JYX
JYVÄSKYLÄN YLIOPISTO
UNIVERSITY OF JYVÄSKYLÄ

This is a self-archived version of an original article. This version may differ from the original in pagination and typographic details.

Author(s): Isohätälä, Jaana; Näykki, Piia; Järvelä, Sanna; Baker, Michael J.; Lund, Kristine

Title: Social sensitivity : a manifesto for CSCL research

Year: 2021

Version: Accepted version (Final draft)

Copyright: © International Society of the Learning Sciences, Inc. 2021

Rights: In Copyright

Rights url: http://rightsstatements.org/page/InC/1.0/?language=en

Please cite the original version:

Isohätälä, J., Näykki, P., Järvelä, S., Baker, M. J., & Lund, K. (2021). Social sensitivity : a manifesto for CSCL research. International Journal of Computer-Supported Collaborative Learning, 16(2), 289-299. https://doi.org/10.1007/s11412-021-09344-8

Social sensitivity: a manifesto for CSCL research

Abstract

Technologies for computer-supported collaborative learning (CSCL) are playing an increasingly prominent role in educational contexts, especially as teachers and students strive to deal with pandemic-related constraints. However, the technologies being used for collaboration on a daily basis are not sufficiently equipped to promote collaborative learning as both a cognitive and a socio-emotional process. They may even run the risk of hindering the constructive exchange of ideas and provoking disputes and negative encounters. In this squib, we argue that the field of CSCL is failing to address this risk, because our research efforts are far too scattered and siloed. We introduce a manifesto of social sensitivity: increasing interdisciplinary efforts to enhance constructively critical, respectful, and cohesive collaborations in technology-supported environments. We call for concrete actions in CSCL research that ultimately contribute to more democratic and equitable collaborations.

Keywords: social sensitivity; collaborative learning; emerging technologies; educational technology

Introduction

Educational technology products, such as smart study tools, mobile and online learning environments, and learning analytics services, have become a several billion dollar business (Teräs et al., 2020). Though products using emerging technologies are more oriented toward supporting individual learning (Martin et al., 2020), tools including social media platforms, discussion forums, video conferencing, and learning analytics are also widely used for collaborative learning. Interest in these educational tools has grown over the years (Schleicher, 2018) and even more so since the beginning of the COVID-19 crisis, as much of education has had to rely on digital, rather than face-to-face learning environments (Beaunoyer et al., 2020). The situation has led to emergency remote teaching, which is not equal to pedagogically and theoretically grounded online learning (Hodges et al., 2020). Furthermore, the increased isolation caused by the COVID-19 pandemic has been seen to heighten rates of depression and loneliness, which could be reduced by digital technologies that support maintaining social networks, exchanging ideas, and feeling part of a group or a community (Loades et al., 2020). However, this ideal is still more of an aspiration than a reality.

We fear that the technologies used in educational practice on a daily basis are not sufficiently equipped to promote collaborative learning as both a cognitive and a socio-emotional process. We claim that tools and applications

are not yet bolstered by a theoretical understanding of collaborative learning, as many in-use applications and software packages have not been designed or applied with a theoretical grounding in the learning sciences (Dawson et al., 2019; Harley et al., 2017). Further, too little is known about the potential impact of emerging technologies, such as learning analytics, for collaborative learning (Han et al., 2021; Lämsä et al., 2021). While educational technology is nevertheless being marketed and procured at an increasingly rapid pace, *there is a serious risk that the use of technologies may hinder a constructive and equal exchange of ideas and provoke disputes and negative encounters*.

For example, studies indicate that technologies can induce extraneous cognitive load or limit people's agency in learning and interaction, thereby reducing the capacity for social interaction and learning processes (May & Elder, 2018; Pedro et al., 2018). Similarly, online learning environments may cause students to feel a lack of connection to others (Delahunty et al., 2014). Technologies can also lack or distort multimodal sensory information, such as eye contact or touch, which changes the way people communicate important social cues (Kreijns et al., 2013; Walther, 2012). Further, the collection of personal data, such as people's relations or emotions, and using it for making inferences through Artificial Intelligence raises many ethical concerns (McStay, 2020; Roeser, 2012). For example, learners may be embarrassed to see their faintly expressed emotions being categorized and made explicit for all to see. It is also known that individuals appropriate technological affordances in various ways (Overdijk et al., 2012; Tchounikine, 2016), making it complicated to predict whether specific technological affordances will be beneficial for learning and interaction or not. More worrysome is the idea that mass social technologies might create echo chambers that can reinforce existing views and even increase radicalization (Judele & Weinberger, 2017).

The combination of broad interest in technologies for CSCL, their increasing availability, and their technocentric development is problematic at the societal level. Rather than bringing people closer together, in cognitive and socio-emotional terms, computer-mediated interactions in educational situations can lead instead to a form of "co-alienation" (Schwarz et al., 2012) or being alone together. The technocentric development of technologies for collaborative learning contradicts the theoretical understanding of what constitutes productive collaborative learning. In their classic papers, Barron (2003) and Roschelle and Teasley (1995) have already shown that collaborative groups can reach deeper-level knowledge construction and better learning outcomes by engaging in constructively critical, respectful, and cohesive interactions. Decades of CSCL research shows that intersubjective meaning making is needed for a group to share and build upon each other's ideas with the goal of learning, but how well people learn together cannot be explained solely by how they process information. Explainability requires also taking into account how learners feel and relate to each other in CSCL environments (e.g., Cress et al., 2021; Kreijns et al., 2013; Nokes-Malach et al., 2015).

Given the richness of CSCL research, why is it that research evidence is not keeping up with educational technology practices? *We argue that CSCL research—with its many theoretically fragmented strands and silos—is currently failing to create and communicate a coherent picture of how constructive, respectful, and cohesive collaborations are helped or hindered by technologies.* As a result, our understanding of what constitutes productive CSCL is neither transferring to the development of technologies nor to the skills of teachers for promoting productive collaborative learning. Furthermore, CSCL research is far from complete: emerging digital and computational resources, such as Artificial Intelligence, learning analytics, and machine learning, are extending ways to scaffold people's learning and interaction (Järvelä et al., 2020; Spikol et al., 2018). More computational power and better algorithms make it possible to build models and capture patterns of learning and interaction that can potentially be used to provide real-time, adaptive support through mobile apps or computer dashboards (Chanel et al., 2016; Strauss & Rummel, 2020). Providing theory-based evidence of the impact of revolutionary technologies is urgent, but it, too, requires researchers in CSCL to integrate disciplinary approaches more than before (Rosé et al., 2019).

Recently, Uttamchandani et al. (2020) called upon CSCL researchers to focus on equity in CSCL practices as a way to promote educational change. *We argue that a crucial step in fostering equity is that CSCL researchers overcome their difficulties in creating common ground about how technologies can support the cognitive and socio-emotional processes of CSCL.* Thus, to continue Uttamchandani's et al. (2020) call for action, we bring forward a manifesto of *social sensitivity*: increasing interdisciplinary efforts to enhance constructively critical, respectful, and cohesive collaborations in technology-supported environments.

Interdisciplinary efforts for social sensitivity

CSCL is a multidisciplinary framework housing a multitude of approaches (Stahl, 2013), which—as pointed out by Wise and Schwarz (2017)—is both a richness and a challenge. As the corpus of CSCL research grows, it is becoming ever more challenging to communicate our research evidence to educational practitioners, technology developers, or learners themselves. *Currently, we feel that the CSCL community is too willing to simply accept the coexistence of parallel research paradigms and concepts, with too little debate about the conflicts or synergies between them*. As authors of this paper, we admit that we, too, work too often in our comfort zone: clinging onto theories and concepts that we are experts in, citing others mainly within familiar paradigms, and choosing the publication venues and conferences in which these paradigms are discussed. In doing so, the CSCL field is failing to practice what it preaches: we are not doing enough to constructively argue over divergent perspectives and co-elaborate a more coherent understanding of CSCL.

We feel that the field needs to create and communicate a common body of foundational knowledge regarding what constitutes collaborative learning as both a cognitive and socio-emotional process, and how technologies influence it—be the outcomes good or bad. To this end, we urge CSCL researchers to explore the concept of *social sensitivity in CSCL*. Drawing on the core concepts of CSCL (collaboration, co-construction, knowledge building and social interaction), *we broadly define social sensitivity as the individual and collective ability of people to collaborate constructively, respectfully, and cohesively*. We use social sensitivity as an overarching term to span the complexity of CSCL research and the range of empirical evidence that must be acknowledged when developing and applying technologies for productive collaborative learning.

We argue that social sensitivity is an apt term for describing the delicate, reciprocal, and at times conflictual socio-emotional processes of collaborative learning (Baker et al., 2013). By definition, according to Merriam-Webster's dictionary, the term "social" applies to phenomena that are marked by or occur in pleasant companionship; relating to human society, the interaction between the individual and the group; and tending to form cooperative and interdependent relationships with others. Definitions of "sensitivity", in turn, include awareness of the needs and emotions of others; the capacity to respond to stimulation; and being easily hurt. These definitions portray CSCL well because the core characteristics of collaborative learning are social cohesion and interdependency (Altebarmakian & Alterman, 2019). Further, collaborative learning inevitably involves sensitive encounters as group members resolve important socio-cognitive conflicts (Ogan et al., 2012). For example, ego and power struggles can intervene in adapting or not to the other's viewpoint (Molinari & Lund, 2012). However, groups must ensure that tensions or negative emotions and interactions do not brew into counterproductive socio-emotional conflicts (Näykki et al., 2014). Thus, collaborative learning indeed requires sensitivity.

The concept of *social sensitivity* has been used in research inspired by social psychology, where it refers to an individual's capability to understand verbal and nonverbal communications and the feelings and viewpoints of others as well as the skills to apply knowledge of the norms governing appropriate social behavior (Riggio, 1986). Social sensitivity is seen as a kind of social intelligence contributing to collaborative knowledge building (Scardamalia & Beteriter, 2020). Research suggests that social sensitivity—as defined as an individual capability—can correlate with collective intelligence in collaborative groups and successful team performance (Bender et al., 2012; Woolley et al., 2010), thus making it relevant to CSCL. However, we do not use social sensitivity as a psychometric concept that focuses purely on individual capabilities within the social setting. Rather, we introduce social sensitivity as an overarching term that not only focuses on how individuals are able to collaborate with others, but also on how constructively critical, respectful,

and cohesive collaborations are created within the interactive processes of collaborative learning (Baker et al., 2013; Borge & Mercier, 2019). Thus, social sensitivity is created both through individual capabilities and collective processes within social interaction.

Admittedly, our view of social sensitivity is broad, but we argue that a more overarching view of CSCL is necessary, because CSCL research has reached a point where it is difficult to see the forest for the trees. Research on collaborative learning has multiplied over the past 20 years. The influx of research has created a jungle of concepts that portray how productive CSCL is characterized by not only cognitive but also socio-emotional processes. Some concepts, stemming especially from psychological and socio-cognitively oriented theories, stress the role of individual capabilities or perceptions in shaping collaborative learning. Such concepts—amongst many more—include emotion and motivation (Meyer & Turner, 2002), self-efficacy (Bandura, 1982), perspective taking (Lindgren, 2012), empathy and compassion (Bloom, 2016), power (Richmond, & McCroskey, 1984), beliefs about group work (Karau & Elsaid, 2009), and interpersonal beliefs about the social setting, such as psychological safety (Edmondson, 1999). These factors suggest that there are individual differences in people's skills, perceptions, and situation-specific experiences, which all influence individuals' behavior with others in CSCL. Other concepts, drawing from more situative and socio-cultural theories of learning, further emphasize CSCL as an inherently interactive and emergent process (Enyedy & Stevens, 2014). Such concepts include positive socio-emotional interaction and social engagement (Sinha et al., 2015), socio-emotional aspects of group reasoning (Polo et al., 2016), collaborative argumentation (Andriessen & Baker, 2014), socially shared regulation of learning (Hadwin et al., 2018), sound social space (Kreijns et al., 2013), and exploratory talk (Mercer, 1996). These concepts have been used to characterize interactions that influence and foster productive collaborative learning.

In the jungle of concepts there are different terms that mean similar things, and similar ones that mean different things. For example, deliberative argumentation and collaborative argumentation both describe group reasoning that is emotionally charged but constructively critical in nature (Andriessen & Baker, 2014; Polo et al., 2016). This, in turn, comes close to exploratory talk (Mercer, 1996), which also characterizes how constructively critical talk enhances knowledge construction. In contrast, Hadwin et al. (2018) found major diversions in terms and definitions in contemporary research related to social aspects of regulation: for example, socially shared regulation has been considered as social regulation or interpersonal regulation. Similarly, socio-emotional interaction has been operationalized in various ways: some studies have focused on encouragements, compliments, or acts of politeness as positive socio-emotional interaction (Isohätälä et al., 2020), while some studies additionally include elements of cohesive participation as signs of positive socio-emotional interaction (Sinha et al., 2015). Similarities and conflicts between concepts are also debatable: it is often

argued that empathy helps people better understand others, but Bloom (2016) argues that trying to feel the pain of others can distort our reasoning, make us biased, tribal, and even cruel. Compassion for the other, in turn, could prevent this. Furthermore, definitions of concepts, such as identity, can hover between more individualistic, socio-cognitive interpretations or a more situative or socio-cultural interpretations (Öztok, 2016).

These are just some examples of the many conceptual complexities, which are difficult to disentangle by CSCL researchers, let alone by educational technology designers or teachers. However, understanding these different concepts and their relations is critical when using CSCL to support discussion, especially on challenging and emotionally charged topics (Slakmon & Schwarz, 2019). In sum, we do not seek to replace established concepts or theories with social sensitivity, nor do we introduce a new psychometric construct to be empirically tested. Social sensitivity describes the objective that we strive for as a research community: to focus on how to support people's constructively critical, respectful, and cohesive collaborations that allow them to learn together. We argue that this vision is necessary for researchers across theoretical and methodological strands to compare and consolidate their findings. Moreover, this vision is needed for communicating evidence more coherently to educational technology developers, and educational practitioners.

Manifesto of social sensitivity

The field of CSCL has acknowledged the need to cut across different theoretical and analytical lenses (Borge & Mercier, 2019; Damşa & Jornet, 2020) and to increase dialogue between researchers, practitioners, policymakers, and business (Luckin & Holmes, 2016). In the past, we have seen some efforts of dialogue between paradigms in CSCL, for example the productive multivocality in the analysis of group interactions project (Suthers et al., 2013) and workshops bringing together computer scientists and social scientists (Lehmann-Willenbrock et al., 2017). However, projects tend to be more *multi*disciplinary, involving different disciplines and paradigms, than *inter*disciplinary, synthesizing views from different disciplines or paradigms. Multidisciplinary projects tend to have the "special issue" dilemma: researchers with different points of view write separate articles or chapters parallel to one another, which reduces real dialogue and confrontation of ideas. In these cases, the commentary discussing the separate papers usually ends up being the most interesting, valuable and interdisciplinary piece. We argue that *scholars in different paradigms cannot simply do research in parallel, we need to do more research together. Thus, we call upon CSCL researchers to take concrete actions in the pursuit of a more coherent vision of social sensitivity in CSCL*:

1) Crossing theoretical silos: First, we encourage CSCL researchers to increase efforts in clarifying differences, overlaps and relations between concepts. In this work, social sensitivity functions as a useful umbrella under which divergent viewpoints can be debated upon. We recognize a need for researchers in different paradigms of CSCL to work together in writing review articles and creating new models that illustrate the dynamics of different concepts. We would like to see a digital platform for CSCL researchers to map out and co-elaborate their understanding of social sensitivity. Such a platform should also be open for educational designers, teachers, and students to share their experiences of best practices for fostering social sensitivity. Further, the field is missing an analysis of CSCL lexicon: researchers across theoretical silos need to come together to discuss the similarities and differences between concepts representing social sensitivity, and clarify how they all play a meaningful role for social sensitivity as a whole. This work would result in a digital bibliography of concepts representing social sensitivity. Such a bibliography is not only useful for CSCL researchers but also for stakeholders to become familiar with the complexity of factors playing a part in constructive, respectful, and cohesive collaborations.

2) Accelerating interdisciplinary, multimodal empirical research: Second, we urge CSCL researchers to form new interdisciplinary partnerships where the shared goal is to provide evidence about how emerging technologies influence social sensitivity in CSCL. We argue that social sensitivity is an inspiring term because it promotes discussion of how the cognitive and socio-emotional processes of collaborative learning can be captured with various sensing technologies, such as machine vision or wearable physiological sensors, and how such data can be interpreted and used in pedagogical practices and tools (Spikol et al., 2018). Moving toward multimodal research in CSCL has created new bridges across learning sciences and computer sciences (e.g., Järvelä et al., 2020), which should be further strengthened through joint research projects, pilot studies, and interdisciplinary analyses of joint—and preferably open—datasets. Researchers would benefit from sharing methodological progress through an open repository of methods to capture and interpret data of social sensitivity. Furthermore, private-public partnerships must increase with businesses developing and selling educational tools for collaborative learning. We seldom see acknowledgements of collaboration with businesses in CSCL research papers: are we too afraid of jeopardizing our reliability by "fraternizing" with businesses or do we simply struggle forming such collaborations (Jacobson et al., 2016)? Finally, we must keep in mind that a top priority has to be ethical and theoretical consideration of how data collection, analysis and feedback affects learners and interlocutors (McStay, 2020). Thus, we need a strong theoretical understanding as well as strong principles of the ethics of dialogue (Allwood et al., 2000) to filter data and make inferences.

3) Transferring evidence to practices and policies: Finally, we encourage CSCL researchers to use social sensitivity as a theme for interaction with educational technology developers, learning designers, teachers, and students. These stakeholders need a clear message from us as a research community. They need not know in detail the nuances between socio-cognitive and socio-cultural theories of learning, but they should be familiar with concepts such as socially shared regulation of learning or collaborative argumentation, and how such phenomena can be supported. If we are not able to deliver our key findings more coherently and concisely, we fear that many of our important stakeholders will turn to less evidence-based sources. To provide evidence-based input for practices and policies, we invite CSCL researchers to discuss their perspectives on social sensitivity in podcasts or blogs, webinars, stakeholder workshops, and practitioners-oriented publications, such in teachers' trade journals. Similarly, it is urgent for CSCL researchers to reach out to policymakers to discuss what kind of policies would support social sensitivity in everyday collaborative learning in schools. For example, how should the procurement process of educational technology involve an evaluation about how the available tools influence meaning-making, respect, and cohesion in students' collaborative learning? Furthermore, schools' risk and contingency plans could involve an analysis of how educational technologies influence social sensitivity in collaborative learning scenarios and, in turn, act as a way to prevent cyber-bullying.

In all, we claim that strengthening interdisciplinary collaboration will drive the field toward more coherent understanding of social sensitivity, that is, how constructively critical, respectful, and cohesive collaborative learning can be achieved with technology-supported environments. Subsequently, we are better equipped to communicate our understanding to a wider audience and make an impact in educational practices and policies. We cannot deviate from our venture for educational change (Uttamchandani et al., 2020). Nevertheless, we as researchers are not the drivers of change, but learners, practitioners, and educational technology developers are. We must ensure that we are not only communicating to these change-makers through a clutter of concepts, but we are also able to paint a bigger picture of CSCL, which encompasses the richness of CSCL research, but allows drawing connections and teasing apart differences between key concepts in CSCL.

Conclusions

Novel technologies are already changing the way people learn together, but do they yet foster peoples in engaging in constructively critical, respectful, and cohesive collaborations? The CSCL field is struggling to keep up with the increasing adoption and hype of emerging technologies in educational contexts. In this squib, we have brought forward a manifesto of *social sensitivity* to solidify CSCL research on how technologies help or hinder constructively

critical, respectful, and cohesive collaborations. While scholars representing divergent paradigms will certainly need their existing concepts and frameworks to understand CSCL, social sensitivity offers an interdisciplinary vision of CSCL. With this term, we hope to incite CSCL researchers to engage more collectively in co-elaborating their understanding of CSCL and communicating the benefits and risks of the use of technologies. We believe that CSCL research can bring about positive changes as emerging studies indicate that computer-based collaborative tools can promote emotional support, perspective-taking, and meaning making in collaborative groups (e.g., Avry et al., 2020; Slakmon & Schwarz, 2019). This growing evidence should be consolidated and coherently communicated both within and beyond academic discussions. The more quality dialogue there is, the better we can contribute to societally sustainable educational change that fosters equity and democracy (Uttamchandani et al., 2020; Wise & Schwarz, 2017).

Declarations

Funding

Not applicable.

Conflicts of interest

Not applicable.

Availability of data and material

Not applicable.

Code availability

Not applicable.

References

Allwood, J., Traum, D., & Jokinen, K. (2000). Cooperation, dialogue and ethics. *International Journal of Human-Computer Studies, 53*(6), 871–914.

Altebarmakian, M., & Alterman, R. (2019). Cohesion in online environments. *International Journal of Computer-Supported Collaborative Learning, 14*(4), 443–465. https://doi.org/10.1007/s11412-019-09309-y.

Andriessen, J., & Baker, M. J. (2014). Arguing to Learn. In K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (2nd ed., pp. 439–460). Cambridge: Cambridge University Press. https://doi.org/10.1017/cbo9780511816833.027

Avry S., Molinari, G., Bétrancourt, M., & Chanel, G. (2020). Sharing emotions contributes to regulating collaborative intentions in group problem-solving. *Frontiers in Psychology, 16*. https://doi.org/10.3389/fpsyg.2020.01160.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2): 122–147.

Barron, B. (2003). When smart groups fail. *Journal of the Learning Sciences, 12*(3), 307–359. https://doi.org/10.1207/S15327809JLS1203

Baker, M. J., Andriessen, J., & Järvelä, S. (2013). Introduction: visions of learning together. In M. J. Baker, J. Andriessen, & S. Järvelä (Eds.), *Affective Learning Together: Social and emotional dimensions of collaborative learning* (pp. 1–30). Abingdon: Routledge.

Beaunoyer, E., Dupéré, S., & Guitton, M. (2020). COVID-19 and digital inequalities: Reciprocal impacts and mitigation strategies. *Computers in Human Behavior, 111*. https://doi.org/10.1016/j.chb.2020.106424.

Bender, L., Walia, G., Kambhampaty, K., Nygard, K., & Nygard, T. (2012). Social sensitivity and classroom team projects: An empirical investigation. In *Proceedings of the 43rd ACM technical symposium on Computer Science Education* (pp. 403–408). New York, NY, USA: Association for Computing Machinery.

Bloom, P. (2016, December 2). The perils of empathy. *The Wall Street Journal.* Retrieved from https://www.wsj.com/articles/the-perils-of-empathy-1480689513.

Borge, M., & Mercier, E. (2019). Towards a micro-ecological approach to CSCL. *International Journal of Computer-Supported Collaborative Learning, 14*(2), 219–235. https://doi.org/10.1007/s11412-019-09301-6.

Chanel, G., Lalanne, D., Lavoué, E., Lund, K., Molinari, G., Ringeval, F., & Weinberger, A. (2016). Grand challenge problem 2: Adaptive awareness for social regulation of emotions in online collaborative learning environments. Eberle J., Lund K., Tchounikine P., Fischer F. (Eds.). *Grand Challenge Problems in Technology-Enhanced Learning II: MOOCs and Beyond* (pp. 13-16). Berlin: Springer.

Cress, U., Oshima, J., Rosé, C. & Wise, A. (Eds.) (2021). *International Handbook of Computer-Supported Collaborative Learning.* Springer. ISBN 978-3-030-65291-3

Dawson, S., Joksimovic, S., Poquet, O., & Siemens, G. (2019). Increasing the impact of learning analytics. In *Proceedings of the 9th International Conference on Learning Analytics & Knowledge (LAK19)* (pp. 446–455). New York, NY, USA: Association for Computing Machinery.

Damşa, C., & Jornet, A. (2020). The unit of analysis in learning research: Approaches for imagining a transformative agenda. *Learning, Culture and Social Interaction*. Online first. https://doi.org/10.1016/j.lcsi.2020.100407.

Delahunty, J., Verenikina, I., & Jones, P. (2014). Socio-emotional connections: identity, belonging and learning in online interactions. A literature review. *Technology, Pedagogy and Education, 23*(2), 243–265. https://doi.org/10.1080/1475939x.2013.813405.

Edmondson, A. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly, 44*(2), 350–352. https://doi.org/10.2307/2666999

Enyedy, N., & Stevens, R. (2014). Analyzing collaboration. In K. Sawyer (Ed.), *The Cambridge Handbook of the Learning Sciences* (2nd ed., pp. 191–212). New York, NY, USA: Cambridge University Press.

Hadwin, A. F., Järvelä, S., & Miller, M. (2018). Self-regulation, co-regulation and shared regulation in collaborative learning environments. In D. Schunk, & J. Greene (Eds.), *Handbook of Self-Regulation of Learning and Performance* (2nd ed., pp. 83–106). New York, NY: Routledge.

Han, A., Krieger, F., & Greiff, S. (2021). Collaboration analytics need more comprehensive models and methods: An opinion paper. *Journal of Learning Analytics, 8*(1), 13–29. https://doi.org/10.18608/jla.2021.7288.

Harley, J., Lajoie, S., Frasson, C., & Hall, N. (2017). Developing emotion-aware, advanced learning technologies: A taxonomy of approaches and features. *International Journal of Artificial Intelligence in Education, 27*(2), 268–297. https://doi.org/10.1007/s40593-016-0126-8.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020, March 27). The difference between emergency remote teaching and online learning. *EDUCAUSE Review*. Retrieved from https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning.

Isohätälä, J., Näykki, P., & Järvelä, S. (2020). Convergences of joint, positive interactions and regulation in collaborative learning. *Small Group Research, 51*(2), 229–264. https://doi.org/10.1177/1046496419867760.

Jacobson, M. J., Lund, K., Hoadley, C., Vatrapu, R., Kolodner, J. L., & Reimann, P. (2016). Beyond just getting our word out: Creating pipelines from learning sciences research to educational practices. In C-K. Looi, J. L. Polman, U. Cress, & P. Reimann (Eds.), *Transforming Learning, Empowering Learners: The International Conference of the Learning Sciences (ICLS) 2016, Volume 2* (pp. 1071-1073). Singapore: International Society of the Learning Sciences.

Järvelä, S., Gašević, D., Seppänen, T., Pechenizkyi, M., & Kirschner, P. A. (2020). Bridging learning sciences, machine learning, and affective computing for understanding cognition and affect in collaborative learning. *British Journal of Educational Technology*. Online first. https://doi.org/10.1111/bjet.12917.

Judele, R., & Weinberger, A. (2017). Adaptive signposts out of the echo chamber: Enhancing argumentation in social networks. *Civitas Educationis. Education, Culture, and Politics, 6*(1).

Karau, S. J., & Elsaid, A. M. M. K. (2009). Individual differences in beliefs about groups. *Group Dynamics: Theory, Research, and Practice, 13*, 1–13. https://doi.org/10.1037/a0013366.

Kreijns, K., Kirschner, P. A., & Vermeulen, M. (2013). Social aspects of CSCL environments: A research framework. *Educational Psychologist*, *48*(4), 229–242. https://doi.org/10.1080/00461520.2012.750225.

Lämsä, J., Uribe, P., Jiménez, A., Caballero, D., Hämäläinen, R., & Araya, R. (2021). Deep networks for collaboration analytics: Promoting automatic analysis of face-to-face interaction in the context of inquiry-based learning. *Journal of Learning Analytics, 8*(1), 113-125. https://doi.org/10.18608/jla.2021.7118.

Lehmann-Willenbrock, N., Hung, H., & Keyton, J. (2017). New frontiers in analyzing dynamic group interactions: Bridging social and computer science. *Small Group Research, 48*(5), 519–531. https://doi.org/10.1177/1046496417718941.

Lindgren, R. (2012). Generating a learning stance through perspective-taking in a virtual environment. *Computers in Human Behavior, 28*(4), 1130-1139.

Loades, M., Chatburn, E., Higson-Sweeney, N., Reynolds, S., Shafran, R., Bridgen, A,...Crawley, E. (2020). Rapid systematic review: The impact of social isolation and loneliness on the mental health of children and adolescents in the context of COVID-19. *Journal of the American Academy of Child & Adolescent Psychiatry*. Online first. https://doi.org/10.1016/j.jaac.2020.05.009.

Luckin, R., & Holmes, W. (2016). *Intelligence unleashed: An argument for AI in education*. London, UK: Pearson.

Martin, F., Dennen, V., Bonk, C. (2020). A synthesis of systematic review research on emerging learning environments and technologies. *Educational Technology Research and Development, 68*, 1613–1633. https://doi.org/10.1007/s11423-020-09812-2.

May, K., & Elder, A. (2018). Efficient, helpful, or distracting? A literature review of media multitasking in relation to academic performance. *International Journal of Educational Technology in Higher Education, 15*. https://doi.org/10.1186/s41239-018-0096-z.

Meyer, D.G. & Turner, J.C. (2002). Discovering emotion in classroom motivation research, *Educational Psychologist*, *37*(2), 107–114.

McStay, A. (2020). Emotional AI, and EdTech: Serving the public good? *Learning, Media and Technology, 45*(3), 270–283. https://doi.org/10.1080/17439884.2020.1686016.

Mercer, N. (1996). The quality of talk in children's collaborative activity in the classroom. *Learning and Instruction, 6*(4), 359–377. https://doi.org/10.1016/S0959-4752(96)00021-7

Molinari, G. & Lund, K. (2012). How a power game shapes expressing opinions in a chat and in an argument graph during a debate: A case study. In J. van Aalst, B.J. Reiser, C. Hmelo-Silver, K. Thompson (Eds.), *The Future of Learning: Proceedings of the 10th International Conference of the Learning Sciences (ICLS 2012)* (pp. 232-236). Sydney: International Society of the Learning Sciences.

Nokes-Malach, T.J., Richey, J.E., & Gadgil, S. (2015). When is it better to learn together? Insights from research on collaborative learning. *Educational Psychology Review 27*, 645–656. https://doi.org/10.1007/s10648-015-9312-8

Näykki, P., Järvelä, S., Kirschner, P. A., & Järvenoja, H. (2014). Socio-emotional conflict in collaborative learning – A process-oriented case study in a higher education context. *International Journal of Educational Research*, *68*, 1–14. https://doi.org/10.1016/j.ijer.2014.07.001.

Ogan A., Finkelstein S., Walker E., Carlson R., & Cassell J. (2012). Rudeness and rapport: Insults and learning gains in peer tutoring. In Cerri S.A., Clancey W.J., Papadourakis G., Panourgia K. (Eds.) *Intelligent Tutoring Systems*. ITS 2012. Lecture Notes in Computer Science, vol 7315. Berlin: Springer. https://doi.org/10.1007/978-3-642-30950-2_2

Öztok, M. (2016). Cultural ways of constructing knowledge: the role of identities in online group discussions. *International Journal of Computer-Supported Collaborative Learning 11*, 157–186. https://doi.org/10.1007/s11412-016-9233-7.

Overdijk, M., van Diggelen, W., Kirschner, P. A., & Baker, M.J. (2012). Connecting agents and artifacts in CSCL: Towards a rationale of mutual shaping. *International Journal of Computer Supported Collaborative Learning, 7*(2), 193–210.

Pedro, L., Barbosa, C., & Santos, C. (2018). A critical review of mobile learning integration in formal educational contexts. *International Journal of Educational Technology in Higher Education*, *15*. https://doi.org/10.1186/s41239-018-0091-4.

Polo, C., Lund, K., Plantin, C., & Niccolai, G. P. (2016). Group emotions: The social and cognitive functions of emotions in argumentation. *International Journal of Computer-Supported Collaborative Learning*, *11*, 123–156. https://doi.org/10.1007/s11412-016-9232-8.

Richmond, V. P. & McCroskey, J. C. (1984). Power in the classroom II: Power and learning. *Communication Education, 33*(2). 125-136.

Riggio, R. (1986). Assessment of basic social skills. *Journal of Personality and Social Psychology, 51*(3), 649–660.

Roeser, S. (2012). Emotional engineers: Toward morally responsible design. *Science and Engineering Ethics, 18*(1), 103–115. https://doi.org/10.1007/s11948-010-9236-0.

Roschelle, J., & Teasley, S. D. (1995). The construction of shared knowledge in collaborative problem solving. In C. O'Malley (Ed.), *Computer-Supported Collaborative Learning* (pp. 69–97). Springer. https://doi.org/10.1007/978-3-642-85098-1_5

Rosé, C. P., McLaughlin, E. A., Liu, R., & Koedinger, K. R. (2019). Explanatory learner models: Why machine learning (alone) is not the answer. *British Journal of Educational Technology, 50*(6), 2943–2958. https://doi.org/10.1111/bjet.12858.

Scardamalia, M. & Bereiter, C. (2020). Will knowledge building remain uniquely human? *QWERTY 15*(2), 12–26. https://doi.org/10.30557/QW000028.

Schleicher, A. (2018). *Teaching and Learning International Survey TALIS 2018. Insights and interpretations.* OECD report. Retrieved from: http://www.oecd.org/education/talis/TALIS2018_insights_and_interpretations.pdf.

Schwarz, B. B., Ben-David Kolikant, Y. & Mishenkina, M. (2012). 'Co-alienation' mediated by common representations in synchronous discussions. *Learning, Culture and Social Interaction, 1*, 216–231. https://doi.org/10.1016/j.lcsi.2012.09.002.

Sinha, S., Rogat, T. K., Adams-Wiggins, K. R., & Hmelo-Silver, C. E. (2015). Collaborative group engagement in a computer-supported inquiry learning environment. *International Journal of Computer-Supported Collaborative Learning, 10*(3), 273–307. https://doi.org/10.1007/s11412-015-9218-y

Slakmon, B., & Schwarz, B. (2019). Deliberative emotional talk. *International Journal of Computer-Supported Collaborative Learning, 14*(2), 185–217. https://doi.org/10.1007/s11412-019-09304-3.

Spikol, D., Ruffaldi, E., Dabisias, G. & Cukurova, M. (2018). Supervised machine learning in multimodal learning analytics for estimating success in project-based learning. *Journal of Computer Assisted Learning, 34*(4), 366-377. https://doi.org/10.1111/jcal.12263.

Stahl, G. (2013). Theories of cognition in collaborative learning. In C. E. Hmelo-Silver, C. A. Chinn, C. Chan, & A. M. O'Donnell (Eds.), *The International Handbook of Collaborative Learning* (pp. 74–90). New York, NY, USA: Routledge.

Strauss, S., & Rummel, N. (2020). Promoting interaction in online distance education: Designing, implementing and supporting collaborative learning. *Information and Learning Sciences*, 121(5), 251–260. https://doi.org/10.1108/ILS-04-2020-0090.

Suthers, D. D., Lund, K., Rosé, C. P., Teplovs, C., & Law, N. (2013). *Productive Multivocality in the Analysis of Group Interactions*. Boston, MA, USA: Springer. https://doi.org/doi.org/10.1007/978-1-4614-8960-3.

Tchounikine, P. (2016). Contribution to a theory of CSCL scripts: taking into account the appropriation of scripts by learners. *International Journal of Computer-Supported Collaborative Learning*, *11*, 349–369. https://doi.org/10.1007/s11412-016-9240-8.

Teräs, M., Suoranta, J., Teräs, H., & Curcher, M. (2020). Post-Covid-19 education and education technology 'solutionism': A seller's market. *Postdigital Science and Education*, 1–16. https://doi.org/10.1007/s42438-020-00164-x.

Uttamchandani, S., Bhimdiwala, A., & Hmelo-Silver, C. E. (2020). Finding a place for equity in CSCL: ambitious learning practices as a lever for sustained educational change. *International Journal of Computer-Supported Collaborative Learning*, 373–382. https://doi.org/10.1007/s11412-020-09325-3.

Walther, J. (2012). Interaction through technological lenses: Computer-mediated communication and language. *Journal of Language and Social Psychology, 31*(4), 397–414.

Wise, A. F., & Schwarz, B. B. (2017). Visions of CSCL: eight provocations for the future of the field. *International Journal of Computer-Supported Collaborative Learning*, *12*(4), 423–467. https://doi.org/10.1007/s11412-017-9267-5

Woolley, A., Chabris, C., Pentland, A., Hashmi, N., & Malone, T. (2010). Evidence for a collective intelligence factor in the performance of human groups. *Science, 330*(6004), 686–688. https://doi.org/10.1126/science.1193147.