Collaborative Agency That Drives Collaborative Problem-Solving and Learning

Yu Xia and Marcela Borge
yzx64@psu.edu, mbs15@psu.edu
The Pennsylvania State University

Abstract: Collaboration learning in small groups is a complex phenomenon that involves all cognitive, socio-emotional, metacognitive, socio-cultural, and historical aspects. It happens at both group and individual levels where collaborative learning is constructed by individual members with the use of mediational means but cannot be reduced by the summation of individual contributions. Collaboration agency is a property that also belongs to both individual members and the whole group, which can be empirically examined through the placemaking practice and mediational means. Through the analysis of a case episode, we presented the complexity of one group's collaborative problem-solving effort and evidenced the criticality of analyzing placemaking practice and mediational means. This analysis helps expand our view of agency in classroom beyond the dilemma resulted from a felt need to control, or the power relations, and further bears implications for learning design practitioners.

Keyword: collaborative agency, collaborative learning, placemaking, mediational means, design

Collaborative learning and collaborative agency

Small-group collaborative learning is a multifaceted phenomenon that involves all cognitive, socio-emotional, metacognitive, socio-cultural, and historical aspects. Collaborative learning happens when the small group collaboratively problem-solve and overcome the constraints they are facing through co-constructing heuristic solutions. During collaborative learning, learners are exposed to learning opportunities that they do not typically get when learning individually (Stahl, 2017). Collaborative agency is critical to collaborative problem-solving. This paper aims to conceptualize the concept of agency from sociocultural theories in small-group collaborations, which we call collaborative agency. Collaborative agency is viewed as the property of both individual members in the group and the group as one unit, by which they co-construct the collaborative process through place-making in spatial practices (Jornet & Roth, 2018; Slakmon & Schwarz, 2017) and mediational means (Wertch, Tulviste, & Hagstrom, 1993), which are not mutually exclusive since place-making involves the construction, appropriation, and reproduction of mediational tools, and mediational means take up spaces in meaningful ways.

Placemaking being a powerful spatial practice in small-group collaboration, much research has been focused on the community or city space (e.g., Taylor, Silvis, & Bell, 2018) with an increasing effort on smaller scales, such as classrooms (e.g., Clement, 2019; Sánchez, 2011). However, little examined the role of place-making to agency in small-group collaboration. Only Slakmon and Schwarz (2017) looked at agency through placemaking in small-group collaborative learning. To answer questions concerning spatial practices, spatial norms, and their influence on talk, Slakmon and Schwarz (2017) conducted two phases of analysis on groups' online text-based synchronous discussions, including discussions on spatial organizations, spatial actions, spatial practices and more. However, in face-to-face, small-group collaboration, placemaking looks different. It refers to how interactants and material tools take and make the space, i.e., the physical setup of the infrastructure in the learning contexts (e.g., how learners are seated), the participation structure of the interactants (e.g., how group members position themselves spatially when interacting), the spatial organization of resources, and all of these changing and emerging. That is, they are situated in socio-cultural-historical and form socio-techno-spatial relations (Bielaczyc, 2006).

Mediational means also take up spaces, but the emphasis is on its mediational function without which the human interactant would think and act differently and on how it is co-constructed and reproduced collectively in the sociotechnical system. Given the essential role that mediational means plays, Wertsch et al. (1993) argued for taking the unit of analysis in agency as "individual(s)-operating-with-mediational-means", and for understanding this human agency as "mediated agency" (p. 342). Individual mental processes are dialogic (Wertsch et al., 1993) and small group interactions are also dialogic at both interpsychological and intrapsychological planes (Vygotsky, 1934/1978), between human and material world. Language has been studied as a powerful mediational tool in fields such as second language acquisition (e.g., Swain & Watanabe, 2012), along with empirical studies on other tools such as computers (e.g., Gutiérrez, 2006). Through placemaking and mediational means and thus collaborative agency, groups of learners create the interactive process, change and

transform the socio-material conditions, are constrained and transformed by those conditions, and go through all these processes iteratively. Collaborative learning happens when groups create, transform and are transformed by the social and material situations.

Collaborative agency as conceptualized in this study differs from other constructs of agency. For example, collaborative agency as conceptualized by Kafai (2012) in the "unstructured, self-organized collaboration" (p. 65) refers to learner effort to "search out, organize and distribute responsibilities" (p. 67) while working with others on collaborative products. This conceptualization focuses on the learners' active activities in self-organized ways; in other words, learners make decisions to participate, have the motivation to contribute, and work collaboratively to construct knowledge. This type of conceptualization resembles the construct of productive agency as proposed by Schwartz (1999), but slightly differs in the way that collaborative agency as conceptualized by Kafai (2012) also emphasized the importance of sharing. Relational agency (Edwards and D'Arcy, 2004) is another construct of agency related to collaboration since it involves other resources by definition, as evident in the description of it being "the ability to seek out and use others as resources for action and equally to be able to respond to the need for support from others" (Edwards & D'Arcy, 2004, p. 149). Nevertheless, it fundamentally differs from our conceptualization of collaborative agency in that the capacity or agency it refers to belongs to individuals only without taking into consideration of the group at all. We address agency at both individual and group level, in which individuals work as part of the group.

While we believe human agency is critical to learning, it is often not easy for learners to be agentic in most learning settings. As pointed out by Rainio (2008), the need to manage classroom activity and learner agency are often in opposition to each other. Good student behavior is associated with compliance and this compliance can hinder learners' agentic participation (Martin, 2016). However, the need for control and order in classrooms to optimize learning and the need for students to be agentic are not at odds. In a learning environment without control and order, students will not necessarily be agentic, and similarly, a learning environment with order does not necessarily discourage learners to be agentic. The reality is way more complicated. Changes can be made to formal classrooms to support agentic participation, such as reciprocal teaching (Palincsar & Brown, 1984). Informal learning environments can be designed to support learner agency, but that does not mean that learners should do whatever they want in these spaces. Learning settings are multifaceted and contain multiple possible realizations. We could examine the physical layout, material conditions, socio-technical structures, participation organizations, tools and resources, etc., all of which could possibly encourage or discourage learners' agentic participation. Both classrooms in formal schooling and informal learning environments such as makerspaces and afterschool programs are all spaces where learning take place and where collaborative agency can be supported.

Research project and aim

In our afterschool club, learners are seen as co-designers of the club who make rules for themselves and have freedom to make their own design decisions. We have expectations for student behavior, i.e., be respectful, polite, and kind. Facilitators also promote desired behaviors through modeling of both design and collaboration processes (i.e., the ability to communicate ideas to a broad audience, creative problem-solving, give and receive feedback, empathize with others, regulate emotions and behavior, etc.). At the same time, we provide them with complex design challenges to work on where they need to think deeply to solve problems and devise design solutions that meet the user needs. In devising solutions to design problems, students are expected to develop design thinking skills, which include learning how to seek out, synthesize, and evaluate information; perspective taking; monitoring and regulating thinking and emotion; learning from failure; systems thinking; and communicating complex ideas to different audiences. Our aim is to develop collaborative competence, design knowledge and skills, and agentic participation in students by providing them with opportunities to develop higher order cognitive, metacognitive, and socio-emotional thinking skills. In this study, we took a microgenetic approach to answering the general research question: what does collaborative agency look like in small group of young learners solving a design problem in an afterschool club?

Population and context

The case was selected from a four-year long project for learners to participate in collaboratively designing solutions to design challenges. The club curriculum is informed by theories of Human Computer Interaction and design thinking. Learners typically iteratively go through the HCI design cycle of questioning, planning, creating, and investigating, using a variety of technologies, i.e. art supplies, Legos and video games such as Minecraft. For each regular session, the first and last 10-15 minutes were whole-class discussions that included introductions to design challenge projects, or reflections on previous activity, led by the facilitators. During the 45-55 minutes in between, groups of learners worked on their designs while facilitators observed and provided support when needed. There were 16 students from 4th to 6th grades in the club with a range of abilities, with gender and ethnicity

represented at different levels of expertise. Some of them have been participating in the club from the beginning, so they often come with more expertise. Others might be newcomers in this club, who might not be familiar with the design cycle, the club culture, or the technologies; they are more considered to be novices.

Data collection and analysis

We used six cameras and five tripods to collect video recordings for each session. Four cameras were used to focus on four groups, one with wider range on whole class activities, and one on taking photos. For each session, each camera captured around 75 minutes of learner activities, yielding 375 minutes of video recording in total. Building upon Jordan and Henderson's (1995) interaction analysis and work on multimodality (Jewitt, Bezemer, & O'Halloran, 2016), we conducted multimodal interaction analysis. We referred to the lesson plans as part of the ethnographic fieldwork to determine "hot spots", activities that are most interesting and relevant and where the video recordings "promises to be productive" (Jordan & Henderson, 1995, p. 43). Video recordings were then content logged and transcribed with screenshots to aid the analysis. Upon having the multimodal transcript for the 12-minute episode, we identified how the group encountered the problem of describing their design prototype to their client, how they initiated and developed the heuristic solution to that problem, and how they used the solution to successfully carry on the conversation.

Findings

To illustrate what collaborative agency looks like, we present an example case. This case takes place 16 sessions into the fall semester. In this semester, learners were presented with a big design challenge: to design an accessibility garden for a client with visual impairment. They started off sketching their ideas using paper and pencil design, then built their design as Lego model, and scaled up their designs in Minecraft. By the 16th session, they had completed their paper plan and Lego model, and were carrying out a usability test with their client. They were encouraged to revise their plans after user testing before scaling up their design in Minecraft. Because of school requirements for clearances, the client could not come to the club in person, but the students talked with the client through video conferencing using iPad to accomplish this user testing activity. We focused on one group of four students from a newcomer group (Group 3) that consisted of Ria, Gina, Teddy, and Juba (Pseudonyms are used throughout). Teddy had one semester in this club previously and the other three were all first semester in this club. The lead facilitator (F1) and second facilitator (F2) sat with every group when talking with the client (Jay). Similar to other groups, this group had approximately 15 minutes to have conversations with their client, ask and answer questions, and get feedback on their Lego design prototype. In this episode, students ran across a problem at the very beginning, when they had to describe their prototype to the client, who was visually impaired. They could not describe their design elements with the help of demonstrative words and pointing gestures. They had to devise a way of describing that would make sense to the client who could not see their model and to do so under time pressure.

"Tryin' like east west" episode

This episode started before the conversation with the client took place. Facilitators first came to the group, telling them that it was about time to have the conversation and reminding them about the fact that their client is visually impaired and thus it is better to avoid using words like *this* or *that*. Upon connecting with the client, F1 organized the overall activity. The students interrupted the facilitator because they were excited to ask questions to client, but F1 said "Before we – before we ask questions, somebody needs to explain to him the design. So, who's gonna do that?" Juba answered, "We made a design of your backyard", which was recognized as "Good start" by F1. Juba went on describing where things were located in their design (turn 12). However, the first attempt was not successful. Gina apparently noticed the description was not working, thus trying to stop Juba (turn 13). Juba checked to see if the client understood his description by asking, "do you know the way?" (turn 14). As Juba and Gina became agitated, F1 checked the client's understanding, asking "Jay, did you understand what he said?" (turn 20). The client answered, "I can't", and Gina also said, "He can't". This is when the whole group recognized they were experiencing a problem in describing their design to a person with visual impairment.

Excerpt 1: Identification of the problem

Turn	Speaker	Verbal transcript	Analytic note
12	Juba	*And we have a DOGE house over here.*	Juba continued his description, saying and pointing to places in their Lego model.

13	Gina	*//DON'T say (?)*	Gina was agitated by his description in fear of failing to communicate properly.
14	Juba	*//and a tree over here. And my question is, do you know the way? hhhh*	Juba anticipated the possibility of their client not being able to imagine the design. This is the start of identifying the problem.
15	Gina	*Stop asking memes.*	
16	Juba	*= No, I have to!*	Arguing over what to say to the client.
17	Gina	*= No you DON'T.*	
18	F1	*Ok, hold on, hold on, that was/*	F1 tried to organize the conversation and put a halt to the argument.
19	Client	*//So*	Client wanted to respond.
20	F1	*//Jay, did you understand what he said?*	At the same time, F1explicitly checked with the client for his understanding.
21	Client	*Yes, so, (?) it's uh – over there? But I CAN'T*	Client indicated that he could not understand.
22	Gina	*//He can't/*	Gina emphasized. Here was explicit identification of the problem that they needed to solve on spot.

After identifying the problem, another group member, Ria, continued the description by saying "We have a doghouse for your dog," while at the same time, Gina initiated a possible solution in the second excerpt (turn 25; Figure 1). She had an idea of indicating directions, saying "tryin' to like, east, west" while simultaneously using gestures to refer to their Lego model to show her idea. The Lego model played an important role in presenting the newly incubated idea, and in having the idea in the first place. The Lego model was a critical artifact that was put in the center of the interaction in plain view, easily accessible to all interactants. By incorporating the Lego model as an essential part of the processes, this artifact altered the mental functioning as well as the interactive flow of that moment (Vygotsky, 1934/1978; Wertsch, 1998; Wertsch et al., 1993). More than that, incorporating the model through gesturing as part of the heuristic solution also transformed the model itself, which attached new meaning to it, since afterwards, the model was altered into an object with the potential to have north, south, east, west. This new meaning played a critical role in communicating with the client. This initiated idea, as well as the development of it, reflected the concept of "heterogeneity" (Wertsch et al., 1993, p. 350).

Wertsch et al. (1993) conceptualize heterogeneity as multiple different mental models that could only be useful when solving corresponding tasks in cultural activity, but this example shows how at a micro level, multiple heterogeneous mental models could be developed for one specific task. From this microgenetic analytic perspective, it is clear that how the idea came to be was just one possibility. Taking the space around and above the Lego model as Gina vocalized her idea was also an important spatial move, which powerfully evidenced Gina's, as well as the group's, agency through this placemaking gesture. However, at this time point, the solution to their communication problem was only beginning to form.

Excerpt 2: Initiation and extension of the problem solution

Turn	Speaker	Verbal transcript	Analytical Notes
25	Gina	***// tryin' to like, east, west***	Proposing Strategy 1
26	Client	*= (?) but I don't understand/*	Replying to F1's question in turn 20, recognizing the problem
27	Gina	*// this way*	Continuing turn 25.
28	Client	*I don't know where it's exactly located.*	The client restated the problem.
30	Teddy	*//so from where you*	Attempting to develop Strategy 1
31	Ria	*//on the corner,*	Proposing Strategy 2
32	Juba	*//It is located near the door.*	Trying to explain the relative position using a reference point, i.e., the door.
33	Teddy	*//Shhh*	Teddy tried to stop Juba from taking the turn.
34	Juba	*//In the, in the left corner.*	Attempting to develop strategy 2

Figure 1. The moment of idea initiation.

Excerpt 3: The fully developed heuristic solution

Turn	Speaker	Verbal transcript	Analytic note
38	F1	*Ok, ok, ok, who said what, Juba, what did you say, where is it?*	After a few turns of off-topic talk, F1 chimed in to organize the conversation.
39	Juba	*It is located next to the door on the left top corner.*	Juba restated his expression combining what he said in turns 32 and 34.
40	F1	*Top corner*	F1 echoed.
41	Teddy	*//Here's what I was going to say.*	Teddy indicated his intention to take the turn.
42	F1	*= OK go*	F1 encouraged him to take the turn.
43	Teddy	*= It's located northwest from where you are looking at it.*	This line indicates the full development of the solution, building on the reference point and the four cardinal directions.
44	Client	*Oh, that's good. Thank you.*	The client recognized the effectiveness of the previous description.
48	Teddy	*= u:m/ the door and the tree is northeast/ from where you are looking at.*	The group members built on the solution and carried on explaining their design prototype.
49	Ria	*= uh:/ um/ the chairs and the table is in the middle (.) uh: (when your friends) come over, they can sit down/*	

The facilitators did not tell the group what to do. However, during this seemingly chaotic interaction, all the group members tried to develop for using the Lego model, each of which could have led to different interactional paths. None of strategies they used were taught or scripted. Thus, their attempts to develop the solution were manifestations of agency and as their taking up of this learning opportunity. From excerpt 2, after Gina said "tryin' to like, east, west" with hand movements, the rest three members immediately followed up almost at the same time. Teddy said, "so from where you", trying to pinpoint to a reference position where the design elements could be potentially explained in relation to the position. Ria explained the exact location, saying "on the corner", but this was not helpful in allowing their client to understand the relative positions of design elements. Juba also spoke up and attempted to be clearer by saying "in the left corner". At this time, the solution was not fully developed but progress was made, since combining the reference position (turn 30) and concept of left and right (turn 34) would have worked.

The group continued their effort after F1 helped to resume their conversation after a few seconds of off-topic talk (turn 38). Juba took the turn and restated his idea, combining what he said in turns 32 and 34 in a full sentence, getting closer to the full developed solution but still not there yet. F1 echoed but did not provide any input or direct instruction. Teddy wanted to take the next turn (turn 41) and presented the solution in its full at turn 43, which was effective. After this, the group carried on the description of their design plan, using the reference point and the cardinal directions (turns 48 and 49). Turns 12 to 49 illustrated how individual contributions were introduced and built upon in combination with shared spaces and artifacts to help the group form a shared solution that could not be reduced to any individual.

Whole class reflection

Toward the end of the session after four groups all had the usability tests with the client on their design, facilitators invited reflections on how each group approached the same problem. Besides Group 3's episode presented above, Group 1 also devised their own solution to the problem of describing their design to a visually impaired client.

They decided to use locations on a clock as an analogy, starting with "12 is the entrance" and then placing their design elements into corresponding positions on the clock. Another difference resided in the technologies they incorporated. In addition to the Lego model, Group 1 also had a digital version of their design on computer with more detail, which they referred to when describing their design to the client. In the case of Group 1, both Lego model and the digital design, along with other tools, played essential roles in co-constructing the interaction. After facilitators briefly summarized different approaches invented by each group in tackling the problem of describing their prototypes, they invited the group members to talk about what happened, how they developed the idea, and how this experience could be beneficial in the future. Through the whole class reflection, their experiences were highlighted and consolidated into objects-to-think-with (Borge, Toprani, Yan, & Xia, 2020; Papert, 1980), which were owned by the groups of learners and could be used in the future.

Discussion

With an increasing demand for people with good collaborative skills which are often underdeveloped in learners (Kozlowski & Ilgen, 2006), we aim to develop various types of collaborative skills in an after-school design program for children from 4th to 6th grades. We recognize that collaborative design activities for small groups of children involve a high level of complexities on cognitive, socio-emotional, metacognitive, socio-metacognitive domains and at multiple levels of individual, group, and the club community (Borge & White, 2016; Stahl, 2013). To successfully solve problems collaboratively for groups of children during those activities, collaborative agency plays critical roles in those domains and levels. Collaborative agency is the property of individual members and groups to co-construct their collaborative problem-solving processes through placemaking and mediational tools. The placemaking practice and the use and reproduction of mediational tools lend themselves to empirical analyses on the video recordings we collected on group activities.

In this study, we focused on a usability test episode when groups of learners had already completed their paper sketch design and Lego prototype model, which was right before scaling up in a virtual world. In this usability test, learners ran into an emerging problem of effectively communicating their design to a visually impaired client. Analyzing the placemaking practice (e.g., the position of the Lego model, learners took the space on and above the Lego model, one member was holding the iPad) and mediating roles those critical tools play in co-constructing the solution, allows us to empirically study the agentic participation of the whole group, where the group process (i.e., initiating, developing, and using the solution) and product (i.e., solution) were constructed by the group members with the mediational means, but could not be reduced to the summation of individual contributions. In this shared knowledge construction and regulation, the group not only could devise creative ways of solving emergent problems and overcoming constraints inherent in the contextual conditions and tools, but also had shared responsibility. We believe a close examination into the complexities helps us better understand the nature of collaborative learning, and thus shed light on designing learning environments that are conducive to collaboration and the development of collaborative competence over time.

Furthermore, examining collaborative agency and allowing it to contribute to collaborative learning could potentially solve the dilemma in control and freedom for learners (Rainio, 2008). When agency has been studied in relation to power in classrooms, it recognizes that teachers are the authority that have more power and agency is encouraged when teachers give up some authority over knowledge, such as in reciprocal teaching (Palincsar & Brown, 1984). However, this line of thinking also tend to point us to the very dilemma of control and freedom. We argue for expanding our view of agency beyond the power relations among interactants and further include the placemaking practice and mediational means. Let us not forget that social language in reciprocal teaching was also one mediational means (Wertsch, 1993).

Examining how tools and artifacts have agency, how learners with artifacts form spatial practices, and how the tools and practices change over time shed light on how to break the dilemma of having control and giving freedom. This bears profound implications for practitioners, learning designers, or learning engineers. Taking placemaking and mediational tools as critical parts could make a big difference in design learning environments or learning activities. Without falling prey to existing socio-cultural conditions that constrain human agency in particular ways, learning designers can start with engineering the physical, social, technical infrastructures that are conducive to agentic engagement, and work on the continuing activities to respond to the changing and emerging artifacts and practice. We have already seen its importance in our club. Although we are constrained by the physical layout in the classroom where we have our club sessions, we are mindful to powerful effects that physical, social, technical infrastructures have and how critical it is to build future sessions on the ongoing, emerging practice. In our club, facilitators make sure the artifacts are available and accessible even when they are not actively using them, since we do not know when they might decide to use the artifacts (e.g., their paper plans which usually have the most details) and this potential decision could change the collaborative process. Not only that, facilitators constantly observe group activities and bring critical experiences up in the whole class reflection,

as we did in reliving and consolidating the experience of devising ways to describe designs to a visually impaired client. Learners are agentic in constructing their own collaborative experience and facilitators help to concretize critical learning experiences as objects-to-think-with (Borge et al., 2020; Papert, 1980).

In the learning experience we presented, learners with artifacts and tools were agentic in initiating, developing, and using their own solution to a problem they encountered. The group and the material means are both part of sociotechnical system. Agency is an attribute both combined (Wertsch et al., 1993). It is at both individual and group levels, because individual members contributed to the development of the heuristic solution and at the same time, while facilitators referred to this solution, we can only refer to it as a product of group effort. For future studies, we could examine the development of critical artifacts, i.e., paper plans, Lego models, designed gardens in virtual worlds, in various design activities to see the trade-offs of technological tools in different uses. Informed by Wertsch (1993), we could also conduct further research on one specific mediational tool, i.e., the social language, and its role in supporting collaborative agency and collaborative learning in group design activities for children.

Conclusion

The demand for collaborative competence in adults has brought the issue of enhancing collaborative agency to the forefront. We believe collaborative agency, the attribute of individual members and the whole group that allows them to co-construct the collaborative processes, plays a critical role in collaborative learning and in group functioning as part of the situated social-cultural-historical systems. In co-constructing the collaborative processes, groups of children get to develop heuristic solutions to problems and have opportunities to develop their identity as collaborator. The current study allows us a glance at the complexities in small group collaboration in technology-rich learning environments. Future systematic examinations on how groups of learners approached the challenges and conflicts in collaboratively working on design activities from the lens of placemaking and mediational means could help with the development of concrete curriculum to enhance collaborative agency and collaborator identity.

References

Borge, M., Toprani, D., Yan, S., & Xia, Y. (2020). Embedded design: engaging students as active participants in the learning of human-centered design practices. *Computer Science Education, 30*(1), 47-71.

Borge, M., & White, B. (2016). Toward the development of socio-metacognitive expertise: An approach to developing collaborative competence. *Cognition and Instruction*, *34*(4), 323-360.

Bielaczyc, K. (2006). Designing social infrastructure: Critical issues in creating learning environments with technology. *The Journal of the Learning Sciences*, *15*(3), 301-329.

Clement, J. (2019). Spatially democratic pedagogy: Children's design and co-creation of classroom space. *International Journal of Early Childhood*, *51*(3), 373-387.

Edwards, A., & D'arcy, C. (2004). Relational agency and disposition in sociocultural accounts of learning to teach. *Educational review*, *56*(2), 147-155.

Gutiérrez, G. A. G. (2006). Sociocultural theory and its application to CALL: A study of the computer and its relevance as a mediational tool in the process of collaborative activity. *ReCALL*, *18*(2), 230-251.

Jewitt, C., Bezemer, J., & O'Halloran, K. (2016). *Introducing multimodality*. Routledge.

Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Sciences*, *4*(1), 39-103.

Jornet, A., & Roth, W. M. (2018). Imagining design: Transitive and intransitive dimensions. *Design Studies, 56*, 28-53.

Kafai, Y. B., Fields, D. A., Roque, R., Burke, W. Q., & Monroy-Hernandez, A. (2012). Collaborative agency in youth online and offline creative production in Scratch. *Research and Practice in Technology Enhanced, 7*(2), 63-87.

Kozlowski, S., & Ilgen, D. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest, 7*(3), 77–124.

Martin, J. (2016). The grammar of agency: Studying possibilities for student agency in science classroom discourse. *Learning, Culture and Social Interaction*, *10*, 40-49.

Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1*(2), 117-75.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. Basic Books, Inc.

Rainio, A. P. (2008). From resistance to involvement: Examining agency and control in a playworld activity. *Mind, Culture, and Activity*, *15*(2), 115-140.

Sánchez, L. (2011). Building on young children's cultural histories through placemaking in the classroom. *Contemporary Issues in Early Childhood*, *12*(4), 332-342.
Schwartz, D. L. (1999). The productive agency that drives collaborative learning. *Collaborative learning: Cognitive and computational approaches*, 197-218.
Slakmon, B., & Schwarz, B. B. (2017). "Wherever You Go, You Will Be a Polis": Spatial Practices and Political Education in Computer-Supported Collaborative Learning Discussions. *Journal of the Learning Sciences*, *26*(2), 184-225.
Stahl, G. (2013). Learning across levels. *International Journal of Computer-Supported Collaborative Learning,* 8(1), 1-12.
Stahl, G. (2017). Group practices: A new way of viewing CSCL. *International Journal of Computer-Supported Collaborative Learning, 12*(1), 113-126.
Swain, M., & Watanabe, Y. (2012). Languaging: Collaborative dialogue as a source of second language learning. *The encyclopedia of applied linguistics*.
Taylor, K. H., Silvis, D., & Bell, A. (2018). Dis-placing place-making: how African-American and immigrant youth realize their rights to the city. *Learning, Media and Technology*, *43*(4), 451-468.
Vygotsky, L. (1930/1978). *Mind in society*. Cambridge, MA: Harvard University Press.
Wertsch, J. V., Tulviste, P., & Hagstrom, F. (1993). A sociocultural approach to agency. *Contexts for learning: Sociocultural dynamics in children's development*, *23*, 336-356.