator. Members were asked questions about their past contributions to a number of collective goods for the whole community. This leads to one additional dependent variable indicating the actual participation in the production of collective goods.

The three measurement procedures (perceptions of problems, willingness to participate in collective action and to place trust, and self-reported behavior) thus produce six dependent variables and are described in more detail below.

Table 1: Measurement of six dependent variables

Perceived intensity: 7-point Likert items (variables 1-3: only answers from respondents with more than six months of membership were used to ensure valid answers)

1. Perceived intensity of free riding problem:

There are too few *active* members in the community.

The members do not send enough teaching material to the community.

If there is something to be done for the whole community, then the members wait until other members take the initiative before they contribute themselves.

Principal axis factoring resulting in one factor score: α=.86, explanation of 67% of item variance, KMO measure=.73.

2. Perceived intensity of problems of trust:

Members do not trust each other.

The members hesitate to make use of the information that they can find in the community.

The members hesitate to write about their problems at work.

The members are afraid that the information that they send to the community might be used in ways unfavorable to themselves.

Principal axis factoring resulting in one factor score: α=.81, explanation of 53% of item variance, KMO measure=.76.

3. Perceived intensity membership fluctuation:

There are fluctuations in the number of members in the community. (single item)

Members' willingness (scenarios): Higher scores indicate greater willingness (variables 4-5: answers from all respondents used)

4. Willingness to contribute to collective goods: 5-point Likert items

In the near future, the community will be making more use of the knowledge and capabilities of its members. Therefore, we would like to know to what extent the members are willing to commit themselves to the future development of the community. Your answers to these questions are thus important for the future of your own community.

Would you or would you not be willing to participate in the following activities:

a) distributing flyers about your online community during an evening of information at a school in your neighborhood

b) giving a short presentation about the content and utility of your online community during an evening of information at a school in your neighborhood

c) mediating conflicts between members in the community. You do not need special technical skills, and your involvement is only necessary in cases of conflict.

d) participating in a members' advising committee. The committee would meet once a year. You do not need special technical skills, and the expected time investment will be about eight hours per year (four hours of preparation and a four hour meeting).

Principal axis factoring resulting in one factor score: α=.82, explanation of 53% of item variance, KMO measure=.74.

5. Willingness to place trust: 5-point Likert items

We are planning to develop a number of software tools for your community, but we would like to avoid offering new software tools that no one needs. Therefore, we would like to know whether you would make use of the following tools for your community.
Think carefully about your answers. They affect the future development of your own community.

Because much of the teaching material nowadays is prepared in electronic form (PowerPoint, Word, PDF, etc.), it is possible to prepare a discussion forum in a way that makes it easy for teachers to provide the material to colleagues so that it can be evaluated by others.
a) Would you provide your own teaching material with your name on it to colleagues within your community?
b) Would you provide your own teaching material to colleagues within your community if it is possible to do so anonymously?

Assume that every month there is a review of the latest teaching material by members of a committee from your online community. This review of the material and the discussions that led to the review would be posted and accessible to every member of the community. Assume that you have teaching material in electronic form.
a) Would you be willing to provide your own teaching material with your name on it for review?
b) Would you be willing to provide your own teaching material anonymously for review?

Principal axis factoring resulting in one factor score: α=.88, explanation of 65% of item variance, KMO measure=.67.

Self-reported behavior: Answer options: yes/no (answers from all respondents used)

6. Past contribution to collective goods: Two items asked respondents whether they "…had ever contributed to the newsletter by writing something for it" and "…had ever sent teaching material to the OLC", with a score of 'one' if respondent agreed to at least one item

Independent variables

Embeddedness of an OLC was measured indirectly by a proxy as proposed by Matzat (2009). Experienced community members had to assess the degree of embeddedness of their own community by giving answers to four items. As a characteristic of the community, the resulting embeddedness score should have significant variation between the online communities. However, direct measurement using four items about the amount of offline communication between members led to a scale with high reliability (alpha=.90), but no discrimination between the communities (F=1.0, df_1=24, df_2=106, p=0.47). Measurement thus had to proceed in an indirect way. First, the extent to which the group of teachers constitute an integrated community that shares many activities and interests in common was measured. Second, it was shown that this score is associated with items that directly measure interaction between members outside of the community.

For the first step, embeddedness was measured indirectly with the help of an unfolding scale analysis (van Schuur & Kiers 1994) of three six-point Likert-scaled items, which resulted in a Mudfold scale. A Mudfold scale is similar to the well-known Guttman scale, with the exception that in the Mudfold scale some deviations from the "perfect answer pattern" of the Guttman scale are allowed. One can then test whether these deviations can be explained by chance, allowing an assessment of the quality of the scale. In a Mudfold scale, a number of items and persons can be ordered one-dimensionally with regard to a latent trait (in this case, the perceived degree to which a group constitutes an integrated community that shares many interests and activities in common). The following three items were presented only to experienced OLC members (those who subscribed for more than two years).

To what extent do you agree with the following statements about your own community?
a) It is a set of groups and cliques with their own interests and activities that do not have much in common as a community.
b) It is a set of groups and cliques with their own interests and activities that also have some common interests as a community.
c) It is a moderately integrated community that shares some interests and some activities.

Answers ranged from "completely disagree" to "completely agree". A Mudfold scale analysis resulted in a strong Mudfold scale consisting of the items in the order a-b-c (H=0.86, assumptions of an unfolding scale met). In addition, it discriminated between the communities (11% of variance between groups, F=1.52, df_1=25, df_2=314, p=0.05). Since embeddedness is a characteristic of the whole OLC, the arithmetic mean of the members' answers for every OLC is taken as the indicator of embeddedness.

The assumption underlying the measurement procedure is that the more the group of teachers constitute an integrated community that shares activities and interests in common, the higher the degree of embeddedness. Embeddedness consists of the frequency of the members' interaction outside the online community. The ordering of the OLCs according to the scale scores of embeddedness can be externally validated in a meaningful way, providing evidence for the assumption that the scale captures offline communication between members. In OLCs that score higher on the embeddedness scale there are more members having contact with each other outside of the community than in OLCs that score lower on the Mudfold scale. Respondents who agreed that "in (their) online community there are groups of members who regularly meet each other in face-to-face membership meetings" tend to be in online communities that score significantly higher on the embeddedness scale (t=2.6, df=221.1, p=.01).

Table 2: Other control variables

Digital literacy: Slightly adapted version of Hargittai's (2005) scale: "How familiar

are you with the following internet phenomena?", downloads, advanced searching, preference settings, newsgroups, pdf documents, refresh/reload, mp3 files, blogs, emailing lists, spam filters, all answers on 5 point Likert scales resulting in one factor score (alpha=.91, KMO value=.92).
Socially desirable answering tendency: Shortened version of BIDR 6 scaling procedure (Paulhus, 1991): answers on 7 point Likert scales to the following items: "My first impressions of people usually turn out to be right. It would be hard for me to break any of my bad habits. I always know why I like things. I sometimes tell lies if I have to. When I hear people talking privately I avoid listening. I don't gossip about other people's business."
Trusting disposition: Three items adapted from Jarvenpaa, Knoll, and Leidner's (1998) scale: "Most people are honest in describing their experiences and abilities. Most people answer personal questions honestly. Most people can be counted on to do what they say they will do." Answers lead to one factor score (alpha=.83, KMO value=.70).
Pro-social orientation: Shortened version of the so-called "decomposed games method" (Snijders & Weesie, 1999)
Digital experience: years of internet use ranging from 0 to 8 (8=8 or more years)
Group size: Information from managers or website
Age (log_e), *gender*, and *extent of having a full-time job as teacher* (log_e[percentage]) are also included.

Descriptive findings

Data cleaning resulted in the removal of 7% of respondents; these respondents did not yet have a teaching position (e.g., students) or gave inconsistent answers to the questions on pro-social orientation leading to missing values (6%). The final sample size, which is adequate for the tests of the three hypotheses, consists of 725 respondents in 26 OLCs of practice. The "average member" has subscribed for between 7-12 months, uses the community one day per week, and is not very active in the community (mean=2 on a scale from 1 to 7). About 6% of respondents have contributed to the electronic newsletter, 15% reported having sent some teaching material to the OLC, and 10% attended at least one face-to-face meeting of OLC members organized by the management of the community. Fifty-five percent of respondents are women, and the median age is 46 years. Size of the OLCs varies from 28 to 3682 members. More information can be found in the appendix.

The OLCs ordered according to their degree of embeddedness differ with respect to their members' density of offline relations. The following data clarify to what extent the difference

between highly and weakly embedded OLCs captures differences in the amount of offline relations. The respondents were asked to agree or disagree with the following three items: "In our community there are groups of members who: a) are in regular contact with each other outside of the community, b) meet with each other regularly at face-to-face membership meetings, and c) call each other regularly." The median of the embeddedness scores was taken as a cut-point and the two resulting clusters of communities (weakly versus highly embedded OLCs) were compared with respect to the average proportion of members who agreed with the above mentioned items. For the three items the proportions of agreeing members grew from 28% to 41%, 18% to 33%, and 11% to 19%, respectively. Thus in OLCs with higher embeddedness scores, more members perceive others to be interacting face-to-face or via telephone.

Results of hypotheses testing

For hypothesis testing, multi-level multiple logistic and linear regression analyses are used since the data are clustered (Bryk & Raudenbush, 1992). Unless otherwise stated, the reported p-values are based on one-sided tests because the hypotheses are directional. Table 3-5 present the tests of the first hypothesis about free riding by analyzing the actual contribution behavior (Table 3), the willingness to contribute to collective goods (Table 4), and the intensity of the perceived degree of free riding (Table 5).

The analyses start with the multilevel logistic regression analysis of the actual contribution behavior. Here it does not make sense to split the variance into the two levels so that no "empty model" is presented. Instead, I present a model that includes only the effect of embeddedness. Table 3 shows that embeddedness has a positive and significant effect on the likelihood that a member has contributed to the community, either by submitting teaching material or writing an article for the electronic newsletter. There is a significant bivariate association between embeddedness and contributing behavior. In online communities with a strong embeddedness members are more likely to have contributed to collective goods like the electronic newsletter or to the database consisting of teaching material . Moreover, the effect of embeddedness remains significant after a number of potentially intervening factors are included in the model. Additionally, the likelihood of contribution increases with respondent's digital literacy, digital experience, and their individual degree of trusting disposition, all of which comes as no surprise.

Table 3: Two-level logistic regression analysis of actual contribution behavior

Variable	Model 1	Model 2

	Estimated value (standard error)	Estimated value (standard error)	
Group level effect:			
Social embeddedness	.185* (.088)	.212*	(.101)
Group size		.298	(.265)
Individual level effects:			
Digital literacy		.436**	(.119)
Digital experience		.147*	(.067)
Trusting disposition		.217*	(.109)
Pro-social orientation		.278	(.494)
Social desirability		-.030	(.113)
Gender (1=female)		.189	(.235)
Age		.506	(.413)
Extent of full-time job as teacher		.418	(.326)
*: p<=.05 **: p<=.01 (one sided) N=725 n=26	τ_0^2 = 0.513 (0.207)	τ_0^2 =0.691	(0.300)

N: Level 1 sample size (number of individuals); n: Level 2 sample size (number of groups); τ_0^2 : Level 2 variance of the intercept

Next, I analyze whether the willingness to contribute to collective goods in the future is affected by the degree of embeddedness. Table 4 shows that a number of variables have significant effects. Those who are more digitally literate, who are more trusting, and who have a stronger pro-social orientation are more willing to participate in the contribution of collective goods. Most importantly, the effect of embeddedness is significant and positive. Highly embedded OLCs are more successful than solely virtual ones in the sense that they have more members who report being willing to contribute. Furthermore, as Model 2 in Table 5 demonstrates, the variance between the OLCs reduces to zero after the inclusion of the individual characteristics and the group characteristics. A model that includes a Level-2 residual variance does not fit better with the data (χ^2=1.6, df=1, p>.1). The findings shown in Table 3 and Table 4 both support Hypothesis 1.

Table 4: Two-level linear regression analysis of willingness to contribute

Variable	**Model 1 (empty model)** Estimated value (standard error)	**Model 2** Estimated value (standard error)

Group level effect:			
Social embeddedness		.041*	(.019)
Group size		-.001	(.047)
Individual level effects:			
Digital literacy		.117**	(.036)
Digital experience		.020	(.019)
Trusting disposition		.062*	(.035)
Pro-social orientation		.543**	(.159)
Social desirability		-.015	(.037)
Gender (1=female)		-.052	(.071)
Age		-.015	(.131)
Extent of full-time job as teacher		.001	(.100)
*: p<=.05 **: p<=.01 (one sided)	σ^2=0.809 (0.043)	σ^2=0.789 (0.041)	
N=725 n=26	τ_0^2 = 0.01 (0.01)	τ_0^2 = 0 (-)	

N: Level 1 sample size (number of individuals); n: Level 2 sample size (number of groups); τ_0^2 : Level 2 variance of the intercept, σ^2: Level 1 variance

In Table 5, I show the results for the problem of free riding. The analysis tests whether members in embedded OLCs perceive less free riding than members in virtual OLCs. The results imply that those who have a weaker pro-social orientation, score higher on the social desirability scale, and those who belong to larger communities tend to perceive less free riding. Most important, the effect of embeddedness is negative, as expected. However, this does not reach statistical significance at the 5% level (p=.076).[2]

Table 5: Two-level linear regression analysis of perceived free riding

Variable	**Model 1 (empty model)** Estimated value (standard error)	**Model 2** Estimated value (standard error)	
Group level effect:			
Social embeddedness		-.034	(.023)
Group size		-.196 **	(.056)
Individual level effects:			
Digital literacy		.037	(.045)
Digital experience		-.015	(.025)
Trusting disposition		.008	(.042)

Pro-social orientation		.412*	(.184)
Social desirability		-.087*	(.045)
Gender (1=female)		-.125	(.084)
Age		.032	(.161)
Extent of full-time job as teacher		.088	(.123)
*: p<=.05 **: p<=.01 (one sided)	σ^2=0.764 (0.049)	σ^2=0.778 (0.049)	
N=513 n=26	τ_0^2 = 0.053 (0.028)	τ_0^2 = 0 (-)	

N: Level 1 sample size (number of individuals); n: Level 2 sample size (number of groups); τ_0^2 : Level 2 variance of the intercept, σ^2: Level 1 variance

The results of Tables 3-5 provide two times strong and one time only weak support for the first hypothesis, leading to the conclusion that a high degree of embeddedness indeed comes along with less free riding.

Table 6 and Table 7 examine the willingness to place trust in other community members and the perception of problems induced by a lack of trust between members, thereby testing hypothesis 2 about trust and embeddedness. Table 6 shows that those who have higher digital literacy, more digital experience, are more trustful, and have a higher pro-social orientation are more willing to place trust in other members by sending their teaching material. Older members tend to have somewhat less trust than younger members. The most important point is that the effect of embeddedness is positive and significant. This is in accordance with the prediction of Hypothesis 2. In OLCs with a higher degree of embeddedness, members tend to be more willing to trust placing their materials online than members in solely virtual OLCs. Again, the variance between the groups is reduced to zero.

Table 6: Two-level linear regression analysis of willingness to place trust

Variable	**Model 1 (empty model)** Estimated value (standard error)	**Model 2** Estimated value (standard error)	
Group level effect:			
Social embeddedness		.043*	(.019)
Group size		.051	(.047)
Individual level effects:			
Digital literacy		.069*	(.037)
Digital experience		.037*	(.020)
Trusting disposition		.161**	(.035)

Pro-social orientation	.346*	(.162)
Social desirability	-.031	(.038)
Gender (1=female)	.086	(.072)
Age	-.303*	(.133)
Extent of full-time job as teacher	.101	(.103)
*: p<=.05 **: p<=.01 (one sided)	σ^2=0.861 (0.046)	σ^2=0.817 (0.043)
N=725 n=26	τ_0^2 = 0.007 (0.01)	τ_0^2 = 0 (-)

N: Level 1 sample size (number of individuals); n: Level 2 sample size (number of groups); τ_0^2 : Level 2 variance of the intercept, σ^2: Level 1 variance

Table 7 analyzes the members' perception of a lack of trust in other members. Those who have a stronger pro-social orientation, those with lower digital literacy, males, and members in smaller communities tend to report a greater lack of trust in members. Most importantly, the effect of embeddedness is negative and statistically significant, as hypothesized. Embedded OLCs tend to have fewer problems of trust according to their members than virtual OLCs.

Table 7: Two-level linear regression analysis of perceived problems of trust

Variable	**Model 1 (empty model)** Estimated value (standard error)	**Model 2** Estimated value (standard error)
Group level effect:		
Social embeddedness		-.058** (.023)
Group size		-.159** (.055)
Individual level effects:		
Digital literacy		-.093* (.043)
Digital experience		-.012 (.025)
Trusting disposition		-.061 (.041)
Pro-social orientation		.334* (.181)
Social desirability		-.037 (.044)
Gender (1=female)		-.142* (.082)
Age		-.255 (.158)
Extent of full-time job as teacher		.121 (.121)
*: p<=.05 **: p<=.01 (one sided)	σ^2=0.758 (0.048)	σ^2=0.753 (0.047)
N=513 n=26	τ_0^2 = 0.027 (0.019)	τ_0^2 = 0 (-)

N: Level 1 sample size (number of individuals); *n*: Level 2 sample size (number of groups); τ_0^2: Level 2 variance of the intercept, σ^2: Level 1 variance

Both results presented in Table 6 and Table 7 support hypothesis 2, leading to the conclusion that embedded OLCs face less problems of trust than purely virtual ones.

Table 8 analyzes the problem of membership fluctuation, testing hypothesis 3. Only gender and digital experience have significant effects on the perceived problem of membership fluctuation. Women and those with more digital experience regard the problem of membership fluctuation as less intensive. Most important, embeddedness does *not* show an effect on the perceived intensity of the problem of membership fluctuation. In general, differences in the perceived problem of membership fluctuation cannot be explained very well by the model; only two out of ten variables show significant effects.

Table 8: Two-level linear regression analysis of perceived membership fluctuation

Variable	**Model 1 (empty model)** Estimated value (standard error)	**Model 2** Estimated value (standard error)
Group level effect:		
Social embeddedness		-.039 (.039)
Group size		-.118 (.104)
Individual level effects:		
Digital literacy		-.018 (.055)
Digital experience		-.055* (.031)
Trusting disposition		-.040 (.052)
Pro-social orientation		.170 (.228)
Social desirability		-.015 (.056)
Gender (1=female)		-.278** (.111)
Age		-.244 (.202)
Extent of full-time job as teacher		.036 (.154)
*: $p<=.05$ **: $p<=.01$ (one sided)	σ^2=1.192 (0.076)	σ^2=1.17 (0.08)
N=513 *n*=26	τ_0^2= 0.056 (0.035)	τ_0^2= 0.078 (0.043)

N: Level 1 sample size (number of individuals); *n*: Level 2 sample size (number of groups); τ_0^2: Level 2 variance of the intercept, σ^2: Level 1 variance

The results presented in Tables 3-8 show that OLCs embedded in offline networks face less problems of trust and free riding than purely virtual ones. One might wonder whether this is because of the denser offline network of the community (a macro or group characteristic) or because some members individually have more offline relations (an individual or micro characteristic). The theory expects that even those who have no individual offline relations are affected by a community's high degree of embeddedness in offline networks. Thus, the macro characteristic of the whole community is expected to have an effect, independent of a potential effect the individual characteristic. Therefore, in addition, all models presented in Tables 3-8 were re-analyzed with two additional variables: a dummy indicating the member's personal participation in face-to-face-meetings and a cross-level interaction between this dummy and the embeddedness variable. The results did not change; both variables were insignificant in all analyses and therefore left out (tables available on request). The insignificance of the cross-level effects shows that even for those who do not participate in face-to-face-meetings, embeddedness in the other members' offline relations has an effect.

Discussion of the results

Three hypotheses about differences between embedded and purely virtual OLCs were tested. With respect to Hypothesis 1 about free riding behavior, the amount of reported contribution behavior and willingness to participate in future contributing activities was higher in embedded than in purely virtual OLCs. For the effect of embeddedness on the perceived intensity of free riding only very weak evidence was found. In total, I regard these three findings as supporting Hypothesis 1. With respect to Hypothesis 2 about a lack of trust, differences in the willingness to place trust and differences in the perceived intensity of trust problems can be explained by differences in the degree of embeddedness. I also regard the findings as support for Hypothesis 2, which claims that there are fewer problems of trust in embedded OLCs than in virtual ones. Finally, the tests showed that differences in the perceived intensity of the problem of membership fluctuation cannot be explained by social embeddedness; no empirical evidence for Hypothesis 3 can be found.

There are several possible reasons for the failure to find support for the hypothesis on membership fluctuation. It could be that the Dutch online communities of teachers in general are more stable than other online communities. Many members have a long-term professional interest in the community, and there are no serious alternative online communities for teachers in the Netherlands. So there could be a kind of ceiling effect with respect to stability which makes these communities special. It could also be that the indicator used, which consisted of only a single item in this case, is not adequate. In addition, the beneficial effects of social embeddedness may be of such limited size that they do not affect a member's decision about staying in the community or leaving it. The low proportion of members who

report that membership fluctuation is a problem supports the first explanation. Only 2% of members claim that there is fluctuation 'to a considerable degree' or higher, and only 10% claim that there is fluctuation 'to some extent'. At the group level, the average community scores a '2' on a scale from '1' (no fluctuation) to '7' (very large fluctuation). The numbers suggest that online communities for teachers do not suffer from fluctuation. The section of descriptive findings showed that contrary to the problem of fluctuation, the OLCs suffer from free riding and a lack of placement of trust (see Matzat, 2006 for more details). Nevertheless, it can be that embeddedness reduces fluctuation in other types of online communities that suffer stronger from it. Further research is needed in order to shed more light on this question.

General summary and discussion

This paper tests the claim that mixed communities that include a combination of online and offline interaction offer certain advantages with respect to sociability when compared with purely virtual ones. This is because mixed communities are characterized by a higher density of the members' offline network which provides opportunities for the application of social control. According to Coleman's (1988; 1990) social capital theory individuals realize that under a network with high density misbehavior is likely to damage one's own reputation and may be sanctioned by coordinated action. Matzat (2009) argues that under a high density network members will develop relational interests, making them more receptive for what other members think about them. When members have relational interests, they try to avoid uncooperative behavior that would signal relational disinterest. Both mechanisms should reduce free riding, encourage the placement of trust, and stabilize membership.

The combination of online and offline interaction, called embeddedness in offline networks, was indicated by the extent to which the online community constitutes an integrated community that shares many activities and interests in common. It was shown that in those integrated communities members more often participate in face-to-face meetings, are in regular contact with each other outside the online community, and call each other. Moreover, other members perceive these differences with respect to embeddedness in offline networks. Earlier or later, they realize that some members have offline relations with each other.

These analyses provide evidence that embedded online communities are less susceptible than virtual online communities with regard to problems of trust and free riding. This is promising for the management of online communities and for future research on interaction in online communities. These findings do not provide grounds for claiming that the presented analyses offer evidence of a causal relationship; in fact, for some of the indicators, the causal relationship might function in either direction. Moreover, a causal analysis should test in more detail the underlying theories that specify how embeddedness affects the problems of

sociability. This is beyond the scope of this paper and has to be done by future research. However, other research has shown that dense networks have some of the hypothesized effects in other online and offline contexts (Coleman, 1988; Matzat, 2009; 2004b). In addition, future research should study the effect of embeddedness on membership stability in communities that suffer stronger from it.

These findings have interesting implications for the social design and management of online communities in general, not only for teachers. The degree of social embeddedness can be influenced in a number of ways. When a new online community is founded, one can think about the target group of that community. The target group may be very large, which often implies a more heterogeneous group of members. It is to be expected that in such a community, some degree of offline interaction is interesting only for smaller subgroups of members. The consequence is that although a very broad target group may lead to a larger online community, it will in all likelihood also lead to a limited amount of social embeddedness. During this early phase, the community founders can decide whether they want to accept a higher degree of free riding and lack of trust in such a large community. They may prefer to have a community of limited size with fewer problems of sociability. In an already existing online community, the degree of embeddedness can be influenced in different ways. For example, the administrator can decide not to focus marketing activities for new members on isolated individuals. Rather, he can focus on clusters of individuals who are already in contact with each other. If a complete cluster of related individuals subscribes to the community, then the members 'import' their embeddedness to the online community.

Another strategy to increase embeddedness is to organize or to support offline meetings. The virtual organization of this study followed such a strategy. Other research on online communities also indicates that such initiatives by the management or by members are promising (Dannecker & Lechner, 2007). I would like to add that the organization of member meetings can be beneficial to the group when members are made aware that offline meetings have taken (or will take) place. The members' attention can be drawn to the fact that a number of offline activities take place and that many members know each other and have pleasant relationships with each other. Through such efforts, both the actual and *perceived* degree of embeddedness increase, which is likely to have some beneficial effects.

These findings also have implications for research on OLCs. They support the hypothesis that embedded online communities tend to be more successful than purely virtual ones. They shed light on the link between offline and online relations and thereby substantiate the claims of social network researchers (Wellman, 2001). These findings provide evidence that offline relations have beneficial effects for sociability in online communities and point to the high density as the relevant network characteristic. More importantly, they contribute to clarifying

how the outcomes of online interaction are affected by offline relations and networks. Social networks of the offline world facilitate interaction in online communities by reducing their problems of sociability. In addition, the findings modify earlier claims about the integration of online communication with offline interaction. While earlier research has rightly suggested that offline contacts between members are beneficial (Barab, 2003; Kling & Courtright, 2003), whether members without offline contacts are affected by the offline contacts of others within their community was left open. This study demonstrates that not everyone has to meet face-to-face for an online community to act in solidarity; it is enough if only some members meet face-to-face to reduce problems of sociability and to foster the production of collective goods in the whole community.

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NOTES

1. For the multivariate tests of the hypotheses only data of 26 communities is used because of missing values.

2. Matzat (2006) presents additional analyses of the data showing that the use of a somewhat different embeddedness scale with a lower scalability (H=.3) leads to a significant negative effect of embeddedness on the perceived intensity of free riding. The different finding between the two analyses can be explained by the fact that higher scalability was obtained through the inclusion of only those respondents with a membership of at least two years (instead of at least one year as done in Matzat [2006]). This led to the exclusion of two communities.

Appendix

Variables	Mean	SD	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)
1) Perceived free riding	.04	.93	1													
2) Perceived problem of trust	.02	.90	.53***	1												
3) Perceived fluctuation	2.1	1.2	.35***	.46***	1											
4) Willingness to contribute	0	.90	.17***	.15***	.05	1										
5) Willingness to trust	0	.94	.13**	-.05	.00	.32***	1									
6) Actual contribution behavior (yes=1)	.21	.40	.09*	-.04	-.09*	.21***	.24***	1								
7) Digital literacy	-.08	1.03	.03	-.09	-.02	.15***	.13**	.16***	1							
8) Digital experience	6.41	1.88	-.07	-.06	-.10*	-.05	-.11*	-.13**	-.06	1						
9) Trusting disposition	.03	.95	.01	-.07	-.02	.07	.17***	.06	.04	.09	1					
10) Pro-social orientation	.87	.21	.11*	.07	.02	.12**	.07	.02	-.02	-.06	-.01	1				
11) Social desirability	.58	.89	-.09*	-.06	-.03	-.02	-.03	.00	.002	-.12*	.00	-.04	1			
12) Gender (female=1)	.56	.50	-.07	-.06	-.10*	-.03	.04	.02	-.07	-.21***	-.00	.09*	.02	1		
13) Age ($\log_e$)	3.75	.27	.02	-.03	-.02	-.03	-.12**	.02	-.23***	.14**	.01	.04	.05	-.15**	1	
14) Extent of full-time job as teacher ($\log_e$[%])	4.33	.34	.03	.05	.03	.01	.01	.05	.02	.05	-.06	-.03	.03	-.28***	.12**	1
Group variables (N=26)			Group size	Embeddedness												
Group size (raw data)	740	797	1													
Embeddedness	26.4	4.5	.46*	1												

n=725 (n=516 for variables 1-3), N=26, * p < .05; ** p < .01; *** p < .001 (two-sided)