

Turn-usurping in dialogic collaborative problem solving

Liru Hu, The University of Hong Kong, liru.hu.hku@gmail.com

Abstract: Dialogic collaborative problem solving (D-CPS) emphasizes the equal rights of group members. Turn-usurping is one approach of turn-taking where a student usurps the floor which has been offered to another person by the last speaker. It reflects speaker's strong agency in seeking for participation opportunities and hasn't been fully explored in literature. The present explorative study adopted a mixed-method approach to examine major features and functions of turn-usurping in D-CPS. Participants were 168 primary school students who were assigned into 42 four-person groups to solve three open-process mathematical problems. Results showed that turn usurpers tended to have low intellectual status, low confidence in mathematics and high social anxiety. Turn-usurping had positive impact on maintaining participation equity and moving forward and complexifying group discussions. The findings suggested that it is practically meaningful to promote an equitable interaction environment where each member is encouraged to freely jump in.

Introduction

Following the epistemological assumptions of Bakhtin's dialogism (1929/1984), the present study defines dialogic collaborative problem solving (D-CPS) as a complex dynamic process whereby two or more consciousnesses, with equal rights and each with its own world, combine but are not merged in the unity of solving a shared problem. Students' verbal engagement is an essential end in D-CPS. Joint solutions emerge from and only exist in the dialogue whereby group members open themselves to each other's voices and augment their own.

Students verbally engage in D-CPS through taking the conversational floor, an evolving, socially negotiated space where individuals are allowed to make contributions (Engle, Langer-Osuna & McKinney de Royston, 2014). Turn-taking describes the process whereby the conversational floor transmits among speakers. It affects the amount of opportunities that different individuals have for influencing group discussions through verbal and accompanied non-verbal contributions (e.g., Lemke, 1990). Thus, examining turn-taking structure is essential for understanding the interanimation of various voices in a group.

Gibson (2005) proposed the participation-shift (P-shift) framework to describe "the way in which people move themselves and one another onto and off the floor" (p.1,566). This framework differentiates between the various speakers, targets and third parties in human interactions, and it further identifies four categories of participation shifts (see Table 1). Turn-receiving happens when a target takes the floor offered by a speaker. Turn-claiming happens when a speaker addresses the whole group, and a third party responds to this open invitation. Turn-usurping happens when a third party usurps the floor assigned to the target by the speaker. Turn-continuing occurs when a speaker continues to occupy the floor while talking to various other individuals. These participation shifts cover all possible micro turn-taking motifs, and they can thus describe how dynamic turn shuffling gives rise to participation equity and inequity in the process.

Regarding the degrees of freedom people have to participate, both turn-receiving and turn-continuing tend to reduce the diversity of participation by limiting identity shuffling. Both turn-claiming and turn-usurping, however, strengthen the diversity of the participation structure, and thus they tend to increase the complexity of turn-taking patterns. Individuals who prefer different types of turn-taking may have different individual characteristics. Little research has been done on this issue. Tsvetkova, García-Gavilanes and Yasseri (2016) did one similar study on how individual characteristics affect their reverting behavior patterns on Wikipedia. The authors identified six two-event temporal motifs to describe various behavioural patterns among the reverters and the reverted users. These researchers found that the reciprocal motif (A reverts B, and B reverts A back, AB-BA) usually happened between participants of equal status. Senior Wikipedia editors tended to perform continuous reverts (A reverts B, and A reverts C, AB-AC), and were likely to be reverted by either low-status editors or by others of equal status (A reverts B, and C reverts A, AB-CA).

Table 1 Participation shifts as defined by Gibson (2005).

Participation shift	Formula ^a	Illustration	Description
Turn-receiving	AB-BX		A talks to B, then B talks to X (X could be A or the group).
Turn-claiming	A0-BX		A talks to the group, then B talks to X (X could be A or the group).
Turn-usurping	AB-XY		A talks to B, then to X (X is not B or A) talks to Y (Y could be A, B or the group).
Turn-continuing	AB-AX		A talks to X (X could be the group), then A continues to talk to Y (Y could be the group).

a. The formula denotes the following: (speaker) (target) – (third party) (target of third party). The group is denoted as 0. X and Y represent people other than the neighbouring speaker and target.

The present explorative study tries to shed light on turn-taking approaches by first focusing on turn-usurping. Turn-usurping involves stronger agency than turn-claiming due to the usurper's self-nomination as well as the overlook of last speaker's nomination. It is an approach that an individual actively create participation opportunity rather than passively take a given one. Therefore, it represents a seemingly disruptive turn shuffling approach in D-CPS. However, to the best of my knowledge, this turn-taking approach hasn't been sufficiently explored in existing literature. I did not find relevant studies in addressing how turn-usurping might affect the process of group discussion and whether individuals who prefer usurping turns might have some specific characteristics. Therefore, the present study particularly aims to explore:

1. How does turn-usurping affect the social structure of D-CPS?
2. Who is likely to usurp a turn in D-CPS?
3. What are the intentions for students to usurp a turn?
4. How does turn-usurping shape the flow of group discussion?

Method

Participants and procedures

This study was conducted in a primary school in a city of mainland China. Participants were 168 fourth graders from five classes (41% females, 59% males, aged from 8 to 12). The teachers helped organize the students into groups of four, making gender and prior mathematics grades as balanced as possible. To ease the effect of task structure on individual participation modes, the present study designed three structured, open-process mathematical problems with various difficulties levels. Each group was given 30 minutes to collaboratively solve these three problems in a normal classroom setting. During the test, teachers or the researcher did not moderate group discussions except for clarifying task instructions or maintaining classroom discipline.

After the test, students independently completed a questionnaire concerning their demographic information, mathematics learning enjoyment, mathematics self-concept, and social anxiety. Both measurements on self-concept and learning enjoyment were measured through four-point Likert scales adapted from the TIMSS 2015 questionnaire for fourth graders in Taiwan (Mullis & Martin, 2013) (1 = *strongly agree*, 2 = *somewhat agree*, 3 = *somewhat disagree* and 4 = *strongly disagree*). Social anxiety was measured using the 10-item Chinese version of the Social Anxiety Scale for Children–Revised (La Greca & Stone, 1993). The students were asked to indicate the frequency of specific behaviors on a three-point Likert scale (1 = *always do this*, 2 = *sometimes do this*, 3 = *never do this*). The measures had a relatively high internal reliability, as indicated by Cronbach's alpha values for social anxiety ($\alpha = .835$), mathematics enjoyment ($\alpha = .734$) and mathematics self-concept ($\alpha = .882$) (Tavakol & Dennick, 2011).

Data analysis

Written solutions submitted by the groups were graded according to a standard scoring criteria which considered the correctness of the final solution first and then awarded partial credit for solution steps informed by group discussion audios if the final answer was wrong.

Group discussion audios were transcribed turn by turn. If a speaker paused and then continue to speak, her utterances were viewed as happening in one turn. Therefore, turn-continuing is not considered in the present study. All transcripts of group discussions were coded according to the participation shift framework by two trained coders. The decision tree for identifying the target interlocutor was as follows:

Does the speaker explicitly name the target interlocutor?

Yes, code it as the named interlocutor.

No. Does the speaker use *you* in the utterance?

Yes, code it as the last speaker.

No. Does the speaker use *we* in the utterance?

Yes. Is there any clue indicating *we* not representing the whole group?

Yes, code it as the inferred target.

No, code it as Group.

No. Does the utterances belong to a flow of discussion with one specific interlocutor?

Yes, code it as the specific interlocutor.

No, code it as Group.

Participation shift type was automatically generated through Excel after target interlocutors were determined (see Table 2). Two coders separately coded three groups randomly selected from participants and achieved an acceptable level of inter-rater agreement ($Kappa = 0.692$; Landis & Koch, 1977). All disagreements over coding were resolved through negotiation. One coder then finished the coding of all the left groups.

Table 2: Sample data coding

Turn	Speaker	Target	Content	Participation shift type
42	Gan	Group	8 divided by 2 equals 4.	
43	Gu	Gan	Why? Their prices may not be the same.	Claim
44	Gan	Gu	8 divided by 2 equals 4. Listen to me (5.0), 8 yuan ...	Receive
45	Xun	Gan	Gan, I wanna ask a question (...) ((in a muffled sound))	Usurp
46	Gan	Xun	It means 8 equals one popsicle and one ice cream.	Receive
47	Gu	Group	So, how can we calculate the prices of one popsicle and one ice cream?	Usurp
48	Gan	Gu	One popsicle ...	Claim
49	Si	Group	I think we can calculate like this.	Usurp
50	Gan	Si	Say it.	Claim
51	Si	Gan	2, 8, 16. That is two popsicles and two ice creams. Then 22 minus 16 equals two popsicles. Then divide by 2. It is one popsicle.	Receive

The present explorative study adopted a mixed method approach. Quantitative analysis was used to address the first two research questions; qualitative analysis was used for the last two questions. The qualitative analysis only targeted three representative groups to examine major intentions for students to usurp a turn and the impact of turn-usurping in D-CPS. This study adopted a grounded-theory informed coding process to identify talk moves involved in usurped turns and further extract major functions of turn-usurping in shaping group discussion structure. There was only one coder (the author) for the qualitative analysis part.

Results

Quantitative results

Quantitative analysis was conducted to examine how turn-usurping shifts affect the social structure of D-CPS and who are likely to participation through usurping turns.

There were 42 groups in total in this study. Each group produced an average of 286 turns ($SD = 116$, $min = 104$, $max = 522$) within the half hour testing period. Turn-receiving was the most common type of participation shift within the groups. Around 43% ($SD = 10.3\%$) of turns shift by the current speaker receiving the floor offered by the last speaker. The percentage of turn-usurping ($M = 29\%$, $SD = 8.1\%$) and turn-claiming is similar ($M = 28\%$, $SD = 7.5\%$).

Regarding group level analysis, the incidence of turn-usurping shifts was found to be correlated with the total number of turns one group produced ($r(42) = 0.459, p < .01$). Furthermore, turn-usurping is significantly negatively correlated with the standard deviation of individual participation rates ($r(42) = -0.534, p < .001$). That is, the higher percentage of turn-usurping in a group, the more equal of individual participations.

At an individual level, the higher degree that an individual participated by usurping turns, the higher level of her social anxiety ($r(144) = -0.204, p < .05$), the lower of her prior mathematics grade ($r(144) = -0.281, p < .01$), the lower of her prior Chinese grade ($r(144) = -0.332, p < .001$) and the lower level of her self-concept in mathematics ($r(146) = -0.225, p < .01$). That is, turn-usurpers were more likely to be those with low intellectual status, low self-concept and high social anxiety.

Qualitative results

Qualitative analysis was conducted to examine underlying intentions and the impact of turn-usurping shifts through the scrutiny of three concrete groups. The three groups were selected based on their representativeness of interaction intensity and final solution quality: groups that discussed a lot and achieved a good solution (Talkative-Good), groups that discussed few and achieved a good solution (Quiet-Good), and groups that discussed few and achieved a bad solution (Quiet-Bad) (see Table 3).

Table 3: Characteristics of three selected groups

Group	Talkative-Good	Quiet-Good	Quiet-Bad
Number of turns	361	173	126
Score of group solution	7.67	8.33	3.00
Number of turn-usurping	122	56	33
Average prior mathematics grade of members	105.50	94.75	107.33

Through examining turn-usurping shifts in these three groups, the present study found that turn-usurping shifts seldom caused interruptions of the last speaker. The percentages of interruption were smaller than 10% across three groups.

Major intentions of these turn-usurping shifts were explored through an open coding process. It was found that students usurped a turn mainly to *add on* previous speaker, initiate a turn to *express new ideas* or *propose* some action plans, jump in to *regulate* problem solving procedure and group functions, *disagree* or *agree* with someone, and initiate a *question* (see Figure 1). In addition, students in the Talkative-Good group usurped a lot of turns to *repeat* the last speaker which was not the case in the two quiet groups. A further investigation showed that *repeat* happened frequently when one student wrote down the solution while the other three kept informing him/her on what to write down. Meanwhile, students in the Quiet-Bad group usurped turns mostly to propose action plans, regulate collaborations, initiate *off-task* utterances, and *express emotions*; while there was no agree- or disagreement compared to the other two groups with good solutions.

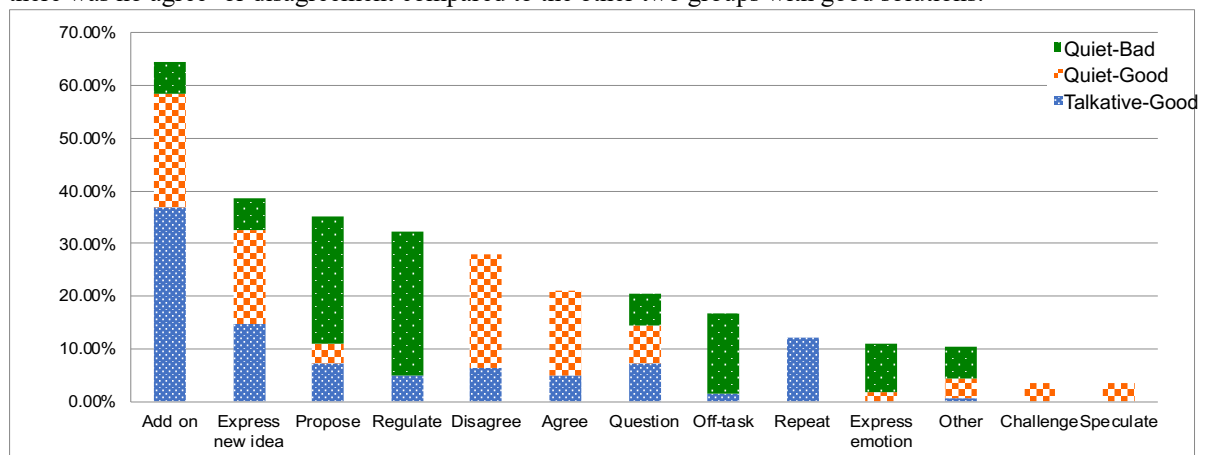


Figure 1. Distribution of major intentions of turn-usurping shifts in three representative groups.

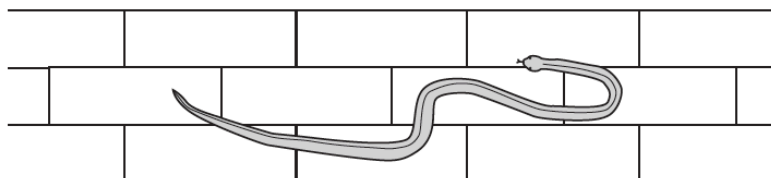
The present study further examined the Quiet-Good group in solving the second problem to illustrate the facilitative and constructive functions of turn-usurping in D-CPS process. The second problem featuring *snake* requires students to propose three solutions to calculate the number of stones a sinuous snake will occupy when it spreads its body (see Figure 2). This problem (item ID: M051006) was adapted from the Trends in International Mathematics and Science Study (TIMSS) that was conducted in 2015 (TIMSS & PIRLS

International Study Center, 2015). It mainly requires students' reasoning ability rather than their specific content knowledge.

There is a snake on a pathway in a park. The pathway is made of stones, as shown below.



If we straightened the snake out to its full length, how many stones would it occupy? Please try to solve this problem by using as many approaches as you can and write out the solutions that you can think of.



Answer: The straightened snake would occupy ____ stones.

Solution 1:

Solution 2:

Solution 3:

Figure 2. A translated English version of the snake problem.

The Quiet-Good group totally generated 51 turns in solving this problem. Four members' characteristics and participations were shown in Table 4. Sun was nominated as the group leader throughout discussions possibly due to his academic advantage. Qiu is academically as advantageous as Sun. While Yan and Chen position in a relatively low academic status. In the process of solving the *snake* problem, Chen and Sun accessed to the conversational floor mainly through receiving turns from others. Qiu had a balance in involving three types of participation shifts; while Yan participated in the discussion mostly through usurping turns. Yan produced the least amount of turns as well.

Table 4. Characteristics of four students in the Quiet-Good group

Pseudonym of the speaker	Yan	Chen	Sun	Qiu
Age	11	11	10	11
Gender	Female	Female	Male	Male
Recent mathematics grade ^a	88.0	81.0	106.0	104.0
Recent Chinese grade ^a	93.5	89.5	114.5	113.0
Mathematics self-concept ^b	2.78	3.00	3.63	3.78
Mathematics enjoyment ^b	3.44	4.00	3.89	4.00
Social anxiety ^c	1.900	1.500	1.200	1.300
Number of occupied turns	6.00	16.00	17.00	12.00
Percentage of turn-usurping	67%	38%	18%	33%
Percentage of turn-receiving	17%	50%	53%	42%
Percentage of turn-claiming	17%	13%	29%	25%

a. The maximum score is 120.

b. Four-point Likert scale. The maximum score is 4.

c. Three-point Likert scale. The maximum score is 3.

The selected excerpt happened when students tried to think about one solution for the *snake* problem (see Table 5). The qualitative analysis found that this discussion segment revealed various functions of turn-usurping shifts in moving forward and complexifying the group discussion. First, turn-usurping could help open

a new dialogic space through initiating new questions (turn 32) or expressing new ideas (turn 37). At turn 32, Yan jumped in and initiated one question to the whole group on whether the small tongue of the snake in the picture should be counted in. This question got an instant response at the following turn which made all group members clear with target length of the snake. At turn 37, Qiu interrupted the arguments on whether the snake occupies three or five stones and proposed one new answer: four stones. This new idea stimulated reflections on previous answers and initiated a new discussion thread on the appropriateness of the answer four.

Second, turn-usurping could also help jump back to previous arguments (turn 34). Sun suggested the whole group to think over again at turn 29 and held back Chen's utterance at turn 31. At turn 34, Chen justified her previous idea of three stones and challenged Sun's answer of five stones. She usurped the turn to continue her utterance at turn 31 and strengthened her arguments at turn 34 which helped shift discussion back to previous unsettled divergence of views between Sun and her.

Third, turn-usurping could diverge the discussion flow through expressing disagreement (turn 42). At turn 42, Chen jumped in to disagree with Qiu's solution which contrasted with Sun's hesitate *yes* towards Qiu at the previous turn. This stimulated Sun to express clear attitude towards Qiu's answer and add on Chen's disagreement at turn 43. Such two continuous turn-usurping shifts involved disagreement and add-on which helped refine existing solutions and stimulate new ideas.

Table 5: How many stones would the snake occupy? Discussion segment in the Quiet-Good group.

Turn	Speaker	Target	Content	P-shift	Intention of usurping
29	Sun	Group	Then think it over again. We think about how to calculate it on earth.	Receive	
30	Chen	Chen	If, if you are right...	Claim	
31	Sun	Chen	Think it over first ((Sun interrupted Chen)) (2.0)	Receive	
→32	Yan	Group	Does the tongue of the snake count or not? ((in low voice))	Usurp	Question
33	Qiu	Yan	It does not count.	Claim	
→34	Chen	Group	I think it should be three stones because the body of a real snake is not that big at all. If it was five stones and each stone is long, how could it be possible?	Usurp	Justify Challenge
35	Sun	Chen	If it was not five stones, it could not be three stones neither because it is crooked here.	Claim	
36	Chen	Sun	But I moved it here like this just now. I did like this after moving it here. Therefore, the crooked part has been counted in.	Receive	
→37	Qiu	Group	I think it is four stones.	Usurp	New idea
38	Sun	Qiu	Why?	Claim	
39	Chen	Qiu	Four stones are somewhat::	Usurp	Other
40	Qiu	Group	Move the head of the snake here, and then move here, then it reaches here after being straightened.	Receive	
41	Sun	Qiu	Yes::	Claim	
→42	Chen	Qiu	If it was straightened, the tail could reach here at most.	Usurp	Disagree
→43	Sun	Chen	Correct if being straightened. Straighten it, and it means it will reach here, right?	Usurp	Add on
44	Chen	Sun	Group leader ((Sun)), I have another idea that is we hypothesize it was several meters long, hypothesize::, hypothesize::	Receive	

Discussion and conclusion

Turn-usurping is one approach of turn-taking where a speaker usurps the conversational floor which has been assigned to someone else by the last speaker. This study presents a concise and very first examination on turn-usurping in D-CPS in terms of its impact on social structure, features of its actor, underlying intentions, and its impact on the interaction process. The findings suggest the positive impact of turn-usurping on maintaining participation equality and its constructive functions in moving forward and complexifying group discussions.

Turn-usurping and participation equality

The present study revealed a positive correlation between the percentage of turn-usurping in one group and the equality of individual participations. This is possibly due to the disruptive nature of turn-usurping. Human interaction is reciprocal (Blau, 1964; Gergen, Greenberg & Willis, 1980). If people talk specifically to someone, there is always an expectation of feedback from the same person. This is also demonstrated in the present study that turn-receiving is a robust turn-taking approach. Continuous turn-receiving shifts tend to cause a locally closed interaction chain unless speakers could consciously involve other members which, however, is a high-level competence that students need to be explicitly taught or guided (King, 2008; Michaels & O'Connor, 2009). In addition, the possible status problem in a group might worsen this situation because students tend to address frequently to the high-status students which can easily cause social dominance or isolation (Cohen & Lotan, 1995, 2014). Turn-usurping as a disruptive turn-taking approach does not follow the usual organization rules of turn-taking (Sacks, Schegloff & Jefferson, 1974). It reflects speaker's strong agency and tends to break current reciprocal turn-taking sequence and initiate a new chain of reciprocal conversation.

This study also found that students who participated mostly through usurping turns were likely to be those with low intellectual status, low-level confidence in mathematics and high-level social anxiety, which indicates the existence of status problem in the present study. Low-status students were seldom addressed by other members and fought for most of their turns in the discussion. This is against the essential premise of dialogic interactions. Genuine dialogue requires the equal rights of various voices (Bakhtin, 1929/1984). Such emphasis on equitable interactions reflects the intrinsic ethical considerations of the dialogism theory (Matusov et al., 2019). Instead of aiming at reducing achievement difference, equity in learning interactions emphasizes the construction of equitable relations among people (Boaler, 2008). Since turn-usurping currently is the major participation approach of low-status students, it seems reasonable that high rate of turn-usurping was associated with higher participation equality.

Constructive functions of turn-usurping

Benefits of turn-usurping also reflect in its constructive rather than disruptive impact on group discussion. The study found students mostly did not interrupt the last speaker when usurping a turn although they overlooked last speaker's allocation of the conversational floor. Therefore, turn-usurpers also show respect for the last speaker by allowing her finishing the turn and smoothly taking up the next turn to contribute.

Furthermore, students tend to produce high-quality utterances in a usurped turn although some turn-usurping shifts might involve off-task behavior. This is possibly because of the strong agency of students when they usurp a turn. A turn usurper possibly thinks long and hard before jumping in the discussion, or blurt out disagreements or queries stimulated by the speaker. Therefore, utterances produced through turn-usurping are more likely to involve productive talk moves (King, 2008; Lazonder et al., 2003; Teo & Daniel, 2007). These productive talk moves in a usurped conversational floor further help manage and shift dialogic space in group discussion (Wegerif, 2007) including initiating a new dialogic space, jumping back to the previous one, or diverging the current one. Therefore, turn-usurping indicates a potential transition point in D-CPS and deserves further investigations in the future.

Practical implications

Previous studies have established that to best enable the success of a collaboration, there should be no significant difference among individual participations in collaborative problem solving (Asterhan & Schwarz, 2009; Dillenbourg et al., 2016). Its absence may lead to information loss, dominance by a majority of the team members or limitations on a team's potential to perform various tasks (Borge & Carroll, 2014; Woolley, Chabris, Pentland, Hashmi & Malone, 2010). The present study briefly demonstrates the positive effects of turn-usurping shifts in mitigating participation inequality and facilitating group discussion. It is thus practically meaningful to encourage students to freely jump right in group discussion through actively usurping turns in D-CPS activities.

In addition, turn-usurping turn out to be a major approach for low-status students to participate in the present context. It is thus also practically necessary to encourage students to monitor whether a turn-usurper has been isolated in discussion. Based on insights of the complex instruction approach (Cohen & Lotan, 1995), teachers could also assign competence to turn-usurpers through publicly praising the intellectual contributions in a usurped turn and arousing peers' attention to this contribution. The equity of learning interaction emphasizes the fairness of accessing to the conversational floor (Shah & Lewis, 2019). In addition to encouraging the behavior of turn-usurping whereby low-status students create participation opportunities for themselves. Teachers can also guide students to talk specifically to low-status students so that low-status students could get more participation opportunities.

The present study is inevitably limited in some ways. There were only three representative groups selected for the qualitative analysis part which aimed to address the last two research questions. Furthermore,

the author was the only coder for the qualitative analysis. Therefore, more data and stricter coding process should be involved to further validate the current explorative findings. In addition, the current study was contextualized in Chinese culture background. Further research is also needed to examine whether turn-usurping features might differ across different cultures.

References

- Asterhan, C. S. C., & Schwarz, B. B. (2009). Argumentation and explanation in conceptual change: Indications from protocol analyses of peer-to-peer dialog. *Cognitive Science*, 33(3), 374–400.
- Bakhtin, M. M. (1929/1984). *Problems of Dostoevsky's Poetics*, Edited and Translated by Caryl Emerson, with an Introduction by Wayne C. Booth (C. Emerson, Trans.). Manchester: Manchester University Press.
- Boaler, J. (2008). Promoting 'relational equity' and high mathematics achievement through an innovative mixed-ability approach. *British Educational Research Journal*, 34(2), 167–194.
- Borge, M., & Carroll, J. M. (2014). Verbal equity, cognitive specialization, and performance. *Proceedings of the 18th International Conference on Supporting Group Work*, 215–225.
- Cohen, E. G., & Lotan, R. A. (1995). Producing Equal-Status Interaction in the Heterogeneous Classroom. *American Educational Research Journal*, 32(1), 99–120. <https://doi.org/10.3102/00028312032001099>
- Cohen, E. G., & Lotan, R. A. (2014). *Designing groupwork: Strategies for the heterogeneous classroom Third Edition*. Teachers College Press.
- Dillenbourg, P., Lemaignan, S., Sangin, M., Nova, N., & Molinari, G. (2016). The symmetry of partner modelling. *International Journal of Computer-Supported Collaborative Learning*, 11(2), 227–253. <https://doi.org/10.1007/s11412-016-9235-5>
- Engle, R. A., Langer-Osuna, J. M., & McKinney de Royston, M. (2014). Toward a model of influence in persuasive discussions: Negotiating quality, authority, privilege, and access within a student-led argument. *Journal of the Learning Sciences*, 23(2), 245–268.
- Gibson, D. R. (2005). Taking Turns and Talking Ties: Networks and Conversational Interaction. *American Journal of Sociology*, 110(6), 1561–1597.
- King, A. (2008). Structuring peer interaction to promote higher-order thinking and complex learning in cooperating groups. In *Computer-Supported Collaborative Learning Series 8*.
- La Greca, A. M., & Stone, W. L. (1993). Social anxiety scale for children-revised: Factor structure and concurrent validity. *Journal of Clinical Child Psychology*, 22(1), 17–27.
- Lazonder, A. W., Wilhelm, P., & Ootes, S. A. W. (2003). Using sentence openers to foster student interaction in computer-mediated learning environments. *Computers and Education*, 41(3), 291–308. [https://doi.org/10.1016/S0360-1315\(03\)00050-2](https://doi.org/10.1016/S0360-1315(03)00050-2)
- Matusov, E., Marjanovic-Shane, A., & Gradovski, M. (2019). Dialogic Pedagogy and Polyphonic Research Art. In *Dialogic Pedagogy and Polyphonic Research Art*. <https://doi.org/10.1057/978-1-137-58057-3>
- Michaels, S., & O'Connor, C. (2009). Conceptualizing Talk Moves as Tools. *Language*, 1–32. <https://doi.org/10.3102/978-0-935302-43-1>
- Mullis, I. V. S., & Martin, M. O. (Eds.). (2013). *TIMSS 2015 Assessment Frameworks*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Sacks, H., Schegloff, E. A., Jefferson, G., & Harvey Sacks, E. A. S. and G. J. (1974). A Simplest Systematics for the Organization of Turn-Taking for Conversation. *Language*, 50(4), 696. <https://doi.org/10.2307/412243>
- Shah, N., & Lewis, C. M. (2019). Amplifying and Attenuating Inequity in Collaborative Learning: Toward an Analytical Framework. *Cognition and Instruction*, 37(4), 423–452. <https://doi.org/10.1080/07370008.2019.1631825>
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53–55.
- Teo, Y.-H., & Daniel, C. (2007). Using Sentence Openers to Support Students' Argumentation in an Online Learning Environment. *Educational Media International*, 44(3), 207–218. <https://doi.org/10.1080/09523980701491658>
- Tsvetkova, M., Garcíá-Gavilanes, R. & Yasseri, T. (2016). Dynamics of disagreement: Large-scale temporal network analysis reveals negative interactions in online collaboration. *Scientific Reports*, 6(November), 1–10. <https://doi.org/10.1038/srep36333>
- Wegerif, R. (2007). *Dialogic education and technology*. Springer.
- Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., & Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. *Science*, 330, 686–688.