Learning Science in Social Networks: Chemical Interactions on Facebook

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Abstract

The purpose of this research is to examine whether and under what conditions the Facebook environment is suitable for learning chemistry. Facebook provides a platform for interaction; hence, it has potential for shared learning and allows students to collectively participate in learning discussions. We have examined what type of chemistry learning exists through Facebook groups, how is it performed, and we evaluated whether the interactions through the discourse facilitate meaningful learning. The research population includes chemistry teachers and their students, who are members of chemistry Facebook groups. In the paper we will show the different types of interactions that were observed within the chemistry Facebook groups and we will demonstrate learning episodes that were identified in the chemistry Facebook groups. The learning that had occurred throughout the episodes was characterized using Sfard’s theoretical framework regarding learning (commognition). The research results identify the conditions under which meaningful chemistry learning accrued in Facebook groups and provide recommendations for teachers' professional development.

Keywords: Social Networks, Facebook Groups, Chemistry Education, Discourse Analysis, Commognition

Literature review

Web 2.0 refers to the second generation of internet services. It includes websites and applications that provide a technological platform for users' content: creating and sharing uploaded content by the users themselves. Web 2.0 provides a high level of activity and promotes cooperation among its users. This contributes to creating new social connections, sharing human experiences, and creating new knowledge. Moreover, contents are rapidly distributed among the users (Greenhow, Robelia & Hughes, 2009; Dede, 2008; Selwyn, 2010; Lankshear & Knobel, 2007). As a social network, Facebook is part of Web 2.0 and allows different types of uses for teaching and learning. Facebook facilitates group interactions between students and teachers and between student peers. It also promotes active work as well as shared learning experiences and knowledge. The various uses of Facebook groups include comments published inside the group (e.g., post, like), uploading of files, links to videos and simulations, adding pictures, conducting surveys, sharing and exchanging knowledge, and allowing discussions and synchronized dialogues.

According to the constructivist approach, learning takes place when the student forms knowledge, and this process requires interaction with others (Vygotsky, 1978). Vygotsky believes that the interactions within a socio-cultural context reflect basic human needs. In his view, social interactions are the primary motive driving intellectual and cognitive development in humans. Sfard (2007) suggests combining the cognitive and communicational terms into a single commognitive term, which helps to clarify using the two terms. The commognitive approach is based on the assumption that thinking is a form of communication and that learning concerns change and expansion of current discourse. The commognition, in both the thinking and communication dimensions, is subject to certain rules that have historical roots. If learning is considered to be a change in discourse, then one can distinguish between two levels of learning. The first is concerned with the object and is expressed by the broadening of existing discourse by expansion of vocabulary, building new routines, and generating new and acceptable narratives. The second level of learning is meta-learning, which involves changes in the meta-discourse. Meta-learning is expected to appear as a result of a direct interaction between the student and the new discourse. Since this discourse is controlled by meta-rules that differ from the ones the student has been using thus far, this interaction is expected to generate a commognitive conflict – a situation in which the communication is hampered by the fact that different discourse components work according to different meta-rules (Sfard, 2007). Facebook, as a social network, allows the existence of these types of interactions between teachers and students and between the students themselves.

In this research we examine the use of the Facebook platform in educational settings. Previous studies have explored different aspects of integrating social networks into education. These studies focused on students' attitudes, achievements, and student-teacher relationships (O’Sullivan, Hunt, & Lippert, 2004; Mazer, Murphy, & Simonds, 2007; Mazer, Murphy, & Simonds, 2009; Junco, 2012; DiVall and Kirwin, 2012; Wang, Woo, Quek, Yang, & Liu, 2012; Hershkovitz & Forkosh-Baruch, 2013; O'bannon, Beard, & Britt, 2013; Prescott, Wilson, & Becket, 2013a; 2013b). Facebook provides a platform for interaction; hence, it has potential for shared learning and allows students to collectively participate in the discussions that take place within this medium. We therefore wish to stress that Facebook can be used as a platform to support meaningful learning and can build new understandings of academic concepts; we will examine this argumentation in the context of chemistry education.

Research objectives

Although students spend increasing time on online social networks, and teachers have been encouraged to utilize online social networks to promote learning, we know almost nothing about how such online interactions affect students’ learning, particularly in the exact sciences. Based on the above, the purpose of this research is to examine whether and how the Facebook environment can be used for learning chemistry by evaluating the learning that takes place in chemistry Facebook groups. We have examined what type of chemistry learning exists through Facebook groups, how is it performed, and we have evaluated whether the interactions through the discourse facilitate meaningful learning. More specifically, we have explored the following research questions:

(1) What types of interactions exist within chemistry Facebook groups?
(2) How can we describe the learning accrued in the chemistry Facebook groups?

Design

Population

The research population includes 12 chemistry teachers and their students (N=250), who are members of chemistry teaching Facebook groups. We focused on groups of students who learn chemistry in the tenth to twelve grades (age 16-17) and their teachers. The teachers participating in this program had different abilities to use Facebook for teaching and were personally tutored by the first author throughout the research regarding how to teach chemistry using Facebook.

Research tools and analysis

The research is based on content analysis of the Facebook discourse, more specifically, analysis of the interactions occurring in the chemistry teaching Facebook groups. The qualitative content analysis provides us with a description and characterizes the learning processes taking place in Facebook groups. To achieve inter-rater reliability, we negotiated the categories that described the different interactions and reached complete agreement on the appropriate categories and the association of episode utterances with specific categories.

The analysis of the interactions of the chemistry Facebook groups is based on the commognitive approach for learning, which was developed by Sfard (2008). According to the commognitive approach, learning is the result of a change in discourse, whether at the object level or the meta-level. It is expected to occur when a commognitive conflict is created. A commognitive conflict occurs whenever different discourse components are obliged to follow different meta-rules (Sfard, 2007). We first examined whether the interaction among Facebook interlocutors is fruitful (Sfard, 2001). We later identified the commognitive conflict and determined whether it is on an object- or meta-level. Finally, we examined whether learning took place, i.e. a change occurred in discourse inside the Facebook group (Sfard, 2007).

Results and discussion

Types of interactions

Different types of interactions were observed within the chemistry Facebook groups, as shown in Figure 1. In most of the interactions (39%) the chemistry Facebook group functioned as a Learning Management System (LMS). The term LMS usually refers to an environment that is supervised by an educator and allows him/her to upload contents to a website, organize these contents in an educational continuum, open discussion groups, and manage the information that is discussed, as well as delete inappropriate parts, and evaluate students (Meishar-Tal, Kurtz & Pieterse). In this research, we use the term LMS only to describe a management system for procedural announcements (e.g., canceling a certain lesson, sending homework assignments, and uploading test materials). Another type of prominent interactions was interactions that were social in nature (18%). The social interactions were not directly linked to chemistry; they are related to social aspects (e.g., encouragement, team building). Fifteen percent of all interactions were learning interactions that were initiated by both the teachers and the students. During the learning interactions, questions were raised concerning the subject matter, and group members (teachers and peer-students) responded to them. An example of a learning interaction is presented in Figure 2. Garrison, Anderson & Archer (2000) found that a virtual community of inquiry demonstrates three complementary components (social presence, teaching presence, and cognitive presence). The different types of interactions that we have identified can be correlated to these components, as will be presented in the lecture. Chiecher and Donolo (2013) examined the type of interactions that took place in a virtual learning environment of 28 virtual forums of students. They found that the most popular interactions were social interactions.

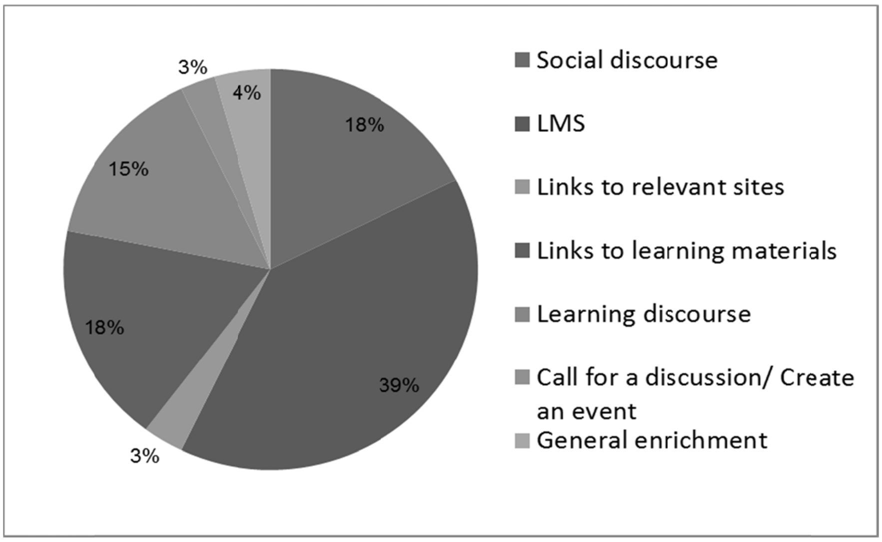

Figure 1. Different types of interactions within chemistry Facebook groups. Total number of posts, N=1,117

Discourse analysis of learning interactions

The episode (presented in Figure 2) deals with stoichiometry, which is taught in the 11th grade in the context of gas-state calculations. A question was asked by one of the students (Dana), who had encountered a problem while doing her homework. Four students participated in the discussion and tried to explicitly explain how they dealt with the question. During the discussion Dana found out that she misunderstood a basic concept in chemistry ("Why it is not HgO_2? It's always like that…the oxygen comes in pairs"). She noticed the commognitive conflict at the meta-level, namely, she noticed a meta-rule that she was not aware of. Dana knows that oxygen always comes in pairs (O_2) and she seems to struggle with understanding why Erez wrote down HgO instead of HgO_2. The discussion was interrupted by the full answer that was given by a student (Ella), who joined the discussion. She did not notice the emerging conflict and gave a full, proper answer to the original question, and ignored the presented problem. Dana thanked Erez and Ella for their comments and raised again the problem she was facing, only this time she stressed the conflict ("It's just new for me that that oxygen doesn't have to be in pairs. Here it's alone in the products…this is strange. "). She was encountering a new rule she was unaware of while solving the exercise. The perception that oxygen always comes in pairs, even while being part of a compound, is a misconception known in the literature (Ben-Zvi & Eylon, 1987). Erez recognized Dana's conflict and proposed a new approach to solve the question, which follows this new rule. He told Dana that the rule she is already familiar with is true as long as oxygen is not part of a compound, and that as part of a compound oxygen can appear as a single atom within the reactants. The discussion ended when the teacher joined the discussion. She did not address the conflict and only reaffirmed Ella's answer.

A meta-level commognitive conflict was found in the discourse – If oxygen always appears in pairs, how come this does not apply to compounds? Dana recognized the conflict she faced and Erez, who accompanied Dana throughout the whole process (as shown in Figure 3), was the one who was able to respond to her conflict and could suggest a solution. Figure 3 illustrates the discourse continuum during the group discussion.

We recognize two different overlapping learning discourses in this episode. In addition to the discourse between the students, which was analyzed above, we found another type of discourse in this episode. The nature of the additional dialogue is close to "the triadic dialogue" (Lemke,

1990) in which a question is asked, a student responds, and the teacher evaluates the student's answer. The shape of the triadic dialogue emerges in Figure 3. It can be seen that both the teacher and Ella did not address the conflict presented; rather, they presented only a solution to the original question. The teacher's responses ended the discussion. If she had noticed the conflict, she might have asked additional questions and verified that learning took place, namely, checking whether Dana really understood the problem and was able to assimilate this newly learned rule.

Dana: Decomposing 0.092 mole of mercury oxide to its elements. What volume of oxygen $O_2(g)$ is obtained from the decomposition in standard conditions (S.T.P.)? 1

a. 0.046 liter
b. 1.03 liter
c. 2.061 liter
d. 4.12 liter

Dana: This is how the question is written.

Erez: 20.61

Ben: Mercury is a transition metal; it really doesn't appear in the first column in the periodic table.

Erez: Oppps, my mistake...

Dana: LOL

Dana: Ben, this is really what I thought! But this is not the right answer.

Erez: What is the right answer?

Dana: Somehow it's b :/

Ben: I don't know....it looks strange. Are you sure that there is no mistake in the book?

Erez: 1.03

Erez: I've got it!

Erez: Balance the equation; you were told that you have O_2, so first write how you see the equation and then you will see that you have to balance it. After the balancing, do everything as usual and you'll get the answer ☺

Dana: I don't think that there is a mistake in the question...

Dana: Can you write the equation?

Erez: Sure, $2HgO \rightarrow 2Hg + O_2$

Dana: How did you understand that Hg is 2?

Erez: From what they say in the question the equation is: $HgO \rightarrow Hg + O_2$.

Erez: The charges don't matter; the equation in not balanced; balance it and then do the calculation.

Dana: Why it is not HgO_2? It's always like that...the oxygen comes in pairs.

Ella: Hi there, if you need help I solved this question ☺ Listen you need to write the equation (note that I write here the equation after I balanced it) $2HgO \rightarrow 2Hg + O_2$. The number of moles of the mercury oxide is 0.092, and the number of moles of the oxygen will be 0.046. Under standard conditions S.T.P. a molar volume is equal to 22.4 liter and if you calculate according to the formula the volume of the oxygen will be 1.03 liter, and this is answer b. ☺ I hope that I helped. 1

Dana: Ella and Erez thank you so much! It's just new for me that oxygen doesn't have to be in pairs. Here it's alone in the products...this is strange.

Erez: In compounds it can be, but when it's not in compounds it has to be O_2, my pleasure ☺

Ella: My pleasure.

Teacher: Ella wrote the right answer.

Figure 2. An example of a learning discourse in the chemistry Facebook group

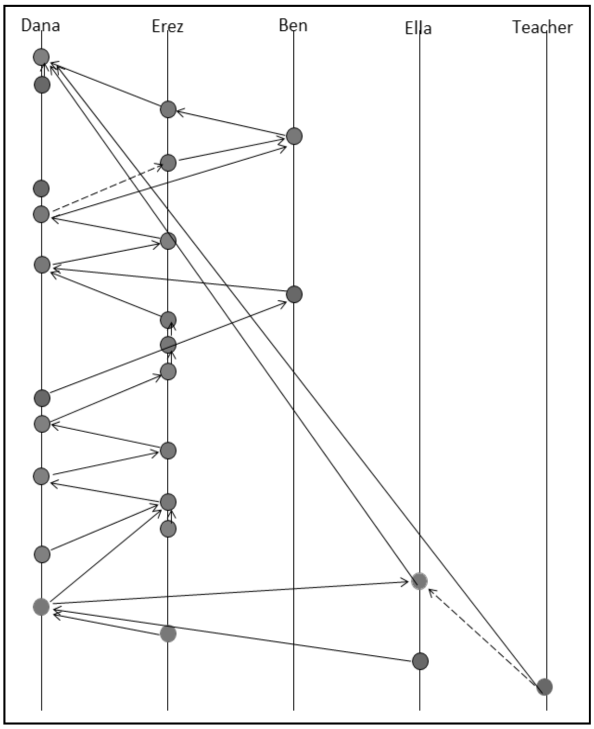

Figure 3. A graphic scheme describing the interactions in the discourse presented in Figure 2 (● represents a written post, a solid line connects the post to the person to whom it was directly addressed, and a dashed line represents an indirect response).

In the presentation I will demonstrate other learning episodes that were identified in the chemistry Facebook groups and I will characterize the learning that has occurred throughout these episodes using Sfard's (2007) theoretical framework.

Contribution

The current study opens a window to the potential of social networks as a learning platform. We have shown an example of a learning episode in a Facebook group in which students discuss problems in chemistry. The learning discussions provide opportunities to recognize conceptual misunderstandings, foster "deep and disciplinary understanding – an understanding of both the subject matter and the ways the disciplinary community works with knowledge in a domain" (Bielaczyc, 2013, p. 233). An overview of these research results will identify the conditions under which meaningful chemistry learning took place via Facebook groups and will provide recommendations for teachers' professional development.

References

Ben-Zvi, R., Eylon, B., & Silberstein, J. (1987). Students' visualization of a chemical reaction. *Education in Chemistry*, *24*, 117-120.

Bielaczyc, K., Kapur, M., & Collins, A. (2013). Cultivating a community of learners in K-12 classrooms. In C. E. Hmelo-Silver, A. M. O'Donnell, C. Chan & C. A. Chin (Eds.), *International handbook of collaborative learning*: Taylor & Francis.

Chiecher, A. C., & Donolo, D. S. (2013). Virtual dialogues and exchanges. The social and cognitive dimensions of interactions among students. *Universities and Knowledge Society Journal, 10*(2), 285-300. doi: http://dx.doi.org/10.7238/rusc.v10i2.1534

Dede, C. (2008). A seismic shift in epistemology. *Educause Review*, *3*(3), 80–81.

DiVall, M. V., & Kirwin, J. L. (2012). Using facebook to facilitate course-related discussion between students and faculty members. *American Journal of Pharmaceutical Education, 76(2)*, 1-5.

Garrison, R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: computer conferencing in higher education. *The Internet and Higher Education, 2*, 87-105.

Greenhow, C., Robelia, B., & Hughes, J.E, (2009). Learning, teaching, and scholarship in a digital age: Web 2.0 and classroom research: What path should we take now? *Educational Researcher*, *38*, 246-259. doi: 10.3102/0013189x09336671

Hershkovitz, A., & Forkosh–Baruch, A. (2013). Student–teacher relationship in the Facebook

era: the student perspective. *International Journal of Continuing Engineering Education and Life Long Learning*, *23*(1), 33-52. doi: 10.1504/IJCEELL.2013.051765

Junco, R. (2012). Too much face and not enough books: The relationship between multiple indices of Facebook use and academic performance. *Computers in Human Behavior, 28*, 187-198.

Lankshear, C., & Knobel, M. (2007). Researching new literacies: Web 2.0 practices and insider perspectives. E-Learning and Digital Media, 4, 224-240.

Mazer, J. P., Murphy, R. E., & Simonds, C. J. (2007). I'll see you on "Facebook": The effects of computer-mediated teacher self-disclosure on student motivation, affective learning, and classroom climate. *Communication Education*, *56*(1), 1-17. doi: 10.1080/03634520601009710

Mazer, J. P., Murphy, R. E., & Simonds, C. J. (2009). The effects of teacher self-disclosure via Facebook on teacher credibility. *Learning, Media and Technology*, *34*, 175-183. doi: 10.1080/17439880902923655

Meishar-Tal, H., Kurtz, G. & Pieterse, E. (2012). Facebook groups as LMS: A case study. *The International Review of Research in Open and Distance Learning*, *13*(4), 33-48. Retrieved from: http://www.irrodl.org/index.php/irrodl/article/view/1294/2295

Lemke, J.L. (1990). Talking science: Language, learning and values: *Norwood, NJ: Ablex*

O'Bannon, B. W., Beard, J. L., & Britt, V. G. (2013). Using a Facebook Group As an Educational tool: Effects on student achievement. *Computers in the Schools, 30*(3), 229-247. doi: 10.1080/07380569.2013.805972

O'Sullivan, P. B., Hunt, S. K., & Lippert, L. R. (2004). Mediated immediacy: A language of affiliation in a technological age. *Journal of Language and Social Psychology*, *23*, 464-490.

Prescott, J., Wilson, S. E., & Becket, G. (2013a). Students' attitudes towards Facebook and online professionalism: Subject discipline, age and gender differences. *Health and Social Care Education*, *2*(2), 3-10. doi: 10.11120/hsce.2013.00032

Prescott, J., Wilson, S. E., & Becket, G. (2013b). Facebook use in the learning environment: do students want this? *Learning, Media and Technology*. *38*(3), 345-350. doi: 10.1080/17439884.2013.788027

Selwyn, N. (2010). Web 2.0 and the school of the future, today. In Inspired by Technology, Driven by Pedagogy, OECD report.

Sfard, A. (2001). There is more discourse than meets the ears: Looking at thinking as communicating to learn more about mathematical learning. *Educational Studies in Mathematics*, *46*, 13-57.

Sfard, A. (2007). When the rules of discourse change, but nobody yells you: Making sense of mathematics learning from a commognitive standpoint. *Journal of the Learning Sciences, 16*, 565-613. doi: 10.1080/10508400701525253

Sfard, A. (2008). Thinking as Communicating: *Cambridge University Press*.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wang, Q., Woo, H. L., Quek, C. L., Yang, Y., & Liu, M. (2012). Using the Facebook group as a learning management system: An exploratory study. *British Journal of Educational Technology, 43*, 428-438.