

Secondary School Peer-to-Peer Knowledge Sharing Through Social Network Technologies

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Abstract: The promise of social network technology for learning purposes has been heavily debated, with proponents highlighting its transformative qualities and opponents its distracting potential. However, very little is known about the actual, everyday use of ubiquitous social network technologies for learning and study purposes in secondary schools. In the present work, we present findings from two survey studies on representative samples of Israeli, Hebrew-speaking teenagers ($N = 206$ and $N = 515$) which explored the scope, characteristics and reasons behind such activities. Findings show that such practices can be described best as *online knowledge sharing*, that is: the up- and downloading of knowledge and knowledge sources to social network peer groups. This teenage, school-related knowledge sharing is common and widespread, entails different types of knowledge, and is mainly motivated by prosocial motives, as well as expectations for future reciprocation. Sharing is predicted by individual differences, such as gender, collectivist values, mastery goal orientations and academic self-efficacy. Relations between competitive-individualist values and sharing are more complex, and are, among others, moderated by expectations for future benefits. Implications for educational practices and for collaborative learning theories are discussed.

Introduction

The prominence of social network sites (SNSs) in everyday life has ignited musings and debates about the implications of these developments for formal learning and education. Skeptics of SNSs for learning purposes pitch online social networking and formal learning as two mutually exclusive activities, emphasizing that SNSs have been designed and are mainly used for pastime socializing (Kirschner, 2015). This pastime socializing comes at the expense of and distracts from academic pursuits (e.g., Hollis & Was, 2016; Junco 2012, Kirschner & Karpinski, 2010). Research shows that teenagers and young adults indeed use SNS technology for various social purposes (e.g., Back et al., 2010; Hew, 2011). However, it does not rule out the possibility that students use SNSs for formal learning purposes as well.

At the other end of the debate, proponents of SNSs for learning envision that social media technologies will have positive and even transformative effects on how students learn, collaborate, share and create knowledge. These envisioned changes are often described in terms of a move away from traditional, hierarchical teaching structures organized in formal institutions, toward self-organized communities of interest, in which peers collaborate and discuss content, tutor newcomers, and create new knowledge, without the interventions of adult, certified teachers or other formal authority figures (e.g., Bingham & Connor, 2015; Collins & Halverson, 2009; Greenhow & Robelia 2009; Harasim, 2000; Wegerif, 2013). Recent educational design research initiatives have shown that some aspects of that vision may be achieved, with the help of extensive technical and professional support and with specifically developed add-ons to existing SNSs (Greenhow et al, 2015; Tsovaltzi et al., 2014). However, even though this shows the *possibility* of SNS-based learning activities in special circumstances and with tailored support, it does not provide further insights about the *everyday* and *spontaneous* use of ubiquitous SNS technology for learning and study in secondary school settings.

Recent work has sought to address this gap by exploring how teachers and students interact in SNSs (Asterhan & Rosenberg, 2015; Ophir, Rosenberg, Asterhan & Schwarz, 2016; Rosenberg & Asterhan, in press; HersHKovitz & Forkosh-Baruch, 2013; Schwarz & Caduri, in press). The combined findings from those studies show that teachers use SNS-based communication with their pupils for social-relational and psycho-pedagogical purposes, but also to support academic-instructional activities. In the present work, we extend this work by focusing on teenage, peer-to-peer, self-organized use of ubiquitous SNS technologies (i.e., Facebook, WhatsApp) for learning purposes in formal school settings.

We first explored this space with a pilot study that consisted of semi-structured teenager interviews (Bouton & Asterhan, 2014). Based on those first findings, we concluded that teenagers' self-organized learning- and study-related SNS activities are best approached under the umbrella of *online knowledge sharing*. Knowledge sharing is a well-known construct in communication, business management and information science. We provide a short overview of these bodies of research and their main findings.

Online knowledge sharing

Communication scholar Nicholas John (2012) has argued that "sharing" has become the constitutive activity of social media, and of social network sites (SNSs) in particular. *Knowledge sharing* refers to activities in which individuals share their own internally stored knowledge or external knowledge sources they have at their disposal by making it accessible to others. There are countless examples of online knowledge sharing, such as contributing to Wikipedia, posting a response to a question on a thematic Q&A forum, uploading a tutorial video to YouTube, or posting college lecture summaries on a blog. Access to this knowledge may or may not require membership. In the vast majority of cases, there is no direct monetary reward involved for making one's knowledge available. Moreover, knowledge sharing is not a zero-sum game, as when one shares a candy bar with a friend or when sharing a dormitory room with another student. It involves letting someone else have something that you have, without entailing any kind of material sacrifice on the part of the sharer (John 2012). In other words, upon sharing one's knowledge one does not become "less knowledgeable". Quite to the contrary, when a sufficient number of participants contribute, knowledge sharing leaves one with more.

However, it does require time and effort to assemble and share knowledge online, and this is done without receiving direct material benefits, without the assurance of reciprocation, and often without knowing who benefits from this knowledge. Moreover, if indeed "knowledge is power", then in a competitive environment the sharer may lose his/her relative advantage over others. In many ways, knowledge sharing has then similar features to a public good dilemma (Connolly & Thorn, 1990): In this case, the public good is knowledge, from which every member of a group may benefit, regardless of whether or not they personally contribute to its provision (Olson, 1965), but whose availability does not diminish with use. According to game theory, defecting (not contributing) is technically considered to be the strategy which from an individual member's standpoint maximizes utility, independent of whether others contribute to the resource or not (Cabrera & Cabrera, 2002; Dawes, 1980). This raises the question: What motivates individuals to voluntarily share knowledge?

One model that has been used as a framework for explaining willingness to share is the gift economy model (Mauss, 1967): In pre-monetary societies, people exchanged goods with their acquaintances in an intricate weave of reciprocal acts. As there were no formal financial systems to protect the wealthy against future misfortunes, 'gifts' donated to society served as a social guarantee that the family that was kind enough to share their good fortune today, will be protected and taken care of, should the need occur in the future. This *quid pro quo* motive for sharing has been used to explain how seemingly altruistic online sharing may be based on expectation for future economic rewards (e.g., Restivo & van de Rijt, 2014; Roberts et al., 2006).

Knowledge sharing, its motivations and rewards has interested scholars from various fields of research, but predominantly so in business management and organizational science, where employee knowledge sharing has been related to a range of success criteria, such as decreased production costs, innovation, revenues and team performance (see Wang & Noe, 2010, for a review). Factors that predict individual willingness to share knowledge with members in an organization are, among others, expectations of reciprocity, expectations of personal benefit (and reduced costs of sharing), interpersonal trust, collectivist values, self-efficacy and lack of evaluation apprehension (Wang & Noe, 2010). Knowledge sharing has also been studied in the context of online professional learning communities (e.g., Belous, 2014; Lin et al., 2008; Tseng & Kuo, 2014), where sharing is mainly motivated by intrinsic rewards, altruism and self-efficacy.

Knowledge sharing in educational contexts

Against this background, it is surprising that, to date, knowledge sharing in educational contexts has received so little scholarly attention. Knowledge sharing in school contexts is different from the aforementioned settings in several ways: First of all, students from a secondary school know and interact extensively with one another offline as well as online. Secondly, individual excellence in secondary school settings does not translate into monetary or other materialistic rewards (such as, salary bonuses, promotions), and the potential of future rewards (such as college scholarships) may be less salient to secondary school students. On the other hand, competition for academic excellence (medals, awards, honors) are by definition based on relative standing in a group. Such considerations may therefore stymie students' motivation to share school-relevant knowledge. Finally, whereas knowledge sharing is actively promoted by managers and leaders in organizations, attitudes towards sharing in the educational realm tend to be more ambiguous: On the one hand, peer assistance and help-giving are valued and encouraged in schools. Collaborative group work, peer tutoring and discussion are cornerstones of progressive pedagogies. In essence, even teaching is a form of knowledge sharing. However, assessment and evaluation is predominantly based on individual performance. Thus, peer knowledge sharing in the sense of giving, receiving and using solved solutions, completed homework assignments, and answers to test items are considered unethical (cheating) and, therefore, prohibited. Moreover, sharing in the sense of

exchanging learning derivatives is often discouraged: By relying on adapted materials that are produced by others, instead of processing the materials by one's self, important learning gains may be forfeited.

The present research

The overall aim of the present research is to map teenagers' school-related knowledge sharing practices in SNSs. Two panel data studies were conducted on representative samples of Israeli, Hebrew-speaking adolescents. The first panel study (Study 1) was exploratory, and designed to gain first insights into the extent and specifics of teenagers' school-related SNS knowledge sharing practices. Based on a representative sample of 206 teenagers, the findings showed that most of them are members of student-organized SNS study groups and that the vast majority (90%) participates in some form of school-related knowledge sharing in those groups, mainly through WhatsApp (and to a lesser extent on Facebook). Moreover, teenagers almost unanimously regard knowledge sharing as beneficial for their learning.

Because of space considerations we do not provide a full report of this study here, as the nature of Study 1 was mainly exploratory and formed the basis for formulating hypotheses to be tested in a larger sample, Study 2. The research questions and hypotheses of Study 2 are organized according to four different aspects of teenage school-related sharing in SNSs (whether, what, why and who):

(1) *Whether*: How common and widespread is the phenomenon? How often do they share, how often do they use shared materials? How many SNS study groups do they participate in, on average? Do they appreciate it or is it considered a nuisance? Based on the findings from the pilot study interviews and the Study 1 survey it is expected that the majority of high school students participate in knowledge sharing through SNS, are members of at least one SNS study groups, and regard sharing positively.

(2) *What*: What types of knowledge sources are shared most often by high school students? Based on findings from Study 1, we expect that materials that require little personal effort to produce (e.g., snapshot, technical messages) will be shared more frequently, compared to learning materials that require substantive individual effort to produce (e.g., reading material summaries).

(3) *Why*: What motivates high school students to share learning materials in SNS study groups, and why in their opinion, do others choose to share? Is this mainly motivated by pro-social motives (i.e., the wish to help others) or by more egocentric motives (i.e., self-enhancement, impression management)? Also, do they feel social pressure to comply with sharing norms and do they experience regret afterwards?

(4) *Who*: Is there a profile for frequent sharers, or central knowledge brokers, and can they be distinguished from less frequent sharers? Based on findings from the aforementioned literatures, we expect that sharing is positively predicted by collectivist, but negatively predicted by individualistic value orientations. We also expect that sharing occurs more frequently among students with higher academic self-efficacy. Based on achievement goal theory, it is expected that mastery orientations are positively associated with sharing, but negatively related with performance goal orientations. Finally, based on existing research on gender differences in peer help-seeking, we hypothesize that sharing is more frequent among female than male students.

Method

Participants

515 Hebrew-speaking Israeli adolescents were recruited from the largest national panel sample (with over 10,000 active adolescent members), which is subjected to state privacy law and ethical regulations. In the registration process, users provide basic biographical data (e.g., age, gender, residence, mother tongue, religious affiliation). This biographical information is used for selection procedures (e.g., mother tongue, ethnicity, religiosity, SES) as well as to build representative samples for surveys. Registration to the panel requires that adolescents as well as their parents read and sign consent forms. Invitations to participate in the current study were sent via e-mail to all registered adolescent members (age 15-17) from the majority population in Israel (mainstream, ethnically Jewish population). Because of substantive differences in school systems, cultural norms, internet availability and/or teacher-student relationships, we did not recruit participants from the ultra-orthodox Jewish and the Arab-speaking population. The invitation did not reveal the research topic. Participation was on a first-come, first-served basis and was closed once the goal of 500 adolescent participants with active SNS accounts was reached, while safeguarding a representative breakdown of gender, age, and the different religious sectors that is representative of mainstream Jewish adolescent population (53% secular, 18% traditional, 18% religious).

Relying on the results of study 1, we assumed that most of the educational uses of SNS were organized via specifically generated SNS learning groups, created mainly by students, in various social network sites such as Facebook or WhatsApp. However, in the current sample only less than two-third of the total sample ($N =$

291) admitted they were members of at least one SNS study group. The remaining 224 respondents then did not complete survey items relating to SNS study group activities. Data analyses of research questions revolving around such group activities is then restricted to 291 participants, instead of 515. Mean age of the 291 remaining participants (127 male) was 16.73 ($SD = 1.04$). All the questionnaires were completed online, during the first week of April, 2015. Net time to complete the survey was estimated at 15 - 20 min.

Tools

The full survey included 93 closed-end items. It included items that provided information about demographic background, overall SNS use, features of SNS study groups (e.g., how many groups, who initiates them, number of members in a typical group), as well as the following measures:

Sharing intensity was assessed with five items, each referring to one of five different types of content categories (Cronbach's, $\alpha = .778$): Administrative messages ("such as homework instructions/reminders, tests notifications and so on"), snapshots ("of the teacher's notes on the class board or handouts given in class"), content summaries ("of class notes, reading material summaries, and so on"), solved homework and other individual assignments, and peer learning ("such as, helping friends and explaining online points they didn't understand"). Frequency of sharing was rated on a 5 point Likert scale, separately for (1) content shared; and (2) using shared content posted by others.

Students' feelings about sharing. Five Likert scale, self-report items were included in which respondents indicated the extent to which they have experienced regret after sharing, feel (themselves / others) pressure to share, are dependent on sharing, their sharing helps others.

Explicit motives for sharing. Based on findings from Study 1, six common motives for (own / other) sharing were phrased: Improving academic achievements, Helping classmates succeed, Positive self-concept, Quid pro quo, Gain social stature and Lack of effort. Likert scales ranged from 1 ('not true') to 5 ('very true').

Individualism and collectivism. Students' individual orientation towards collectivist and individualist values was measured by using two scales from the Singelis et al. (1995) survey, which was translated to Hebrew and validated by Adar (2005). Examples of items are: "Competition is a law of nature", "It annoys me when others perform better than I do", "The well-being of my co-students is important to me", and "I feel good when I cooperate with others". Internal reliability was $\alpha = 0.78$ for the collectivist and $\alpha = 0.75$ for the individualist value orientation scale ($N = 515$).

Academic Self efficacy. Efficacy was measured with 8 items from an adapted version of the English version of the General Self Efficacy scale (Schwarzer & Jerusalem, 1995), namely the NGSE (translated and validated by Chen et al., 2001), which was adapted to target academic SE. Internal reliability was high, $\alpha = 0.93$.

Achievement goals. Individual achievement goal orientations were assessed with 18 items extracted from the Elliott & Church (1997) scales. Internal reliability was $\alpha = 0.76$ for the mastery scale, $\alpha = 0.89$ for the performance approach scale and $\alpha = 0.73$ for the ability-avoidance scale.

Results

Whether students share in SNS study groups

On average, teenage participants ($N = 515$) reported receiving hundreds of notifications daily from the two SNS accounts together ($M = 428.33$, $SD = 554.89$, range from 0 - 2,000). This questionnaire did not include separate questions on memberships in WhatsApp or Facebook, but rather asked generally about number of notifications, as stated above. Only two participants (< 1%) said they do not receive notifications at all.

As in Study 1, participants were asked to indicate the number of SNS study groups they are members of. However, the format was slightly different from that in Study 1: Participants could either tick the "none" option or write the number of SNS study groups in an open-ended format (rather than choose from a close set of predefined intervals, as in Study 1). Unlike study 1, where the vast majority of students admitted being members of SNS groups, in the current sample, only 57% of respondents reported participation in at least one SNS study group, which is significantly less than in the Study 1 sample. Because of the different test item format, it is not possible to infer whether this reflects a genuine difference between the two samples or is an artifact of the different test format (i.e., clicking a predefined answer requires less effort, which increased participants' tendency to choose the "none" option more often). Participants who choose the "none" option, did not receive any further items on sharing in SNS study groups. The remainder of the data analyses on sharing behavior in study groups is therefore limited to $N = 291$.

Overall sharing intensity was calculated based on the mean frequency of the five separate types of learning materials. Mean sharing intensity was $M = 2.81$ ($SD = 1.05$), which is similar to findings from Study 1. Forty-four percent considered themselves prominent sharers in their groups. The majority of respondents (89%)

are members of more than one study group, more than 4 groups on average ($M = 4.33$, $SD = 2.97$). SNS study groups are typically initiated by students (56%), rather than teachers (10%).

What is shared in SNS study groups?

The mean sharing frequency score for each of the five different types of content was calculated separately (see Figure 1). Paired sample t -test comparisons were conducted with Bonferroni alpha corrections for multiple comparisons (0.05/10) within each sharing activity (shared / used). For own sharing the pattern was as follows: administrative messages = snapshots = peer assistance > content summaries > copying. For using shared materials: administrative messages > snapshots > peer assistance > content summaries > copying.

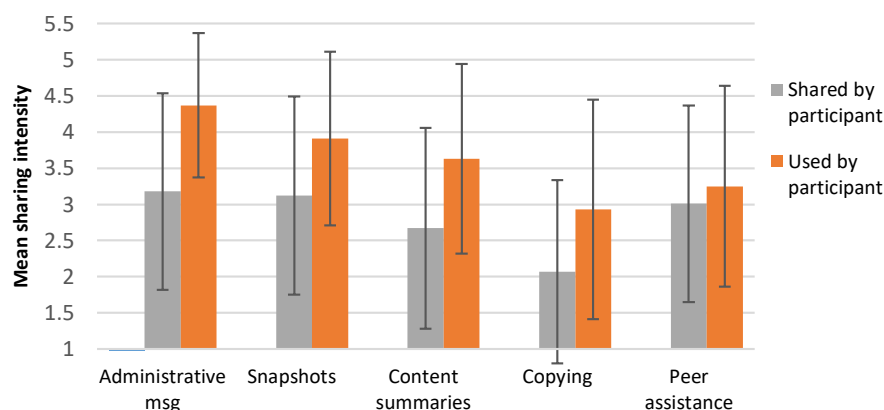


Figure 1. Mean (and SD) sharing intensity in SNS study groups, as shared and used by respondents ($N = 291$).

Why share?

The majority of participants (77%) strongly disagreed with the statements of experiencing regret after sharing ($M = 1.42$, $SD = 0.88$), experiencing peer pressure to share (66%, $M = 1.69$, $SD = 1.15$), or that others are pressured (51%, $M = 1.97$, $SD = 1.23$). On the other hand, participants expressed overall agreement with positive statements endorsing sharing benefits: They feel that sharing their own learning materials helps their fellow classmates to improve their academic performance ($M = 3.79$, $SD = 1.21$). Moreover, 21% of respondents strongly agreed with the statement that they are dependent on sharing to succeed ($M = 3.19$, $SD = 1.26$).

Participants' responses to six predefined sharing motives were measured with separate items for one's own sharing and the sharing by other group members. To examine whether the mean differences between types of motives proved to be significant, paired sample t -test comparisons were conducted with Bonferroni adjustments for multiple comparisons (critical $p = 0.05/15$) within each sharing category (i.e., participants' own motives for sharing and their perceptions on others' motives to share). The pattern that was obtained for own and others' sharing was identical: help classmates succeed ($M = 4.43$, $SD = 0.84$) > improve self-concept = quid pro quo = improve own learning > gain social status ($M = 2.05$, $SD = 1.36$).

Who shares?

Gender differences were tested using a one-tailed independent sample t test. Female students were found to share more overall ($M = 2.90$, $SD = 1.06$) than male students ($M = 2.69$, $SD = 1.03$), $t(289) = 1.70$, $p = .045$. When separately tested for each type of sharing, Mann Whitney test showed that female students only shared content summaries more often ($Mdn = 156.63$) than male students ($Mdn = 132.27$), $U = 12,158.0$, $p = .012$.

Pearson correlations were calculated between the six individual characteristics and overall sharing intensity, as well as Spearman correlations with each of the five different sharing content categories (see Table 1). Inter-correlations between most scales were either non-existent or low. However, a strong, positive correlation was found between the individualist value orientation scale and the performance-approach goal scale, $r(291) = .61$, $p < .001$. Performance-approach goal scales were then omitted and we refer to the remaining scale as "competitive individualism" from here on onward.

Table 1. Bivariate correlations between individual characteristics and different sharing measures ($N = 291$)

| | Collectivism values | Competitive individualism | Self-efficacy | Mastery goal | Performance- avoidance goal |
|---------------------------|------------------------|------------------------------|---------------|-----------------|--------------------------------|
| Overall sharing intensity | .374** | .043 | .267** | .327** | .092 |
| Administrative msg | .340** | .018 | .246** | .255** | .089 |
| Snapshots /handouts | .316** | -.012 | .204** | .225** | .087 |
| Content summaries | .309** | .049 | .186** | .252** | .081 |
| Copying | .202** | .142* | .209** | .248** | .048 |
| Peer learning | .291** | -.003 | .303** | .288** | .060 |

As expected, positive correlations of moderate strength were found between collectivist value orientations, academic self-efficacy, and mastery goal orientation with sharing. Endorsement of performance-avoidance achievement goals was not related with any of the sharing categories. A multiple linear regression analysis showed that these predicted sharing intensity, $F(3,287) = 24.78, p < .001$, accounting for approximately 20% of the variance of overall sharing intensity, $R^2 = .206$, Adjusted $R^2 = .197$. Each of the three individual characteristics contributed separately to the prediction of overall sharing intensity (collectivism: $\beta = .291, p < .001$, mastery: $\beta = .191, p = .003$, self-efficacy: $\beta = .149, p = .014$).

No correlation was found between overall actual sharing intensity and competitive individualism, $r(291) = .04, p = .466$. However, competitive individualism positively correlated with regret after sharing ($r_s = .233, p < .001$), perceived peer pressure to share ($r_s = .302, p < .001$), and the belief that others experience peer pressure ($r_s = .316, p < .001$). Finally, competitive individualism was positively associated with on sharing category, namely the sharing (and using, $r_s = .13, p = .024$) of solved homework tasks (cheating).

We examined the possibility that the relation between competitive individualism and sharing would be moderated by belief in quid pro quo benefits. Respondents were characterized as either endorsing or not endorsing gift economy views, based on the quid pro quo item. Competitive individualism was positively related with overall sharing when students expect future gains from it (48%), $r = .24, p = .032$, whereas among non-believers this correlation was negative, $r = -.28, p = .011$. This pattern was consistent across the five different types of sharing behavior as well.

Discussion and significance

The combined findings presented here provide a first, descriptive account of teenage knowledge sharing via ubiquitous SNSs in secondary school settings. School-related knowledge sharing refers to the up- and downloading (posts, files) of knowledge and knowledge sources that pertain to the learning and studying of curricular topics to/from a SNS group. It includes sharing of logistical and organizational information, sharing of teacher-created materials, providing online peer assistance, and to a lesser extent the sharing of student-created content summaries and even completed individual assignments (cheating).

The findings show that knowledge sharing through SNSs is a widespread phenomenon that has become an integral part of routine study practices among secondary school students. Students have been known to borrow and copy content from each others' notebooks prior the introduction of Web 2.0 tools. Therefore, student peer-to-peer knowledge sharing is not a novel phenomenon in essence, nor is it created by SNS technology. What has changed, however, is the ease, and efficiency, and therefore the scale, with which information and knowledge can be duplicated and shared with the help of modern communication technologies.

We discuss our main findings, their contributions and the directions for future research from two separate angles: a knowledge sharing perspective and a learning theory perspective.

Knowledge sharing in school settings

The present work extends the literature on online knowledge sharing as it is the first to address the phenomenon in formal, secondary education. Similar to findings from adult knowledge sharing in online communities, self-reported motivations for teenage sharing were predominantly pro-social in nature. In secondary school settings, interpersonal competition for material rewards and thus the personal costs of sharing is perhaps less salient than in professional settings. Not all sharing was purely motivated by altruistic motives, however, since quid pro quo motivations were found to play a role as well. Participation in SNS-based sharing is more likely when a teenager is female, endorses collectivist values, is guided by mastery goals, and has high academic self-efficacy.

Finally, in contrast to expectations, competitive individualism was not associated with less overall knowledge sharing or more overall use of shared materials, as may have been expected based on a straightforward utility maximization strategy. The results presented here showed that belief in quid pro quo, i.e., the gift economy rationale for sharing, serves as a moderating factor of the association between peer sharing and

competitive individualism orientation: Among teenagers who expect quid pro quo benefits from sharing, endorsement of competitive individualism was associated with increased sharing (and vice versa). Finally, even though competitively oriented teenagers did participate in sharing activities, they also expressed more regret and felt they were under more social pressure to share content. Moreover, and in alignment with findings on performance goals, competitive individualism was associated with more frequent sharing of the cheating type, that is: sharing and using copied homework and other assignments.

This first empirical study should be followed up by research that explores the phenomenon with additional methodologies (e.g., direct observations and qualitative research tools) and in additional cultures and countries. Given the popularity of SNSs among teenagers in many other countries, it is reasonable to expect that knowledge sharing is a widespread and common phenomenon there as well. However, different norms and practices may evolve locally and are likely to be influenced by local school cultures. Future research should include additional educational settings. In higher education, for example, competition for individual monetary rewards is more salient (scholarships, job offers, placement in graduate schools) and social cohesion not as strong, compared to secondary schools. This may affect the frequency of sharing as well as motivations behind it. Finally, future research should further explore the social structure of school-related knowledge sharing. Recent findings in the Netherlands reveal that, in spite of euphoric prediction about the democratizing effects of so-called consumer-directed sharing economies, sharing of under-utilized physical goods (such as cars, tools, and apartments) is in fact highly stratified within social class. Moreover, the supply and the demand of shared goods is dominated by middle-class participants, with considerably less participation from the upper and lower classes (de Beer & de Gier, 2015). The quid pro quo expectation may in fact deter the 'have-nots' from using shared goods, as they will have difficulty to return the favor in the future. Similar questions can and should be raised regarding knowledge sharing: Who gains most from knowledge sharing, who loses out on potential benefits and who is (purposefully) left out?

Knowledge sharing, peer collaboration and learning

From an organizational point of view, knowledge sharing is a means to reach the organization's end goals more efficiently (Wang & Noe, 2010), but is not an end goal in itself. From an educational point of view, however, the desirability of online knowledge sharing between students is less clear cut. Whereas values of collaboration, sharing and pro-social behavior are encouraged and nurtured by society, parents and in schools, assessment and evaluation is predominantly based on individual performance. Individual mastery of knowledge is (one of) the end goal(s) of formal education. The most obvious case of undesirable sharing is that of solved homework tasks and other assignments. Even though it proved to be the least frequent type of sharing in the current study, still more than a quarter of the participants in both studies admitted to using it very frequently. Copying assignments and handing them in as one's own is considered unethical ('cheating'), since it provides an inaccurate picture of whether the end goal has been reached. Aside from the ethical aspects, however, the overarching question is whether SNS-based knowledge sharing is conducive to individual learning, or not?

Our findings showed that, overall, teenage students regard online peer-to-peer knowledge sharing positively and beneficial to their individual learning. However, these subjective perceptions may not necessarily reflect actual learning benefits. There are, in fact, several reasons that dampen such positive expectations.

First of all, a vast body of empirical research has shown that peer-based learning may indeed produce individual learning gains, provided that peers engage in particular rich forms of egalitarian, reasoned, transactive dialogue in which they co-construct knowledge (for reviews see Resnick, Asterhan & Clarke, 2015). Learners improve their individual knowledge and understanding through negotiating, externalizing and challenging (the reasons for) each other's knowledge structures. This collaborative knowledge construction shares some surface features with online knowledge sharing as it is described in the present work: It is a collaborative, peer-based effort in a formal learning context. However, it lacks the pivotal attributes of knowledge co-construction and can therefore not be assumed to improve individual learning in a similar vein. Quite to the contrary, by overly relying on learning derivatives that are produced by others, instead of self-made, students may forfeit important individual learning activities that produce knowledge gains as well as develop important competencies (e.g., summarizing, highlighting and integrating information).

A second reason to be cautious about expected learning benefits from online knowledge sharing stems from recent research on transactive memory systems and the increasing role of the Internet as the ultimate transactive memory partner (Sparrow, Liu, & Wegner, 2011; Ward, 2013a; Wegner, 1987). The Internet contains infinitely more expertise than a singular human partner, is accessible to all and is ever available. Recent research shows that people systematically overestimate their own internally stored knowledge, as they conflate it with the vast amounts of knowledge that are available through the Internet (Ward, 2013b). For example, Fisher, Goddu & Keil (2015) showed that the mere act of searching the Internet for knowledge creates an

illusion whereby people mistake potential access to Internet-stored information for their own personal understanding of the information even when the transactive memory partner is unavailable. Extrapolating from this research to the current settings, it is possible that the information gathered through and stored in online SNS study groups may cause a similar illusion of knowledge: The mere act of storing shared learning materials and derivatives in one's cell phone or cloud, combined with the knowledge that one can access this information at any time, may cause learners to overestimate their own internally stored knowledge and underestimate the need for extra study time. This could then paradoxically lead to less actual learning.

Finally, the findings reported here show that students share and gather shared materials on a regular basis. They do not provide further insight about whether and how they actually keep track, store, utilize and integrate these different knowledge resources, however. Are these shared resources mainly used as additional materials, or do they replace learning from the teacher-assigned, canonical materials? How do students select and decide what is relevant, important or helpful, especially when they have several knowledge resources at their disposal (e.g., shared summaries, lesson notes, whiteboard pictures, textbooks) from potentially different individuals?

The present work is a first step toward a better understanding of a novel, widespread phenomenon that was hitherto underexposed and could potentially have many implications for learning and study performances in formal education. More research is needed to broaden and deepen this understanding, not only for scientific purposes, but also to enable informed decision-making when addressing the practical, ethical and social questions that come along with it.

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