

June Lee, Yangmi Koo,
Mi Hwa Kim
Korea

Enhancing Problem Solving Skills in Science Education with Social Media and an e-Collaboration Tool

DOI: 10.15804/tner.2016.43.1.21

Abstract

This study aimed to explore a collaborative problem solving case using social media and an e-collaboration tool, and analyze its educational implications in a qualitative research method. For achieving the research goal, a case study was conducted in a middle school class. Two rounds of one-to-one interviews with a teacher and written interviews with students were conducted. In addition, relevant class resources and the students' final reports were also collected as data. It was shown that using social media and an e-collaboration tool could encourage students' scientific inquiries and enhance problem solving skills as well as set up a healthy communication culture among teachers and students.

Keywords: *problem solving, social media, e-collaboration, collaborative learning, science education*

Introduction

Many educational professionals emphasize the enhancement of problem solving skills as a core competence in public education in the 21st highly advanced technology society (Rychen & Salganik, 2003).

Collaborative activities help promote problem solving skills of participants by enabling them to work together on problems that are difficult to solve individually (Alves, Marques, Saur, & Marques, 2007). In order to solve problems, it is required to select sub-problems after considering all aspects of a specific problem, to check

all information available, and then analyze them to figure out the best answer among the possible options. The process is established as problem solving can be effectively achieved when ensuring the cognitive diversity of various people (Page, 2008). From this perspective, collaborative learning that encourages socio-cultural interactions among students should be integrated into the curriculum for actualizing the public education enhancing problem solving skills.

Application of technologies is another useful way to promote learners' collaboration (Karkkainen & Vincent-Lancrin, 2013). Collaboration through technology can facilitate individual and small group learning (Thompson and Ku, 2010; Kelly, Baxter and Anderson, 2010). For instance, technology can help students collaborate and learn together at their own pace without physical limitations (Resta and Laferriere, 2007; Zhu, 2012). In online collaboration, learners can structure their knowledge collaboratively as communications keep articulating (Bonk et al., 2007), and create knowledge and meanings of learning, enhance higher cognitive thinking abilities, such as critical thinking and communication skills, while attempting to achieve their common goal (Palloff & Prat, 2005; Tutty and Klein, 2008).

However, a collaborative environment with technology does not guarantee an enhancement of problem solving skills (Wang, 2010). Keeping both the quality and quantity of learners' interactions at a certain level is more important. In particular, interactions based on emotional support are helpful in increasing problem solving skills (Cole, Sugioka, & Yamagata, Lynch, 1999; Grant & Berry, 2011; Reeve, 2006)

Therefore, accessibility that allows learners to participate in educational activities is important to increase the frequency of learners' interactions (Roper, 2007). When considering teachers' and students' accessibility and convenience, social media (i.e., Facebook) and e-collaboration tools (i.e., Google Drive) are considered to be useful and attractive technologies in educational settings. Due to the widespread use of the smart phone and the tablet PC among youth in their daily life, these social media can be used as a convenient tool for promoting students' communication. Dabbagh and Kitsantas (2012) note that social media encourage collaborative learning and help learners generate collective knowledge. E-collaboration tools are also known for being effective to learners' collaborative knowledge generation (Forte and Bruckman 2010; Glassman & Kang, 2011). E-collaboration tools also facilitate the collaboration of students, as they can use their personal devices without difficulty.

In science classes, fostering inquiry-based learning and developing problem solving skills are the most important learning goals (Jonaasen, 1997). There have been many attempts to increase problem-solving skills using technology in schools. Despite the effort, however, current science education, the one enhancing

scientific inquiry ability and innovative problem solving skills using technology, is still under way in real educational settings.

Even though many researchers have revealed that collaboration based on technology can contribute to effective learning, there are only a few studies that analyze teaching strategies, the learning environment, and teaching effects that ensure both the quality and quantity of interactions in actual science education settings except in experimental special circumstances. To this end, this study investigates the effect of collaborative problem-based learning with social media and an e-collaboration tool on enhancing students' problem solving skills by furnishing communication not only among students but also among students and teachers. This study is a case study that adapts a qualitative research method. It analyzes the case of a middle school science class that applies the problem-based learning approach, and discusses the result.

Overview of Problem Solving with Social Media and an e-Collaboration Tool

Sequence of learning

Technology in the science classroom is helpful in promoting the learning and study of basic scientific concepts. By exploring scientific phenomena happening around them via individual and collaborative activities, students can cultivate scientific manners and communication skills, and have positive attitudes towards solving social problems originated from natural phenomena (Schraw, Crippen, & Hartley, 2006).

Problem solving activities in this study focus on generating and sharing creative ideas for solving problems. The specific class management rules are: first, study a scientific concept by investigating a phenomenon that can be easily accessible in daily life; second, learn the scientific inquiry method for solving science problems by performing inquiry activities (i.e., observation, experiment, investigation, and discussion); third, provide opportunities of solving scientific or social problems by applying knowledge and the inquiry method; fourth, encourage students to learn a self-directed learning method, a sense of cooperation, and communication skills; fifth, use social media that facilitate active interactions in the classroom and run online and offline connected classes for providing a more effective collaborative learning environment. The class procedure developed under such construction principles is shown in Figure 1.

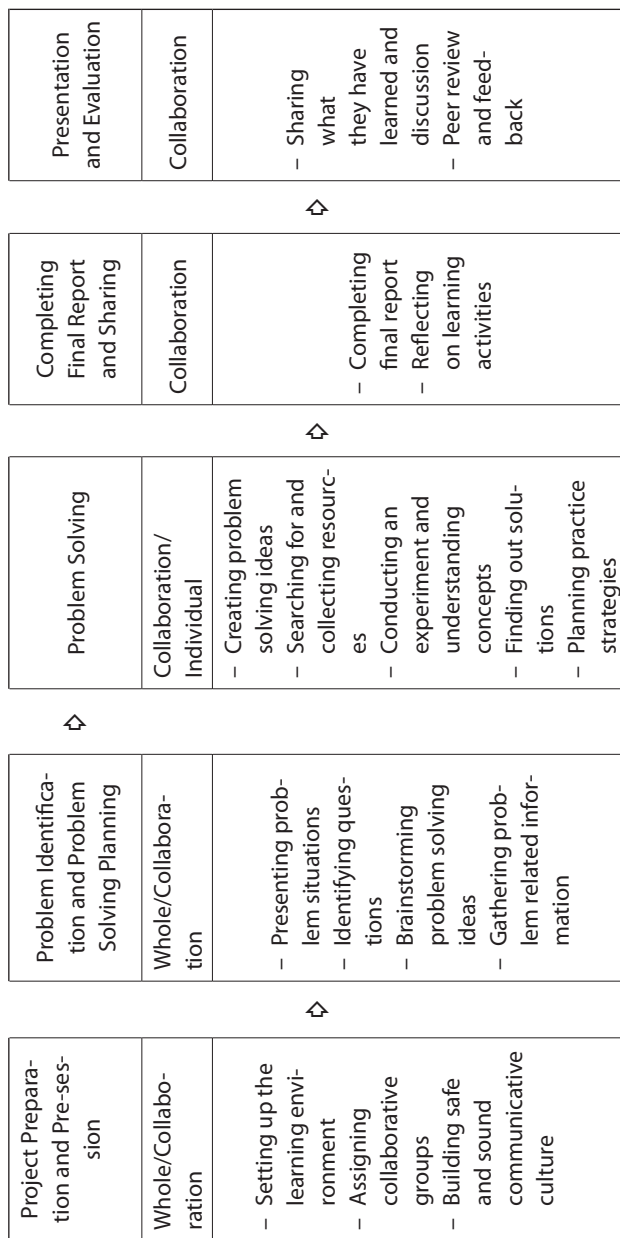


Figure 1. Class procedure of problem solving project

Use of Social Media and e-Collaboration

The teaching strategies used for applying social media and an e-collaboration tool in this study are to increase the frequency of interactions for problem solving by connecting offline activities and online activities. These media usage strategies are summarized in Table 1.

Table 1. Strategies of using social media and e-collaboration

Stage	Procedures and Strategies of Using Social Media and e-Collaboration
Project Preparation and Pre-session	Creating each collaborative group's space in the social media and encouraging students to join in (T) Proceeding pre-session about expressing emotional support among students using SNS per each group (T)
Problem Identification and Problem Solving Planning	Announcing the problem solving assignments and the procedure of class and in SNS (S) Organizing each student's role in a collaborative group in Google Doc (S)
Problem Solving	Brainstorming through SNS, searching for and collecting resources, and sharing, summarizing scientific concepts, finding out solutions and planning practice strategies (S)
Completing Final Report and Sharing	Completing final report using Google Doc collaboratively (S) Sharing opinions about the reports (S) Revising the reports (S)
Presentation and Evaluation	Sharing the collaborative learning outcomes as a whole class via SNS (S) Peer reviewing the other groups' learning outcomes using SNS (S) Providing the teacher's feedback (T)

* T : Teacher, S : Student

Research Methodology

Problem Solving Task

Social media were used for the project that was titled “Global Warming Prevention Project”. It consisted of four missions and the missions and assignments were released on Google Drive before the class started. The whole class consisted of three sections: preparation for searching for required materials to perform missions, class activities such as discussion, experiment, presentation, and post activities wrapping up the procedures of mission performance and content.

Participants

32 middle school students participated in the Global Warming Prevention Project. As science classes in middle school mainly focus on transferring knowledge to students rather than performing practical operations and explorations, students do not show much interest in this subject. In this project, both personal computers and smart devices were used to access the Internet and mobile environment. Most of the students had a computer and a mobile device that were connected to the Internet. Personal smart phones were used for students' individual activities and two smart devices were used for each group's collaborative activities.



Figure 2. Procedures of the Global Warming Prevention Project

Social Media and an e-Collaboration Tool

There is a social media that is originally developed for educational purposes in the area of public education, exemplified in Classting (<http://classting.com>) in Korea. In this study, Classting, along with Kakaoagit (<http://agit.kakao.com>) were used for learning activities. Google Drive (<drive.google.com>) was used for collaboration and making out a final report. The students used social media in their daily life, but no one had a prior experience of using Google Drive. Thus, the students learned how to use Google Drive at the beginning.

Data Collection and Data Analysis

To analyze the effect of the problem solving project using social media, 2 one-on-one interviews with a teacher and a written interview via e-mail were performed with 22 students (11 female and 11 male). Unstructured questionnaires were distributed for the interviews with a teacher, and the questionnaires consisted of items concerning the purpose of the project and its achievement level, the link between offline class and online class among IT technology, class activities, and online learning activities, and educational implications of the project on students' ability and their learning attitude, classroom atmosphere, and the teacher himself, etc. Aside from the interview with a teacher and students, the learning materials and students' final reports were collected. The collected data were analyzed under categories of changes from the class in which the transmitted knowledge is one way, improvement of scientific ability, and suggestions for future research.

Research Results

Changes: Sharing, Participation, and Collaboration

During the project period, social media and an e-collaboration tool allowed for prompt communication of the teacher-student and student-student type and offered the students a collaborative environment for sharing resources, discussing, and writing up a report without any limits in time or space. Especially, the students learned how to share their own materials in order to achieve the common goal.

The students tried not to share their own know-how and learning resources with other students in the past; however, their attitude has changed to the one of sharing what they had and they participated in the collaborative problem-solving process after using social media. (Teacher)

Most of the students felt responsible for their group and actively participated in the problem solving process and noted the positive effect of using social media and Google Drive as learning aids. In addition, the teacher prevented students from free loading by assigning their roles based on each one's ability, and encouraged the application of social tools in the learning environment.

Through performing the project based on teacher-student and student-student communication, the students could discover their peers' abilities and understand

each other better. By sharing not only learning resources but also their personal lives in the social media space, they became more interested in their classmates, and further in their class. As a result, shared interests, understanding, and responsibility for each other served as a stepping-stone for collaboration and unity towards achievement of the common goal.

Social media and Google Drive facilitated student-student interactions and student-teacher communications. The students could feel closeness and unity with the teacher through consistent communication. Trust that was built in and outside of the class via social media influenced the class atmosphere in a positive way.

Direct and instant communication with the teacher was really helpful as I was able to ask questions whenever I had ones. The formal relationship with the teacher formed space of the classroom developed closer and more connected one. I felt like I am working 'with' my teacher. (Student 1)

Improvements: Scientific Inquiry and Enhanced Problem Solving Skills

This project increased students' interests in science and scientific inquiry, as well as helped them to gain problem solving skills and acquire the knowledge related to the topic. Many students participating in the project used to think that science was boring. However, since they started to use SNS and Google Drive to explore their daily lives in a scientific manner, they were able to understand the importance of science and become more interested in the subject. In addition, the students acquired a broad spectrum of knowledge not limited to textbooks but from encyclopedias, academic journals, or dissertations, and they figured out various ways of solving problems.

I searched for the resources with my friends through various ways and shared them via SNS, and discussed which would be the most appropriate. Then we could make the final decision. This collaborative learning was more helpful for me to learn not only the knowledge in the textbook but also in a variety of ways (Student 17).

The students could enhance their capabilities of task commitment, problem solving, and creative inquisition through the process of applying scientific principles to find effective and useful solutions via social media and Google Drive.

I got the habit of delving into the problems through discussion with friends, and could reflect on how to solve them. We could draw a newer and more creative conclusion that is not typical or included in the textbook. (Student 29)

Limitations and Solutions: Obstacles, Negative effects, and Solutions

Even though the students learned how to use SNS and Google Drive in a pre-session, there were students who had difficulty, as they were not familiar with the entirely new applications. Moreover, a few students still admitted that they had felt uncomfortable when participating in the activities as there were limitations in accessing the Internet.

Most students pointed out fatigue as a negative effect resulting from the long-time usage of smart phones. Playing games or other irrelevant applications was another side effect. The students noted cyber-bullying, infringement of copyright, and abuse as negative effects, too. For solutions to avoid the negative effects, they suggested using smart phones only in class and with a limited allocated time, and emphasized the importance of pre-session and teacher discipline. Meanwhile, there was an opposition to the limit of time and usage of smart phones as it might offset the advantages of using the SNS and Google Drive such as participation, sharing, collaboration, and communication. The students who brought forth the counterargument suggested a prevention education program as the most appropriate and applicable solution to decrease the negative effects of using them without losing their positive effects. However, they also insisted that a prevention education program could not be the solution to all problems and emphasized that it was necessary for the students to control themselves in order to gain the advantages of learning with SNS and Google Drive. In contrast, the teacher had faith that the students could set up the environment for using social media in a proper way and foster healthy communication culture through the experience of learning activities with them. The teacher's belief was reflected in the students' comments.

Conclusion

This study explored a collaborative problem solving case using social media and an e-collaboration tool, and analyzed their educational implications in a qualitative research method. The result shows that a learning environment for problem solving with social media and an e-collaboration tool facilitated communication among students, enabled them to build unity as a group, to share opinions and ideas, and promoted active participation and collaboration. In addition, the communicative environment helped the students to build a collaborative community and enhance unity and cooperation to achieve their common goal, and contributed to problem solving experiences and to ultimately conceiving new and creative conclusions as

a group. Thus, it reveals that social media and an e-collaboration tool can facilitate learners' knowledge sharing activities based on the trust built among the learners (Hsu et al., 2007; Yu et al., 2010), and learners can acquire knowledge via social interaction (Chiu et al., 2006). Therefore, this study confirms that problem solving can be processed more effectively based on interactions. It also shows that social media and an e-collaboration tool are not just simple communication tools but also effective tools for creating common knowledge and they can be used to enhance scientific inquiries and problem solving skills.

The teacher attempted and supported a new way of teaching by applying SNS and an e-collaboration tool. This trial brought out a shift from lecture-based traditional teaching to communicative and participative learning, and facilitated the students' scientific inquiries and problem solving skills. In order to prevent the students' distraction, the teacher adopted the strategy of assigning roles to the students based on their capacity. The teacher built a sense of intimacy and trust in the students by communicating with them directly in and out of class through social media and an e-collaboration tool; the strategy worked well and resulted in creating an active and alive learning atmosphere.

However, there were several obstacles and negative effects. A few students had difficulty in learning with the use of new tools despite the pre-session. In addition, fatigue was pointed out as a negative effect of using the smart devices. Using applications irrelevant to learning, infringement of copyright, cyber-bullying, and emotional abuse were also noted as negative ones. These results were consistent with the research findings revealing that social media could be used for ditching or bullying classmates (Cantanzaro, 2011; Siegle, 2010). In order to decrease these negative effects and increase the merits of using SNS and an e-collaboration tool, it is necessary to introduce a prevention education program and to equip students with an ability to control them.

The study showed that social media and an e-collaboration tool could be used to shift the way of traditional education to a new one. It encourages students' scientific inquiries and enhances problem solving skills as well as sets up a healthy communication culture among teachers and students. More practical research into the ways of encouraging learners' scientific inquiries and enhancing problem solving skills with social media and e-collaboration and development of specific instruction-learning strategies should be conducted in the future.

References

- Alves, J., Marques, M.J., Saur, I., & Marques, P. (2007). Creativity and innovation through multidisciplinary and multisectoral cooperation. *Creativity and Innovation Management*, 16(1), 27–34.
- Bonk, C.J., Lee, S., Liu, X., & Su, B. (2007). Awareness design in online collaborative learning : a pedagogical perspective. In F.M. Neta & F.V. Brasileiro (Eds). *Advances in Computer-Supported Learning*. Information Science Publishing.
- Cantanzaro, M.F.(2011). Indirect aggression, bullying and female teen victimization: A literature review. *Pastoral Care in Education*, 29(2), 83–101.
- Chiu, C, M., Hsu, M.H. & Wagn, E.T.G.(2006). Understanding knowledge sharing in virtual communities: an integration of social capital and social cognitive theories. *Decision Support System*, 46(2), 1872–1888.
- Cole, D.G., Sugioka, H.L., & Yamagata, Lynch, L.C. (1999). Supportive classroom environments for creativity in higher education. *Journal of Creative Behavior*, 33(4), 277–293.
- Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning, *Internet and Higher Education*, 15(1), 3–8.
- Forte, A., & Bruckman, A. (2010). Citing, writing and participatory media: Wikis as learning environments in the high school classroom. *International Journal of Learning and Media*, 1(4), 23–44.
- Glassman, M., & Kang, M.J. (2011). The logic of wikis: The possibilities of the Web 2.0 classroom, *Computer-Supported Collaborative Learning*, 6(1), 93–112
- Grant, A.M., & Berry, J.W. (2011). The necessity of others is the mother of invention: Intrinsic and prosocial motivations, perspective taking, and creativity. *Academy of Management Journal*, 54(1), 73–96.
- Hsu, M.H., Ju, T.L., Yen, C.H. & Chang, C.M.(2007). Knowledge sharing behavior in virtual communities: The relationship between trust, self-efficacy, and outcome expectations, *International Journal of Human-Computer Studies*, 65(2), 153–169.
- Siegle, D.(2010). Cyberbullying and sexting: Technology abuses of 21st century. *Gifted Child Today*, 33(2), 14–16.
- Page, S.E. (2008). *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*. Princeton University Press.
- Palloff, R.M. & Prat, K. (2005). *Collaborating Online*. Jossey-Bass.
- Reeve, J. (2006). Teachers as facilitators: What autonomy – upportive teachers do and why their students benefit. *Elementary School Journal*, 106(3), 225–236.
- Resta, P., & Laferrière, T. (2007). Technology in support of collaborative learning. *Educational Psychology Review*, 19(1), 65–83.
- Roper, A.R. (2007). How students develop online learning skills. *Educause Quarterly*, 30(1), 62–65.
- Rychen, D.S.E., & Salganik, L.H.E. (2003). *Key competencies for a successful life and a well-functioning society*. Hogrefe & Huber Publishers.
- Tutty, J.I., & Klein, J.D. (2008). Computer-mediated instruction: A comparison of online

- and face-to-face collaboration. *Educational Technology Research and Development*, 56(2), 101–124.
- Wang, M.J. (2010). Online collaboration and offline interaction between students using asynchronous tools in blended learning. *Australasian Journal of Educational Technology*, 26(6), 830–846.
- Yu, T.K., Lu, L.C., & Liu, T.F.(2010). Exploring factors that influence knowledge sharing behavior via weblogs. *Computers in Human Behavior*, 26, 32–41.
- Zhu, C. (2012). Student Satisfaction, Performance, and Knowledge Construction in Online Collaborative Learning. *Journal of Educational Technology & Society*, 15(1), 127–136.