

## Self-regulated learning and social media - a ‘natural alliance’? Evidence on students’ self-regulation of learning, social media use and student-teacher relationship

abstract

Research on the educational consequences of social media has led to divergent findings that are difficult to integrate and studies often examine specific courses. It remains unclear what types of social media use in classroom prevail on a broader scale and how teachers, if at all, can affect outcomes. We contribute to answering these questions by studying classroom social media use of 459 secondary school teachers in The Netherlands teaching in the humanities, the social and the natural sciences. We test the idea that the use of social media would be “naturally allied” with self-regulated learning (SRL). Results show that teachers apply social media for information sharing with students outside of the class and, more often, for teaching within the class. A bottleneck consists of the application of social media for the facilitation of SRL. Only in the performance phase of SRL, teachers facilitate SRL via social media slightly. Consequently, the limited use of social media for the facilitation of SRL does not affect student-teacher relationships. Testing the hypothesis of a natural alliance between SRL and social media use, we find evidence for the claim that teachers, who practice SRL in the classroom, are more inclined to use social media.

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## 1. Introduction

Education professionals and the scientific community see a large potential in integrating social media technology in secondary and higher education (Junco, Elavsky, and Heiberger 2013; Purcell et al. 2013). Especially in Dutch schools there are many enthusiastic proponents of social media, such as Facebook, Twitter and YouTube (Schouwenburg 2011) and students easily accept the integration of social media in educational practice (Van't Klooster and Janssen 2012). At the same time, teachers are looking for advice on how to best use social media for teaching and learning (Stichting Kennisnet 2013). However, there is no clarity on educational revenues and adverse effects of the use of social media, as their student outcomes are quite varied (Lane and Lewis 2013).

Research on the effects of social media tends to rely on studies examining (often higher) education in the U.S. (e.g., Roblyer et al. 2010). Research in Dutch secondary education mainly provides information about single best practices, but also indicates some degree of reluctance and scepticism among teachers (van 't Klooster and Janssen 2012; van Gennip and van Rens 2011). Empirical research so far has shown that the effects of social media integration in education are diverse and not always desirable. For instance, some studies found a negative correlation between time spent on Facebook and students' grades (e.g., Kirschner and Karpinski 2010; Paul, Baker, and Cochran 2012) while other researchers found inconsistent results across different studies (Hargittai and Hsieh 2010). At the same time, research shows that the integration can increase students' involvement in education (Junco 2012b; Junco, Heiberger, and Loken 2011), which in turn leads to better school performance (Kuh 2009; Lane and Lewis 2013). Furthermore, some studies found that (specific forms of) social media use enhance the student-teacher relationship and affective learning (Johnson, 2011; Mazer, Murphy, and Simonds 2007; 2009). Accordingly, the results of various studies are difficult to integrate.

We aim at getting a better view on the circumstances that may explain when social media integration in education yields desirable educational outcomes. In this article, we focus on the student-teacher relationship. Our study incorporates two new elements. Contrary to earlier research, we focus on the use of social media that is guided by the teacher because teachers can act as intermediaries between students' social media use and outcomes. Furthermore, we focus on the use of social media in secondary education.

Earlier studies indicate that the (desirable or undesirable) effects of social media integration strongly depend on the way students use them and that some outcomes can be influenced by the interference of the teacher (e.g., Junco 2012; Junco, Elavsky, and Heiberger 2013; Ahn 2011; Mazer, Murphy, and Simonds 2009). It is therefore important to analyse which types of social media use combined with teacher activity result in desirable educational outcomes. Some researchers argue that, at least in higher education institutions, there would be a kind of “natural alliance” between social media use and practices of self-regulated learning (SRL). SRL is a form of learning that stimulates the student to contribute actively to the formulation of learning goals, the determination of means, and the evaluation of the reached learning outcomes (Zimmerman, 1990). The use of social media extends, for example, students’ collaborative learning experiences (McLoughlin and Lee 2007), in this way providing opportunities for students’ SRL (Vrieling 2012). In line with this thinking, Dabbagh and Kitsantas (2012, 5) claim that increasingly, teachers would use social media to facilitate a combination of traditional classroom instruction with SRL practices. Another related claim is that social media use can result in beneficial educational outcomes if it is utilized to facilitate students’ SRL (e.g., McLoughlin and Lee 2010). To the best of our knowledge, however, for both claims only anecdotic evidence exists. What is needed is a systematic comparison of teaching practices in classes to test these two claims.

We need to know whether teachers who practice SRL in the classroom, are more likely to experiment with social media use in their class. Furthermore, it is necessary to test whether teachers who use social media in order to provide opportunities for SRL, experience beneficial outcomes in their class. For teachers of secondary education in the Netherlands who teach in the social sciences, the humanities and the natural sciences, we aim at such a comparison. Accordingly, our study contributes to answering the following four research questions. a) To what extent are teachers who provide more opportunities for students’ SRL more likely to use social media for their teaching? This would speak in favour of an “alliance” between practices of SRL and social media use in class. b) What type of social media use is more prevalent? In the case of research question b, we make a distinction between the use for information sharing with students outside of the classroom meetings versus the use of social media as a substantive didactical extension of their teaching during the classroom meetings. c) To what extent do teachers who use social media as a substantial didactical extension of their classroom teaching, provide opportunities for students’ SRL via these tools? For research

question c, we distinguish the three well-known phases of SRL, namely the forethought phase, the performance phase, and the reflection phase (Zimmerman 1990; 2000). d) To what extent is the use of social media for providing students with SRL opportunities related to beneficial student-teacher relationships?

The article is structured as follows. In section 2, we first summarize existing research on educational outcomes of social media use in secondary and higher education. Furthermore, we introduce the concept of SRL in detail and sketch the discussion about the interrelationship between social media and SRL. The arguments as presented in section 2, result in two hypotheses and two open questions that are addressed subsequently. In section 3 we present the design of our study. For testing our hypotheses we make use of data of 459 Dutch teachers of secondary education in six different school disciplines in the social sciences, the humanities, and the natural sciences. The data arise from a random sample of teachers in six large online communities for teachers of secondary education in The Netherlands (response rate=20.3%). We decided to utilize a random sample of teachers who use online communities because earlier research indicates that social media use and beneficial outcomes of ICT in schools are more likely to be expected when teachers have some digital expertise at their disposal (Stichting Kennisnet 2009) and teachers of these online communities have shown to possess reasonable digital skills (Matzat 2013). In section 4, we test our hypotheses and address our research questions by using bi- and multivariate statistical tests. Finally, section 5 summarizes the most important findings and points to implications for further research.

## **2. Theoretical background**

### ***2.1 Implications of social media technology for educational practice***

Several studies analyse the educational outcomes of social media use. A number of studies within U.S. universities examine the relationship between the private use (i.e. not initiated or guided by the teacher) of various social media and students' grades. On the one hand, it is found that Facebook use both within (Junco 2012a) as well as outside the classroom meetings (Junco and Cotten 2012), is associated with less study involvement, a shorter attention span and lower student grades, most likely caused by multi-tasking (Kirschner and Karpinski 2010; Paul, Baker, and Cochran 2012). On the other hand, findings as presented by Pasek, More and Hargittai (2009) and Hargittai and Hiseh (2010) report about a sometimes positive, sometimes negative and sometimes absent associations between the intensity of Facebook use and

grades. In these studies it is argued that Facebook use does not necessarily imply a negative effect on educational outcomes per se and that the type of Facebook use should be examined in more detail. Overall, these findings indicate that the educational benefits are unclear and research needs to identify the conditions under which desirable outcomes are more likely to appear.

Only a few studies examine what specific activities are carried out with social media. These are limited to the private use of Facebook and Twitter by university students in the U.S. Junco (2012) found that the more time is spent on Facebook, the lower the students' grades are on average. This correlation gets smaller, but does not disappear completely, when the analyses control for a number of specific types of Facebook use. The effects of the various specific types of Facebook use are quite diverse. For instance, the time spent on status updates is negatively associated with the average grade of the student while link sharing on Facebook shows a positive correlation with the average grade. Junco (2012) suspects that the negative correlation between Facebook use and the average grades could not completely be explained by the data because multi-tasking might have played an important role and was not included in this study. With regard to educational interventions, he concludes that the negative impact of Facebook would be relevant only for students who spend a lot of time on Facebook and who choose "disadvantageous" activities (such as chatting).

In a second study, Junco (2012b) examined the effect of time spent on (various types of use of) Facebook on the involvement of U.S. university students in their education because of the positive effects of student involvement on their academic development (Kuh, 2009; Lane and Lewis, 2013). Although Heiberger and Harper (2008) suggest that Facebook use can increase student involvement in the classroom lessons, Junco (2012b) shows that the time spent on Facebook is negatively related to involvement in class, not correlated with the study time and positively related to extracurricular involvement. This means that the effects of Facebook use on the various forms of involvement in this study, again, are quite diverse.

Although the studies of Junco (2012; 2012b) indicate that it is important to distinguish different types of social media use for different educational effects, there are still some issues. For evidence-based advice, more insight is needed into the mechanisms that explain which Facebook activity has which effects. The point is that the same technical activity can have different effects, depending on whether the activity is used for educational purposes under

guidance of the teacher or not. A second issue lies in the fact that the studies always applied a cross-sectional design, leading to difficulties in distinguishing between cause and effect. For instance, it could also have been the case that students' poorer school performance resulted in an intensification of their use of Facebook, rather than the other way around.

Both issues were addressed in recent experimental research that looked at the effects of Twitter. Junco, Heiberger, and Loken (2011) analysed seven groups of U.S. university students during 14 weeks of (face-to-face) teaching. Out of these seven groups, four randomly selected (treatment) groups were selected to receive Twitter messages from their teacher with additional information, assignments, questions, etc. The three other groups in the control condition received the same messages from the same teacher through an electronic message board. The students in all groups did a pre- and post-test in which their study involvement and their earlier high-school grades were measured. In the post-test, students in the experimental (Twitter) groups scored higher on commitment and tended to have higher grades while there were no such differences between the groups at the beginning of the study. Further analyses showed that the students in the Twitter groups were considerably more active than the students in the control groups. While the teachers' tweets stimulated numerous tweet reactions and discussions, there was less activity of the students who used the message board. According to the authors, the tweets were more appropriate than the static messages on the message board to facilitate interactive communication and collaboration between the students. This would explain the effects on involvement and grades. The researchers, however, note that it remains unclear to what extent the desirable effects were caused by the technology or by the increased activity of the teachers (they responded to questions from students) and their enthusiastic attitude and motivation. Nevertheless Junco, Heiberger, and Loken (2011) argue that their study shows that Twitter communication if initiated and guided by the teacher, can increase students' involvement and grades if the teacher encourages collaborative learning.

Also Junco, Heiberger and Elavsky (2013) examined the effects of the use of Twitter in a 14-week course for U.S. university students. In contrast to the previous study, the use of Twitter was voluntary. The voluntary use of Twitter in class was stimulated once and questions that came in via Twitter were briefly discussed for everyone in the audience. In this course, the teacher did not encourage any form of collaborative learning. In line with the previous study, the effects of Twitter use on students' involvement and grades were examined. In this case, however, after completion of the course no significant differences in involvement and grades

were found between the two groups. Junco, Heiberger and Elavksy (2013) therefore argue that it is not enough to stimulate Twitter use. Teachers should in addition explicitly encourage independent and collaborative learning of students to achieve desirable effects.

The above-described findings suggest that differences in the teacher's guidance and stimulation of learning through the use of social media (in this case by Twitter) can make a fundamental difference for students' learning outcomes. However, a serious limitation of the studies of Junco et al (2011; 2013) is that they have not measured the extent to which their way of teaching was promoting collaboration and independent activation of the student. Therefore, it remains open which didactical principles were implemented by using social media and can explain the effects.

## ***2.2 Teachers' use of social media technology as a facilitator of self-regulated learning***

McLoughlin and Lee (2007) argue that social media, such as Facebook, offer special affordances that facilitate collaborative and participatory learning of students. They plead for special pedagogical concepts to exploit their potential. Dabbagh and Kitsantas (2012) go one step further. They not only state that social media have the potential to support the promotion of informal learning and SRL. Moreover, they claim that teachers increasingly use social media, at least in higher education, to offer spaces for informal learning and SRL. In line with this thinking, to support teachers, this section elaborates on possible ways to facilitate SRL in classroom practice supported by the use of social media.

Accordingly, we draw parallels between the forms of learning (independent, collaborative, active) that are often aimed for through the use of social media, and process-oriented teaching (Vermunt and Verloop 1999) that represents a way of teaching that facilitates students' use of SRL skills. In general, SRL is defined as a goal-oriented process, proceeding from a forethought phase through self-monitoring and self-control to self-reflection (Pintrich 2000, 2004). SRL can foster deep and meaningful learning as well as significant gains in student achievement. Because of these positive effects, policy makers increasingly initiate new developments aimed at promoting students' SRL in educational practice (Vrieling 2012). Moreover, it is known that teachers can encourage and facilitate students' SRL by diagnosing and extending so-called "SRL opportunities" (Vrieling, Bastiaens, and Stijnen 2013).

In the following we argue for combining social media and SRL to clarify under which circumstances social media may yield favourable outcomes. In section 2.3 we focus on one of these outcomes, namely an enhanced student-teacher-relationship. The usefulness of the combination of social media and SRL can be tested by empirical classroom research because of three reasons: (1) Much research has been conducted showing that SRL is favourable for student development (e.g., Caprara et al 2008), (2) principles of SRL rest on general theories of learning (e.g., Zimmerman 2000), and (3) there are validated scales for measuring teachers' creation of SRL opportunities in classes (e.g., Vrieling, Bastiaens, and Stijnen 2013), allowing a systematic comparison between classes.

Therefore, we would like to put the idea that social media is allied with SRL to a test in the Dutch system of secondary education. While Dabbagh and Kitsantas (2012) leave open the precise foundation of this alliance, we argue that use of social media in class facilitates students' learning control, as social media provide opportunities for pupils' independent and more personalized learning (McLoughlin and Lee 2007). Also, teachers who are familiar with SRL are more likely to realize that providing opportunities for pupils' independent and personalized learning can have positive outcomes, thereby reducing their hesitation to use social media in the class. If Dabbagh and Kitsantas (2012) are correct about a "natural alliance" between social media and practising SRL in class, then teaching professionals who exercise SRL in class should have discovered the opportunity for combining social media with SRL in class. Accordingly, we should find that teachers who are already familiar with SRL are more likely to realize the potential of social media for facilitating SRL in their class. As a consequence, we expect those teachers to be more likely to use social media for their teaching. This is tested by the following hypothesis:

*Hypothesis 1:* The more opportunities teachers provide for their students' SRL in classroom teaching, the more likely teachers use social media for classroom teaching.

### *2.2.1 Types of social media technology use*

Scholars' arguments about the use of social media for teaching almost exclusively focus on social media use within the classroom (e.g., Dabbagh and Kitsantas 2012; McLoughlin and Lee 2007). What is neglected is their use for providing additional information about the teaching to pupils outside of the classroom. In our open interviews with Dutch teachers (Matzat, Snijders, and Den Brok 2013), some indicated that they used for instance Twitter for

sending information about deadlines or interesting links. By doing so, they felt that they provided pupils additional access to the teacher that was unobtrusive and that did not create a large threshold to overcome. Furthermore, such use does not require much time-consuming planning and preparation for the teacher, as it does not interfere with the classroom teaching. This leads to an open question:

*Open question 1:* What types of classroom use of social media prevail? We make a distinction between on the one hand the use of social media as a didactical part of teaching within the classroom and on the other hand their use outside of the classroom for information sharing with students.

### *2.2.2 Social media technology use and the three phases of self-regulated learning*

Theories of SRL distinguish three phases: the forethought phase, the performance phase, and the reflection phase (Zimmerman 2000). In the SRL forethought phase (Zimmerman 1990; 2000), students can learn how to set goals. Academic goals are regarded as important variables for students because of a number of reasons. First, goals can serve as reference points that determine the further processes of SRL, such as planning, executing and monitoring (Schunk and Ertmer 2000). Second, the activation of prior knowledge enables students to understand the task and its goals, to recognize the required knowledge for performing the task and to distinguish the several task characteristics and their prediction of performance (Eilam and Aharon 2003). Third, ‘metacognitive knowledge activation’ includes the activation of knowledge about cognitive tasks and cognitive strategies in the SRL forethought phase (Pintrich 2000, 2004). Fourth, ‘task value activation’, includes perceptions of the relevance, utility and importance of the task (Pintrich 2000). Finally, time management is an important component of SRL as well (Dembo and Eaton 2000). This aspect involves making schedules for studying and allocating time for different activities.

In the performance phase, ‘metacognitive awareness and monitoring of cognition’ (Pintrich 2000, 2004) is a core component within information processing models of SRL (e.g., Nietfeld, Cao, and Osborne 2006). It is important for students to develop thinking activities to decide on learning contexts, to exert control over their processing and affective activities and to steer the course and outcomes of their learning (Vermunt and Verloop 1999).

In the SRL reflection phase, Pintrich (2000, 2004) distinguishes two cognitive key processes. The first process involves learners' 'judgements' and evaluations of their performance of the task. Students can learn to make judgments about the way their work relates to the criteria. The second process of the reflection phase concerns students' 'attributions' for performance. Attributions are beliefs concerning the causes of outcomes (Butler 2002). Teachers can facilitate effective SRL by providing attribution feedback to students that stresses the factors students can control, such as effort and strategy use (Schunk 2007). Depending on the nature of the outcomes and the attributions students make, these self-evaluative judgments may affect future course of actions related to the forethought phase of the model. In this way, self-reflective learners engage in a cyclical feedback loop until they successfully achieve their goals.

Because of the potential of an alignment between SRL and social media use, we need to know more about the use of social media in the three SRL phases. This results in our second open question:

*Open question 2:* To what extent do teachers provide opportunities for their students' SRL via social media in the three phases of SRL, namely the forethought phase, the performance phase, and the reflection phase?

### ***2.3 Use of social media technology and student-teacher relationships***

A positive student-teacher relationship facilitates the student's affective and cognitive learning (Frymier and Houser 2000). In line with the work of several researchers (e.g., Hung and Yuen 2010; Mazer, Murphy, and Simonds 2007, 2009; O'Sullivan, Hunt, and Lippert 2004), we argue that social media use in the class as a supplement to educational face-to-face courses might be positively related to student-teacher relationships. Teacher credibility can be enhanced by the use of Twitter (Johnson 2011) and Facebook (Mazer, Murphy, and Somonds 2007; 2009) because social media use is expected to increase the (perceived) teacher's immediacy (O'Sullivan, Hunt, and Lippert 2004). That is, use of social media in the class reduces the psychological distance between pupils and teacher (ibid.). Moreover, when use of social media is combined with opportunities for pupils' SRL, this is likely to influence students' learning motivation, as is known from studies about SRL (Vrieling 2012). Besides the use of social media within regular classroom meetings, students for example can reflect on their learning (in the SRL reflection phase) by participation in discussion forums. Such

extended learning opportunities can lead to interactivity beyond the classroom walls and can also enhance participation in face-to-face classrooms (Hung and Yuen 2010). In addition, we argue that the combination of SRL with social media, leading to intense class participation, high student motivation and low psychological distance, offers teachers special opportunities to present themselves in favourable ways towards their students. Teachers can, for example, react more immediately on questions, problems and discussions in the forums, or on any other issue in classroom discussions without having to confront the student in face-to-face interaction that might be embarrassing for the student. This will make the teacher appear as more helpful and as more understanding in the eyes of their students. We test this reasoning with the following second hypothesis:

*Hypothesis 2:* The more SRL opportunities a teacher provides via social media a) the more the teacher appears as helpful, and b) the more the teacher appears as understanding.

### **3. Research design and measurements**

We utilize data of a survey of 459 Dutch secondary education teachers who provide courses in the natural sciences (mathematics and physics), the social sciences (economics and history) and the humanities (Dutch and English language). The data were collected from July-October 2014 in a random sample of teachers of six prominent online communities for teachers of these six disciplines. These six online communities were chosen because they represent typical school subjects and because of their size. They receive governmental subsidies and have in total about 35.000 members. The community moderators and the financing educational foundation DigiSchool allowed us to send email invitations to a random sample of online community members. We sent email invitations (including two reminders) to 4347 valid email addresses of teachers. 1068 respondents participated in the survey (reaction rate=24.6), out of which 426 members were no (longer) active teachers, leaving us with 642 participating teachers. Filling in the questionnaire took on average 13 minutes. Unfortunately, 183 teachers dropped out before they provided information about their social media use, so that for the multivariate analyses of social media use information about 459 teachers is available, leading to a response rate of 20.3%. The response rate is highest for the physics teachers (24.1%) and lowest for the teachers of Dutch language (16.5%). The difference between these two extreme groups is significant ( $n_1=727$ ,  $n_2=680$ ,  $z=3.53$ ,  $p<.001$ ). Furthermore, among the respondents, teachers of Dutch language scored significantly lower on operational digital skills than physics teachers ( $n_1=100$ ,  $mean_1=3.29$ ,  $n_2=54$ ,  $mean_2=2.89$ ,

$t=2.77$ ,  $p=.01$ ). At the same time, the likelihood of using social media for teaching does not differ between the two groups of teachers ( $n_1=98$ ,  $n_2=49$ , Chi-Square=.66,  $p=.42$ ). This comes as no surprise because the invitations sent to the respondents announced the study as being about the use of ICT. So a stronger affiliation with ICT might have motivated teachers' participation in the study. The topic "social media", however, was not mentioned in the announcements.

In the following we test whether those who dropped out in the survey ( $n_1=183$ ), differ from the remaining respondents ( $n_2=459$ ). Those who dropped out do not differ from other respondents with respect to the percentage of having a job as full-time teacher ( $n_1=459$ ,  $n_2=183$ ,  $t=1.13$ ,  $p=.26$ ), their years of working experience ( $n_1=459$ ,  $n_2=183$ ,  $t=1.64$ ,  $p=.10$ ), their response latency measured in number of days since the invitation ( $n_1=459$ ,  $n_2=183$ ,  $t=.84$ ,  $p=.40$ ). However, drop-outs scored somewhat lower on the scale measuring the provision of opportunities for SRL in face-to-face teaching ( $n_1=459$ ,  $mean_1=3.28$ ,  $n_2=47$ ,  $mean_2=3.07$ ,  $t=1.98$ ,  $p=.05$ ). Furthermore, those respondents who answered later (measured in number of days after the first invitation has been sent) than the median respondent do not differ with respect to their likelihood of using social media from respondents who answered earlier.

Overall, the higher response rate within the group of teachers of the natural sciences in combination with the lower digital skills scores of teachers of Dutch language suggest that teachers with a stronger affiliation with ICT may have been somewhat more likely to participate. This potential bias in favour of ICT does not necessarily imply a bias in favour of use of social media. The conclusions have to take into account the potential bias.

### ***3.1 Measurement of dependent variables.***

In hypothesis 2, we distinguish between two dimensions of the student-teacher relationship, namely the teacher's helpfulness and the teacher's understanding. For measuring the two dimensions, we use ten items (five items for each dimension) of the well-established 'Questionnaire on Teacher Interaction' (QTI; Fisher, Fraser, and Creswell 1995; Wubbels et al. 2006). In line with the original formulation and means of the QTI, teachers were asked to fill in the items and view themselves from the perspective of their pupils (e.g., for understanding 'The teacher trusts the pupils'). The items can be found in Appendix 1. As research has shown that teachers tend to perceive themselves more favourable than students

with respect to their helpfulness and understanding (Den Brok et al. 2002), we control in the analyses for the teacher's tendency to answer in socially desirable ways. For this we utilize a shortened version of Paulhus' (1991) 'Balanced Inventory of Desirable Responding' (BIDR) including four items that lead to a score ranging from zero to four (see Appendix 2). The two sub-scales of the QTI have high reliabilities (Cronbach's  $\alpha=.84$  for teacher's understanding and Cronbach's  $\alpha=.77$  for teacher's helpfulness). In the multivariate analyses, a logarithmic transformation of the helpfulness scores is used to correct for the small kurtosis. Use of social media outside of the class was measured by the following question after a short introductory text about social media: "During the past two years, did you make use of any social media (e.g., Twitter, Facebook, YouTube, Instagram, WhatsApp) for communicating with your [math/physics/history, economics/Dutch/English] pupils outside of the class?" This leads to a dichotomous item about social media use outside of the class. After that, we asked questions about the intensity of the use of five social media tools (Twitter, Facebook/Hyves/LinkedIn, YouTube, WhatsApp, or something else) for outside of the class-communication on seven point Likert scales (see also item for next construct). Use of social media inside the class applied the following item: "During the past two years, did you make use of any social media (e.g., Twitter, Facebook, YouTube, Instagram, WhatsApp) for extending your teaching in your [math/physics/history, economics/Dutch/English] class? This includes the use of social media within your class and your stimulation of the pupils' use of social media at home for your teaching." So use of social media 'inside the class' includes pupils' social media use at home as well as long as it is guided by the teacher's in-class instructions. After this question, we proceeded by measuring the intensity of use of five specific social media tools for in class-communication on seven point Likert scales (Labels: 1=not at all, 7= very intensively) with the following items: "To what extent did you apply the following social media for your class or did you stimulate your students to use them"? The teachers could then answer the question for each of the five social media separately. We selected the five types of social media (Twitter, Facebook / Hyves / LinkedIn, YouTube, WhatsApp, or something else) in such a way that the seemingly most prominent ones were included. Furthermore, we offered opportunities for the respondents to name other social media that might be popular. Limitations in the length of the questionnaire did not allow a more detailed specification.

### ***3.2 Measurement of independent variables.***

The teacher's provision of opportunities for SRL was measured by 14 items of the 'Self-

Regulated Learning Opportunities Questionnaire' (SRLOQ; Vrieling, Bastiaens, and Stijnen 2013). The original SRLOQ was developed and validated in a four-phase research design consisting of scale development, score validation, further validation in primary teacher education and a confirmatory factor analysis. In our sample, the SRLOQ has a reliability of  $\alpha=.89$ . The measurement of provision of SRL opportunities via social media rests on 14 selected and adjusted items for secondary education (see Appendix 3) that lead to a scale with an overall reliability of  $\alpha=.94$ . The SRL related questions were asked two times at remote moments of the filling-in procedure, but in slightly adjusted ways: (1) to measure the opportunities teachers provide for their students' SRL in classroom teaching in answer to hypothesis 1 (e.g., 'In my [physics] class, I offer my pupils opportunities for making choices in their own educational program') and (2) to measure to what extent teachers provide opportunities for their students' SRL via social media in answer to open question 2 (e.g., 'In my [physics] class, I have used social media to offer my pupils opportunities for making choices in their own educational program'). Appendix 3 shows the extended version of the questions including the use of social media for facilitation of SRL. Distinguishing between the three phases of SRL via social media leads to three sub-scales with high reliabilities ( $\alpha=.81$  for the forethought phase,  $\alpha=.87$  for the performance phase, and  $\alpha=.88$  for the reflection phase).

In addition, as control variables we measured the teacher's operational digital skills by utilizing six items of a scale proposed by Hargittai (2009), yielding a highly reliable scale ( $\alpha=.79$ ). Furthermore, we measured the teacher's time spent on teaching preparation, the number of colleagues who use social media for their teaching, the school policy on social media use, the teacher's online communication skills, and the teacher's teaching motivation (see Appendix 4).

## **4. Results**

In the results section, we first report on our descriptive findings to provide a detailed image of the teachers that participated in our study. Then, we elaborate on the open questions (Section 4.1), followed by the results of the hypotheses (Section 4.2) explaining relations between SRL opportunities, social media use and student-teacher relationships.

### ***4.1 Descriptive findings and answers to the open questions***

Out of the 459 respondents about 36% have a full-time position as a teacher and about 65% work four or five days per week as a teacher. The large majority (58%) has more than 11 years of teaching experience, 6% have less than two years experience. 22% of the respondents teach Dutch or English language, 38% teach Economics or history, and about 40% teach mathematics or physics. 45% of the respondents are female. The average age is 48 years, 10% are 31 years old or younger, and 10% are 61 years or older. On a scale from 1 (“not at all applicable”) to 5 (“fully applicable”) the teachers score on average a mean=3.3 (standard deviation=.67) for the provision of opportunities for SRL in face-to-face teaching. That is, many teachers provide a moderate amount of opportunities for SRL in their face-to-face teaching. 90% of the teachers are familiar with the Internet and use it for more than 10 years. They have a moderate level of operational digital skills (mean=3.1 on a scale from 1 to 5). Their online communication skills are somewhat lower (mean=2.8 on a scale from 1 to 5); 31% reject the statement that they are “good in making new contacts on the Internet”. Most of the teachers claim to be a motivated teacher, as 86% agree to the statement “I like preparing my teaching”.

The teachers perceive their relationship with the pupils in their class mostly positive. With respect to helpfulness and understanding they score a mean=4.2 on each of the two five-point scales. In line with the findings of earlier research about a bias in self-perception (Den Brok et al. 2002) these scores are significantly correlated with the tendency to respond in socially desirable ways ( $r_1=.26$  for helpfulness,  $r_2=.19$  for understanding, both  $p's<.001$ ).

Many, though not all, teachers have a positive opinion about the use of social media for teaching. Only 12% agree to the statement “social media are NOT good for the learning process”. 49% reject the statement, and 39% are indifferent. As the potential of social media for supporting teaching in classes is heavily debated in the Netherlands, it comes as no surprise that many teachers know of at least a few colleagues who tried out social media for their teaching. Only 13% claim that they know of no such colleague, 66% know of more than three colleagues who have tried out social media in their class. Only 12% claim to teach in a school “that does NOT at all consider the use of social media”, 75% reject the statement and 13% are indifferent. 42% claim to teach at a school that “has a formal policy describing how teacher and pupils can deal with social media”.

With respect to our open question 1 about the prevalence of different types of social media use, the results are as follows. 49.8% of the teachers claim to have used social media within their classroom as supplement of their traditional teaching within the last two years. Furthermore, 34.0% claim to have used them within the last two years for sharing information with their pupils outside of the classroom. While this difference is significant ( $n_1=459$ ,  $n_2=458$ ,  $z=4.5$ ,  $p<.001$ ), both forms of use are very popular. However, these numbers deserve some qualifications. Within the group of social media users for teaching within the class, 43% claim to have used only one tool, and this is (almost for all respondents) YouTube. Stated differently, of all teachers about 50% do not use social media for in-class teaching, 21% exclusively have used YouTube, and 29% claim to have used in addition another tool, such as Facebook, Twitter, WhatsApp, or something else. The intensity of YouTube use is not associated with the use intensity of other social media ( $r_1=.07$ ,  $p=.27$  for Twitter,  $r_2=.04$ ,  $p=.54$  for Facebook,  $r_3=.07$ ,  $p=.27$  for WhatsApp). At the same time, intensity of Facebook use within the class is associated with other social media use intensity ( $r_1=.41$ ,  $p<.001$  for WhatsApp,  $r_2=.23$ ,  $p<.001$  for Twitter). Also, the use intensity of Twitter and WhatsApp is associated ( $r=.19$ ,  $p=.01$ ). Furthermore, the results indicate that teachers, who exclusively rely on YouTube, conduct other types of learning with this tool than teachers who in addition use other social media. They use YouTube significantly less often for providing opportunities for SRL than teachers who in addition use other social media ( $n_1=87$ ,  $mean_1=2.15$ ,  $n_2=132$ ,  $mean_2=2.82$ ,  $t=5.46$ ,  $p<.001$ ). In a standardized score difference, this corresponds to a standardized mean difference of  $d=.71$  which is near to a large effect size ( $d=.8$ ) in the terminology of Cohen (1992).

We also tested whether there are differences in the proportions of users of social media for teaching in the class between the disciplines. Teachers in the humanities (Dutch or English language) are somewhat more likely than teachers in the natural sciences (Mathematics or Physics) or the social sciences (Economics or History) to have used any social media in the class, but the difference is non-significant (all Chi-Squares $<1.5$ , all  $ps>.10$ ). Also, there were no significant differences between the three groups of teachers with respect to the likelihood of having used a combination of YouTube and additional social media for teaching in the class.

With respect to our open question 2 about the use of social media for facilitating SRL, we analyse the group of teachers who utilize social media within the class. We examine to what

extent they use them to provide opportunities for their pupils' SRL. On a scale from 1 ("completely disagree") to 5 ("completely agree") the teachers score on average a mean value of  $m_1=2.56$  ( $n=219$ ) which is below the theoretical scale midpoint of "3". That is, the teachers tend not to utilize social media for the provision of opportunities for SRL. When compared to the same teachers' provision of opportunities for SRL in general teaching ( $n=219$ ,  $mean_2=3.40$ ) the difference  $m_1 - m_2 = -.85$  is significant ( $n=219$ ,  $t=13.4$ ,  $p<.001$ ) and large, as it corresponds to 1.3 of the standard deviation of the scores of SRL in general teaching. Stated differently, while teachers in general teaching tend to stimulate SRL, they do so only to a much lower degree via social media. A comparison between the three phases of SRL (the forethought phase, the performance phase, and the self-reflection phase) sheds more light on this. The use of social media for the facilitation of SRL is most intensive in phase 2 (performance,  $mean_2=2.70$ ), somewhat less intensive in phase 1 (forethought,  $mean_1=2.55$ ), and even less intensive in phase 3 (reflection,  $mean_3=2.33$ ). All three differences are significant (all  $ps<.01$ ). The difference between phase 3 and phase 2 is of a substantial nature ( $m_1 - m_3 = .37$  or 0.36 of a standard deviation of the scores in phase 3). That is, in phase 2 teachers tend to use social media a bit more to facilitate SRL. However, in all three phases the facilitation of SRL via social media is much less intensive than the facilitation of SRL in general teaching in the class.

Further analyses show that humanities teachers do not significantly differ from social science teachers in their intensity of using social media for the facilitation of SRL ( $n_1=52$ ,  $mean_1=2.66$ ,  $n_2=80$ ,  $mean_2=2.79$ ,  $t=.83$ ,  $p=.41$ ). However, teachers in the natural sciences score significantly lower than teachers in the humanities ( $n_1=52$ ,  $mean_1=2.66$ ,  $n_2=87$ ,  $mean_2=2.27$ ,  $t=2.3$ ,  $p=.02$ ). Teachers in the natural sciences thus use them least often for the facilitation of SRL.

As a summary, almost every second teacher uses social media for supplementing teaching in the class. The proportion of teachers who use them for communication with pupils outside of the class is lower, but still about one third tries social media for this purpose. Their use in the class for facilitating pupils' SRL, however, is limited. Only in the second phase of SRL, the performance phase, teachers tend to utilize social media for providing opportunities for SRL a bit more. In all three phases of SRL, however, the average teacher provides much less opportunities for SRL via social media than via general teaching. Teachers who exclusively rely on using YouTube (21% of the teachers) provide much fewer opportunities for SRL via

social media than teachers who in addition use other social media (29% of the teachers). Also, teachers in the natural sciences tend to provide fewer opportunities for SRL via social media than teachers in the humanities or social science although there are no significant differences between the disciplines in their' provision of opportunities for SRL in general teaching.

#### **4.2 Results of hypotheses testing**

We first test the hypothesis that teachers who provide more opportunities for SRL in general teaching are pushed to use social media for teaching in the class. We start by comparing the provision of opportunities for SRL in general teaching between those who use social media for teaching in the class versus those who do not. Thereafter, we use a multivariate model to analyse whether the likelihood of using social media for teaching in the class is affected by the tendency to provide opportunities for SRL in general teaching, even when we control for other factors that may affect the likelihood to use social media in the class. These other factors include the teacher's operational digital skills, the digital communication skills, the number of colleagues who are using social media, whether the teacher is at a school with a pre-university education, the teaching motivation, and the teachers' intensity of preparing classroom teaching.

Teachers who are using social media in the class provide significantly more opportunities for SRL in their general teaching ( $n_1=230$ ,  $mean_1=3.15$ ,  $n_2=228$ ,  $mean_2=3.39$ ,  $t=3.97$ ,  $p<.001$ ). The standardized mean difference is  $d=.36$  which corresponds to a medium to small effect size (Cohen 1992). This difference is somewhat larger when we compare those teachers who rely on more social media than just YouTube for teaching in the class with teachers who do not use any social media ( $n_1=230$ ,  $mean_1=3.15$ ,  $n_2=131$ ,  $mean_2=3.43$ ,  $t=3.84$ ,  $p<.001$ ). Here the standardized mean difference is  $d=.42$  which is near to a medium-sized effect (Cohen 1992). Table 1 provides the results of a multivariate logistic regression analysis of the likelihood to use social media in the class.

(Table 1 about here)

Table 1 shows that teachers who offer more opportunities for SRL in general teaching are more likely to use social media in the class. The effect still holds after controlling for several other potential factors of influence and is in line with hypothesis 1. Furthermore, teachers with stronger operational digital skills, teachers who are more motivated for teaching

preparation, and teachers who know of more colleagues who have used social media are more likely to use them in the class. Additional analyses show that age, gender, and disciplinary background do not have any significant effect (tables available on request from the authors). Table 1 also shows the changes in the odds ratio (e.g., odds ratio multiplied by a factor of 1.5 for a 1 unit change in the SRL scale) and, more important, changes in the odds ratio when the independent variables are standardized. (For the latter we use the ‘listcoef’ Stata command of the spost13 program.) This facilitates comparing the effect sizes. Table 1 shows that for a 1 standard deviation increase in opportunities for SRL the odds ratio of using social media has to be multiplied by a factor of 1.3. The same change in the odds ratio of using social media occurs for a 1 standard deviation change in the teaching motivation. We see that the changes in the odds ratio are of a similar size for most variables. That is, offering SRL opportunities is one out of four significant factors that increase the likelihood of using social media.

Next we test hypothesis 2 claiming that teachers who more intensively use social media in class to facilitate SRL experience better relationships with their pupils. We look at two relational dimensions, namely being perceived as a helpful teacher and as an understanding teacher. Here we (have to) restrict the analyses to the group of teachers who use social media in the class. The correlations show that teachers who use them more intensively for SRL also score higher on their helpfulness ( $n=207$ ,  $r=.16$ ,  $p=.02$ ), but not on understanding ( $n=207$ ,  $r=.08$ ,  $p>.10$ ). Again, we run multivariate analyses to find out whether other factors of influence may affect these associations.

(Table 2 about here)

Table 2 shows that those teachers who have a stronger tendency to answer in socially desirable ways also report to be perceived as more helpful. Furthermore, teachers who are more motivated to prepare their teaching also report to be perceived as more helpful. Most important, teachers who use social media more intensively for SRL do not report to be perceived as more helpful to their pupils. That is, the bi-variate association between use of social media for SRL and being perceived as more helpful can be explained by some of the control variables. The results do not provide evidence for hypothesis 2.

(Table 3 about here)

Table 3 shows a similar pattern of results that Table 2 shows, but now for the other dimension of the student-teacher relationship, namely understanding. There is no significant effect of use of social media for SRL on being perceived as an understanding teacher. The results do not support hypothesis 2. In line with the findings of Table 2, teachers who have a stronger tendency to answer in socially desirable ways and teachers who are more motivated to prepare their teaching also report to be perceived as more understanding teachers. The standardized coefficients presented in Table 2 and Table 3 also show that teaching motivation and social desirability scores have the largest effects. Furthermore, additional analyses show that age, gender, and disciplinary background do not have any significant effect on any of the two dimensions of the student-teacher relationship (tables available on request from the authors).

## **5. Summary, conclusions, and discussion**

Earlier research about student outcomes of social media use demonstrates that the effects of social media use are quite diverse. Besides this, most studies focus on single classes or students of a specific university. As a consequence, it remains unclear what forms of social media use are more promising and which forms of use do prevail on a broader scale. For that reason, our study contributes to this discussion by studying the use of social media by 459 Dutch secondary education teachers who educate classes in the social sciences, the humanities, and the natural sciences.

Contrary to earlier research, we study the use of social media that is guided by the teacher because teachers can be seen as intermediary between students' social media use and academic outcomes. Furthermore, we examine social media use within classes on a broad scale. The teachers participated in a survey of a random sample of members of the six largest Dutch online communities of teachers in six disciplines. The moderate response rate of 20.4% and additional analyses suggest that the sample may have a slight bias in favour of teachers who have an affiliation with ICT.

Although there are other factors influencing the use of social media in class, Table 1 shows that the use of SRL in face-to-face teaching is a relevant influencing factor, just like some other factors are. These findings provide preliminary evidence in favour of the idea that there would be a "natural alliance" (Dabbagh and Kitsantas 2012) between teachers' SRL practices in general teaching and a trying out of social media in the class. More than a third of teachers use social media for communication with pupils outside of the class. Almost half of the

teachers try out social media for in-class teaching. However, a large group (21% of all teachers) exclusively rely on YouTube, and these teachers provide significantly fewer opportunities for pupils' SRL than teachers who in addition use other social media in the class (28% of all teachers). While teachers who practice SRL in class teaching are more likely to use social media in class, they do not use social media intensively for the facilitation of SRL. In all three phases of SRL, the 'average' teacher who uses social media in class rather was reluctant to utilize social media for the provision of SRL opportunities. Only in phase 2, the performance phase, social media were used a bit more for the provision of opportunities for SRL. We were not able to find evidence for the hypothesis that the use of social media for the facilitation of SRL affects the student-teacher relationship.

The findings have important implications for further research. To the best of our knowledge, our study is the first that puts the idea of a natural alliance between SRL and use of social media in class to the test. While the results are promising, they should be interpreted with care. While we controlled for a number of other factors that have the potential to explain why teachers who stimulate students' SRL in general teaching are more likely to use social media, there are many more conditions that may play a role. Further research should put the idea that exercising SRL in class stimulates the use of social media for in-class teaching to a more thorough test. While the absolute numbers about the proportions of different types of social media users (e.g., exclusively YouTube user vs. user of several social media) should be treated with caution, we have the feeling that the use of social media for teaching in the class as well as for communicating with pupils outside of the class has become very popular. A bottleneck consists of the provision of opportunities for SRL via social media. Although general SRL may drive the teachers' use of social media in the class, teachers hesitate (or do not know how) to utilize social media for the facilitation of SRL. This may explain why we found no evidence supporting our hypothesis of beneficial effects of social media use for SRL on the student-teacher relationship. While many teachers use social media, only a few teachers use it for the facilitation of SRL. In this sense, the alliance between SRL and use of social media in school classes may come into being, but a useful combination of both elements still needs to be developed in much more detail. To test this claim of a natural alliance between the provision of SRL opportunities and social media use, in future research we plan to integrate social media use in educational SRL approaches to support teachers. In this way, it can be observed whether and how such alliances result into fruitful teaching and learning experiences. Through the use of social media teachers may, for example, facilitate

additional feedback opportunities to their students: a critical educational intervention for developing students' SRL (Vrieling 2012). In these circumstances, student-teacher relationships may flourish while the use of social media increases the interaction opportunities between students and teachers.

As can be learned from the results of the present research, teachers who solely rely on YouTube as a social media tool, facilitate other types of learning than teachers who extend the use of YouTube with additional social media. The exclusively YouTube users can therefore be regarded as different from the users that combine several social media. Why is that? Different possible explanations can be put forward. One possible explanation is that YouTube offers only limited affordances for facilitating SRL. YouTube is often applied as an important knowledge tool next to the teachers' oral presentation in and outside classroom practice. However, the tool may be less suitable to plan, execute or evaluate learning processes. In other words, the tool may not be appropriate for the self-regulation of learning as a process. When we take one of the other mentioned tools in this paper, namely WhatsApp, teachers can inform their students about relevant aspects while working on their assignments. Students can, for example, be reminded about the deadlines of their work or be asked to read relevant sources in preparation of the forthcoming lesson. Another possible explanation focuses more on the users' characteristics. Teachers who exclusively rely on YouTube may have different digital skills, preventing them from extending their social media activities in such a way that pupils' SRL activities are facilitated. These teachers may use YouTube because it offers easy-to-use access to video products that motivate pupils. Their repertoire of digital skills, however, does not allow them to utilize YouTube, or any other social media, for facilitating social interaction as part of a learning process. Should teachers lack competencies, then schools may want to stimulate their (self-)learning of digital skills (Matzat and Sadowski 2012). Testing these two explanations is out of the scope of this study. Future research needs to have a closer look at different types of social media use in classes (product intended versus process intended) and their determinants and consequences.

Our findings also have implications for educational policy and teaching practice. In a society that requires lifelong learning, the ability to steer one's own learning is becoming more and more important to be successful in academic as well as in non-academic contexts. For that reason, teachers are increasingly searching for learning opportunities that activate students towards SRL. However, SRL implementation only results in successful learning if teachers

provide sufficient guidance to their students (Hmelo-Silver, Duncan, and Chinn 2007; Vrieling, Bastiaens, and Stijnen 2010). Findings indicate the importance of creating a balance between teacher-centred and student-centred learning in the curriculum, gradually moving from teacher to student regulation of the learning process (Vrieling, 2012). In the secondary education of The Netherlands the potential of social media for student-centred learning still needs to be implemented in the curriculum.

To support a gradual development of SRL skills, teachers can arrange learning environments that enable students to practice SRL. As can be seen in the findings of the present study, the use of social media may be enhanced by familiarity with SRL in classroom teaching. Grounded on the findings, however, it can also be concluded that secondary teachers' use of social media for the facilitation of SRL is still scarce. Teachers seem to be in need of pedagogic and didactic guidelines for implementation of social media in educational (SRL) settings. Research so far has generated powerful learning designs that provide more insight for teachers during SRL implementation in educational programs (Vrieling, 2012). However, the use of social media as a facilitator for SRL has not often been taken into account in these innovative designs. If we aim to support teachers' professional development in this matter, it is crucial to be explicit about the teaching behaviors expected from the teachers. Teachers play a crucial role in the interpretation of the SRL design and its translation to educational practice. Therefore, to approach the natural alliance, future designs can integrate social media use as a facilitator for SRL.

The findings of the present study show that teachers who do use social media for SRL, most often apply them in the SRL performance phase. Maybe this is the easiest way to start using them for providing opportunities for SRL. Innovative learning designs for the combination of SRL with social media may focus on this phase in order to extend this combination. The performance phase is also an important phase while it demands much of the meta-cognitive skills of students. Such enhancement of students' use of metacognitive skills is only achieved by explicit strategy promotion to support their learning. Students, for example, can practice to provide peer feedback (in the performance phase) as observed from a best practice in face-to-face meetings. After observing, it is important for students to receive opportunities to imitate and practice the model's performance. However, during face-to-face meetings, teachers' time is often limited and students are usually expected to provide peer feedback during working on their assignments without really practising the skills (Vrieling 2012). Possibly, the use of

social media might be of help in this process through providing additional opportunities for students to practice SRL. This could be elaborated in more detail in learning designs. Research demonstrates that young students and pupils integrate social media seamlessly in their daily life, making use of it as a mundane habit (Roblyer et al. 2010; Duernberger, Reim, and Hofhues 2011, Purcell et al. 2012; van't Klooster and Janssen 2012) that can be utilized more for promoting self-regulation. In this way, teachers can guide metacognitive activity during task performance and a more fluent development of SRL skills within educational curricula in the three phases of SRL can be enhanced. Future empirical research should continue evaluating this process so that young people are better trained for the demands of the information society that require self-regulation skills. In this evaluation process, the earlier mentioned implications (i.e., integration of social media use in educational SRL approaches as well as distinguishing between process- and product oriented tools of social media for the facilitation of SRL) should be taken into account.

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## TABLES

**TABLE 1: multiple logistic regression of social media use in the class**

Variable	<i>B</i> (standard error)		X-stand.		Z-value	p-value
			Odds ratio	Odds ratio*		
Self-regulated learning opportunities in face-to-face teaching	.39	(.17)	1.48	1.3	2.26	.02
Operational skills	.30	(.14)	1.35	1.3	2.22	.03
Time spent on teaching preparation	.15	(.11)	1.16	1.2	1.38	.17
Teaching motivation	.34	(.14)	1.40	1.3	2.49	.01
Number of colleagues	.21	(.05)	1.24	1.5	3.97	<.001
Pre-university education	.40	(.21)	1.49	1.2	1.92	.06
Digital communication skills	.11	(.12)	1.12	1.1	.89	.37
<i>n</i> =429, Pseudo-R <sup>2</sup> =.1007		LR chi2(7)=59.88				P<0.0001

\*:  $e^{bStdX}$ : change in odds for 1 SD increase in X

**TABLE 2: multiple linear regression of student-teacher relationship: helpfulness**

<b>Variable</b>	<i>B</i> (standard error)	Beta	T-value	p-value
Self-regulated learning opportunities via social media	.01 (.01)	.07	1.15	.25
Operational skills	.00 (.01)	.04	.57	.57
Time spent on teaching preparation	.01 (.01)	.10	1.61	.11
Teaching motivation	.03 (.01)	.23	3.46	.001
Social desirability	.03 (.01)	.32	4.93	<.001
Pre-university education	.02 (.01)	.09	1.39	.17
Digital communication skills	.01 (.01)	.11	1.52	.13
<i>n</i> =207, Adj. R <sup>2</sup> =.2306	F(7, 199)=9.82		P<0.0001	

**TABLE 3: multiple linear regression of student-teacher relationship: understanding**

<b>Variable</b>	<i>B</i> (standard error)	Beta	T-value	p-value
Self-regulated learning opportunities via social media	.01 (.03)	.03	.41	.68
Operational skills	.04 (.04)	.09	1.18	.24
Time spent on teaching preparation	.04 (.03)	.10	1.51	.13
Teaching motivation	.15 (.04)	.25	3.61	<.001
Social desirability	.09 (.03)	.23	3.31	.001
Pre-university education	.09 (.06)	.11	1.61	.11
Digital communication skills	-.01 (.04)	-.02	-.22	.82
<i>n</i> =207, Adj. R <sup>2</sup> =.1341	F(7, 199)=5.56		P<0.0001	

## **APPENDIX 1: Measurement of teachers' helpfulness and understanding**

For each dimension (teacher's helpfulness (H) and understanding (U)) we use five items of the Dutch version of the 'Questionnaire on Teacher Interaction' (QTI) for teachers (Wubbels et al. 2006). All items can be answered on a 5-point Likert scale (labels: 1=never, 5=always).

- The teacher trusts the pupils. (U)
- If pupils disagree with this teacher, they can talk about it. (U)
- This teacher is willing to explain things again. (U)
- If pupils have something to say, this teacher will listen. (U)
- If pupils want something, this teacher is willing to cooperate. (U)
- This teacher helps pupils with their work. (H)
- The teacher realizes when pupils do not understand. (H)
- The teacher is someone you can depend on. (H)
- The teacher takes a personal interest in the pupils. (H)
- The teacher creates a pleasant atmosphere in the class. (H)

## **APPENDIX 2: Measurement of tendency to answer in socially desirable ways**

We use four 7-point Likert scales of the established 'Balanced Inventory of Desirable Responding' (BDIR) scale (Paulhus 1991).

- My first impressions of people usually turn out to be right.
- It would be hard for me to break any of my bad habits. (reversed coding)
- I always know why I like things.
- I sometimes tell lies if I have to. (reversed coding)

## **APPENDIX 3: Facilitation of self-regulated learning opportunities via social media**

We adjusted the Self-Regulated Learning Opportunities Questionnaire' (SRLOQ; Vrieling et al. 2013) and selected the following 14 items (5-point Likert items, labels: 1=completely agree, 5=completely disagree).

- In my [physics] classes, I have used social media...
- ...to offer my pupils opportunities for making choices in their own educational program. (phase 1)
- ...to clarify to my pupils the value of the assignments they have to deliver. (phase 1)
- ...to provide feedback to my pupils on mid-term deliverables on the basis of pre-defined criteria. (phase 2)
- ...to show to my pupils that making mistakes is a natural part of the learning process. (phase 2)
- ...to evaluate my pupils' work on the basis of pre-defined criteria. (phase 3)

- In my [physics] classes I have taught my pupils how they can utilize social media for...
- ...collaboration with others. (phase 2)
- ...asking for feedback and support. (phase 2)
- ...thinking about concrete learning goals of the course. (phase 1)
- ...making a plan to achieve the learning objectives. (phase 1)
- ...displaying their progress. (phase 2)
- ...bringing up topics for lessons and other moments of consultation. (phase 2)
- ...describing their way of collaboration with others. (phase 3)
- ...describing in what way the chosen learning activities have been challenging. (phase 3)
- ...evaluating their work. (phase 3)

#### **APPENDIX 4: Control variables**

The following control variables were applied:

**Time spent on teaching preparation:** My teaching preparation is very time-consuming. (5-point Likert scale)

**Number of colleagues who use social media for their teaching:** From how many other teachers at your school do you know that they are using social media in their teaching or have used them?

**School policy on social media use: mean value of two 5-point items ( $r=.33$ ):** a) There is an informal discussion at my school about the use of social media. b) There are informal rules in my school that describe how teachers and students can use social media.

**Teacher's online communication skills:** I'm good at making new contacts on the Internet. (5-point Likert scale)

**Teacher's teaching motivation:** Preparing my teaching is very easy to me. (5-point Likert scale)