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iTalk–iSee: A participatory visual learning analytical tool for developing productive peer talk

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Abstract: iTalk–iSee is a participatory visual learning analytical tool that aims to support students' learning and use of productive peer talk moves in dialogic collaborative problem solving. This short paper elaborates on the key design aspects of iTalk–iSee, including its underlying theoretical framework, design of visualizations, and promotion of learners' agency. Additionally, an empirical application of iTalk–iSee in an elementary school is briefly introduced. In the interactive demo, the audience will be guided through a simulative talk analysis task to experience the major affordances of iTalk–iSee.

Productive peer talk is essential for effective collaboration (Chi & Menekse, 2015; Gillies, 2019). Efforts have been made to develop visual learning analytical tools to facilitate productive peer interaction (Martinez-Maldonado et al., 2021; Vieira et al., 2018). However, these tools mainly focus on the online context and seldom consider learning theories and visualization design principles simultaneously. Furthermore, most of these tools are merely mirroring tools that provide few advanced interpretations for users such as cueing desired or important events or suggesting strategies or remedial action (Hu & Chen, 2021).

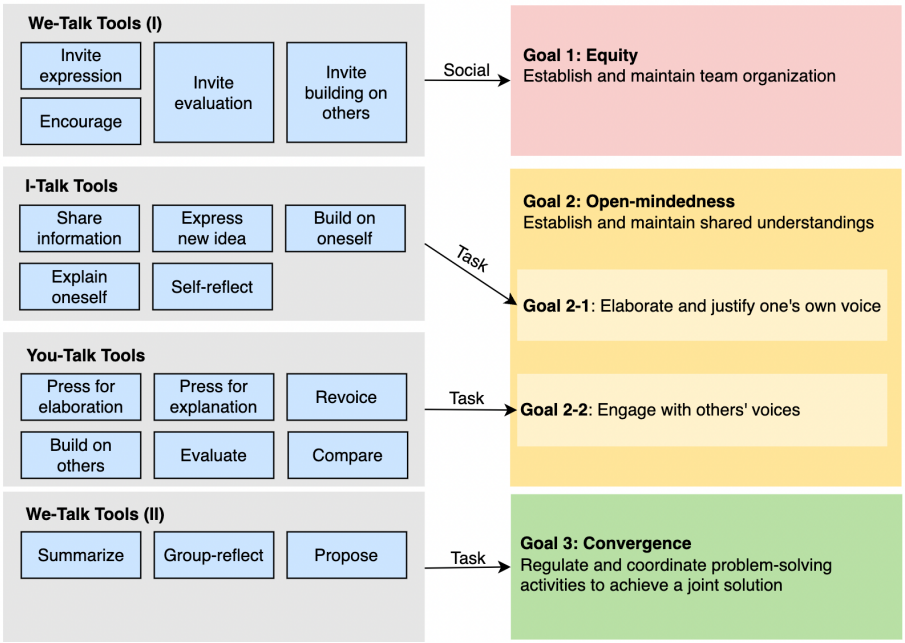
This short paper describes our efforts to facilitate productive peer talk in collaboration by developing a participatory visual analytical tool called iTalk–iSee (Hu et al., 2022). In contrast with previous studies, iTalk–iSee is based on both learning theories and visualization design principles and provides advanced affordances for students. Furthermore, it focuses on face-to-face dialogic collaborative problem solving (DCPS) by a population of elementary school students. In the following, we elaborate its key design considerations, one empirical application, and the session sequencing of the interactive demo session.

Theoretical framework

iTalk–iSee is oriented in dialogism theory (Bakhtin, 1999) and aims to help young learners develop dialogic interaction in the context of DCPS. We define DCPS as a complex dynamic process in which 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 (Hu & Chen, 2022). This definition acknowledges the value that dialogue adds to collaborative problem solving on at least two levels. First, DCPS emphasizes the role of dialogue in collaborative problem solving. This is consistent with other theoretical perspectives that emphasize the role of language in thinking (Piaget, 1932; Vygotsky, 1978). Second, DCPS emphasizes solving a problem through dialogic interaction in which collaborators treat each other as equals and with respect, and in which they engage in internally persuasive discourse (Bakhtin, 1981; Wegerif, 2020).

An essential feature of Bakhtinian dialogue is the presence of equity among voices (Bakhtin, 1929/1984). When students do not treat each other as equals, destructive discourse will occur, in which teammates devalue, ignore, or exclude others' ideas rather than interact respectfully and responsively. Therefore, equity is an essential requirement for effective DCPS. Genuine dialogue in Bakhtinian dialogism also requires individuals to be open-minded (Bakhtin, 1929/1984). That is, individuals should interact in an internally persuasive rather than authoritative manner and allow themselves to be changed by others (Bakhtin, 1981). Effective DCPS is also characterized by convergence on a joint solution. Such convergence does not involve the increasing similarity of individual knowledge that occurs when cognitive conflicts are resolved (Weinberger et al., 2007). Neither does it require agreement to be achieved. Instead, such convergence occurs when all individuals make efforts to reach an optimum joint solution to a problem through dynamic task regulation (Baker et al., 2020). Based on the three essential talk virtues (equity, open-mindedness, and convergence) of DCPS discussed above, we propose its three essential goals (see Fig.1). Goal 2 is divided into two parts, corresponding to the two parties in a dialogue, which indicates the open-mindedness of both parties in authentic dialogic interactions.

Figure 1
Mapping Talk Moves to the Goals of Dialogic Collaborative Problem Solving.



Studies have identified a set of productive peer talk moves (e.g., "elaborate on one's idea", "press for explanation", and "invite evaluation") that characterize productive peer interactions (Gillies, 2019; King, 1997; Noroozi et al., 2013; Webb et al., 2014). Based on a synthesis of studies on the efficacy of productive peer talk moves (Hu & Chen, 2023), this study further conceptualized empirically validated productive peer talk moves as 18 talk tools to fulfill the three goals of DCPS. For instance, when students find someone is marginalized or speaks very few, they can invite the silent member to express new ideas, add on existing ideas, and give the member encouragement. These talk tools were further structured into three categories according to the personal pronouns of initiators (i.e., "I-Talk," "You-Talk," and "We-Talk"), to ease remembering and understanding by young learners. Specifically, I-Talk tools are used to persuade others by elaborating and justifying one's own viewpoints; You-Talk tools are used to interact with others by engaging with their viewpoints; and We-Talk tools are used for team organization and consensus building.

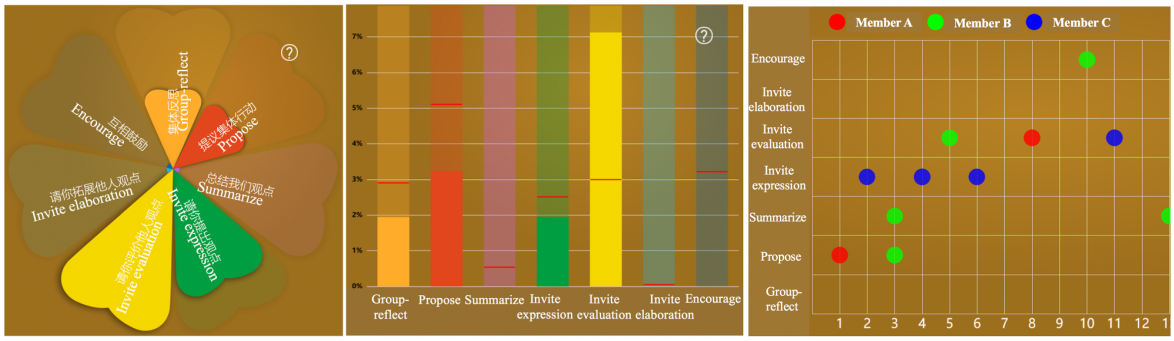
Visualization designs

iTalk–iSee follows graphical design principles (Kosslyn, 2006) and multimedia learning theories (Mayer, 2014) to design visual representations that connect with the users, direct their attention and promote their understanding. It mostly employs illustrations accessible to young learners such as tables, bar graphs and bubble plots. To engage young learners, iTalk–iSee includes several embellishments as visual metaphors, such as windmill, five-pointed star, lemon-slice, and rainbow flower, which serve as powerful learning aids to simplify complex problems and promote conceptual understanding (Schwartz, 2020). Bright colors are used to create a positive emotional tone throughout the interface and visual representations.

To help students understand talk virtues, iTalk–iSee provides multiple complementary visual representations to explore their performance from different perspectives. For instance, Fig. 2 illustrates three different visualizations of students' usage of We-Talk tools in DCPS. The rainbow flower shows where students have reached the standard for each tool. The bar chart displays the individual usage frequency of each tool as well as the average level of the whole class. The bubble plot provides detailed temporal information on individual usage of We-Talk tools throughout the collaboration process. These visualizations focus on different aspects of students' use of We-Talk tools and are deeply connected and cross-validated, providing students with a comprehensive understanding of their performance in team organization and task regulation.

Figure 2

Three Visual Representations of the Usage of Regulative Talk Moves in iTalk–iSee. ***a.*** *Rainbow Flower. Petals Grow Bigger if the Usage Frequency of Talk Moves Get Closer to Teacher-set Standards.* ***b.*** *Bar Chart of Usage Frequency. The Red Short Line Indicates the Average Level of the Whole Class.* ***c.*** *Bubble Plot. It Indicates When Various Talk Moves Are Used by Group Members.*



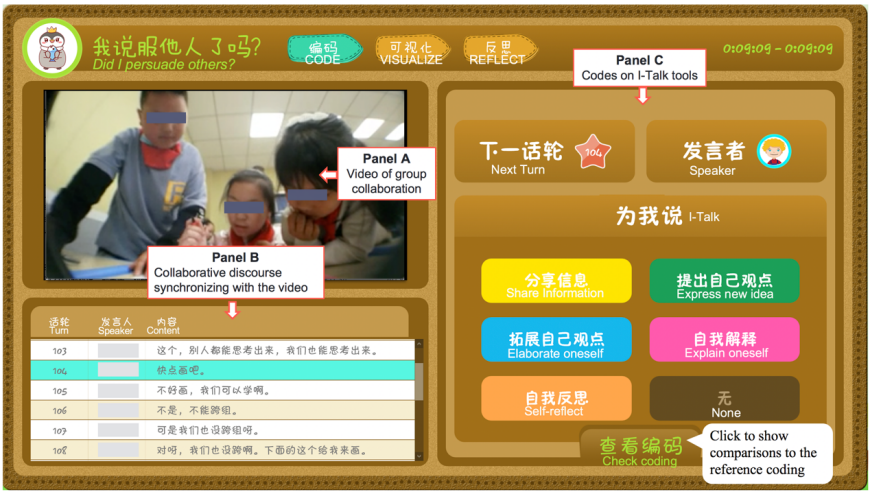
Learners' agency

iTalk–iSee is participatory to promote learners' agency. Effective learning analytics intervention designs should support rather than detract from students' development and use of self-regulatory skills (Wise, 2014). Therefore, iTalk–iSee does not provide students with ready-made analytics results; rather, it engages students in the analytical process. Specifically, iTalk–iSee provides interactive visual interfaces to help students to analyze their collaborative discourse around the three goals of DCPS. It provides students with the three-step macro-script *code → visualize → reflect* to scaffold the coding of their group talk (i.e., *I Talk*), visualization of the coding results (i.e., *I See*, intuitively seeing the talk), and reflection on their group talk with the aid of visualizations (i.e., *I See*, understanding how they have performed and how to improve).

In the coding step, iTalk–iSee provides students with multiple synchronized panels to ease and facilitate coding. For example, in the analysis of the question "*did I persuade others?*", iTalk–iSee provides students with a video of their group talk (panel A) and a synchronized transcribed discourse (panel B) (see Fig. 3). Students can easily review the video and the transcripts turn by turn and code them by selecting appropriate talk moves (panel C). They can also adjust their coding by comparing it with an example provided by the teacher.

Figure 3

Affordance of Coding on the Usage of Productive Talk Moves



After the coding, iTalk–iSee provides visual results of the coding and guide students to have further reflections. For example, when considering the question "*did I persuade others?*", students are prompted to identify which I-Talk tools met the usage standard and which were used least and to discuss why they seldom used certain tools and how they could improve the usage.

Empirical application

iTalk–iSee has been applied to a semester-long talk teaching program for fourth-grade elementary school students in China as an independent course called "Mathematical Dialogue and Thinking". In this course, the teacher taught students various talk virtues and talk tools and used iTalk–iSee to assist them in analyzing and reflecting on their group talk while solving mathematical problems. The results indicated that after the talk intervention program, students employed more productive peer talk moves during their collaborations, became more responsive to group members, and improved their group reasoning ability. Usability scales, surveys and interviews were also

employed to evaluate and enhance the usability of iTalk–iSee. It was discovered that elementary school students were able to code their collaborative discourse and interpret the visual representations. They enjoyed reviewing their group discussion videos and discussing the visual feedback. By involving students in the coding process that underlies the visualizations, iTalk–iSee aided students in comprehending how the visualizations are generated and how to make use of the visual feedback. This participatory approach is effectively strengthened students' agency in reviewing, analyzing, and reflecting on their group performance.

Interactive demo session

The proposed interactive demo session will guide the audience through the major affordances of iTalk–iSee. The session will be divided into three parts. Firstly, an overall introduction of iTalk–iSee will be given, covering design considerations and empirical applications. Secondly, participants will be assigned to groups of three to analyze sampled group talk, following the three-step scaffolds of iTalk–iSee (*code → visualize → reflect*). Each group will require one internet-connected computer. Finally, time will be allocated for open questions, critique, and any comments or suggestions.

Major references

Bakhtin, M. M. (1929/1984). *Problems of Dostoevsky's poetics* (C. Emerson, Ed., Trans.). Manchester: Manchester University Press.

Martinez-Maldonado, R., Gašević, D., Echeverria, V., Fernandez Nieto, G., Swiecki, Z., & Buckingham Shum, S. (2021). What do you mean by collaboration analytics? A conceptual model. *Journal of Learning Analytics*, *8*(1), 126–153. https://doi.org/10.18608/jla.2021.7227

Gillies, R. M. (2019). Promoting academically productive student dialogue during collaborative learning. *International Journal of Educational Research*, *97*(2019), 200–209. https://doi.org/10.1016/j.ijer.2017.07.014

Hu, L., & Chen, G. (2023). A systematic review and meta-analysis of productive peer talk moves. *Journal of Behavioral Education*, 1-33.

Hu, L. & Chen, G. (2021). A systematic review of visual representations for analyzing collaborative discourse. *Educational Research Review*, *34*, 100403. https://doi.org/10.1016/j.edurev.2021.100403

Hu, L. & Chen, G. (2022). Exploring turn-taking patterns during dialogic collaborative problem solving. *Instructional Science*, *50*(1), 63–88. https://doi.org/10.1007/s11251-021-09565-2

Hu, L., Wu, J., & Chen, G (2022). iTalk–iSee: A participatory visual learning analytical tool for productive peer talk. *International Journal of Computer Supported Collaborative Learning,* 1–29. https://doi.org/10.1007/s11412-022-09374-w

Kosslyn, S. M. (2006). *Graph design for the eye and the mind*. New York: Oxford University Press.

Martinez-Maldonado, R., Gašević, D., Echeverria, V., Fernandez Nieto, G., Swiecki, Z., & Buckingham Shum, S. (2021). What do you mean by collaboration analytics? A conceptual model. *Journal of Learning Analytics*, *8*(1), 126–153. https://doi.org/10.18608/jla.2021.7227

Schwartz, N. (2020). Making the invisible visible: Practical applications of visual metaphors in teaching and learning accounting. *Journal of Visual Literacy*, *39*(1), 49–71. https://doi.org/10.1080/1051144X.2020.1737906

Vieira, C., Parsons, P., & Byrd, V. (2018). Visual learning analytics of educational data: A systematic literature review and research agenda. *Computers and Education*, *122*, 119–135. https://doi.org/10.1016/j.compedu.2018.03.018

Webb, N. M., Franke, M. L., Ing, M., Wong, J., Fernandez, C. H., Shin, N., & Turrou, A. C. (2014). Engaging with others' mathematical ideas: Interrelationships among student participation, teachers' instructional practices, and learning. *International Journal of Educational Research*, *63*, 79–93. https://doi.org/10.1016/j.ijer.2013.02.001

Wise, A. F. (2014). Designing pedagogical interventions to support student use of learning analytics. In *Proceedings of the Fourth International Conference on Learning Analytics and Knowledge* (pp. 203-211). New York: ACM.

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