Concrete Definition of Beneficial Collaborative Dialogues

Michelene T. H. Chi, Mary Lou Fulton Teachers College, Arizona State University, Michelene.Chi@asu.edu

Abstract: Collaborative learning is often superior to individual learning, but not consistently so. To understand why not, we applied the ICAP theory of cognitive engagement to define and operationalize various collaborative dialogue patterns and identified the co-generative pattern as the optimal one for maximizing learning. We used the definitions to code dialogues from data collected in our prior studies and show that dyads with higher co-generative scores learned more than dyads with lower co-generative scores. This suggests that collaborative learning is more effective if a certain dialogue pattern occurs.

Interacting with a peer through dialogues often promotes greater learning than learning alone (Dillenbourg, Baker, Blaye, & O'Malley, 1995; Perret-Clermont, Perret, & Bell, 1991), but not always (e.g., Barron, 2003). Although numerous reasons have been proposed over the last few decades for why collaboration is beneficial for learning (such as that learning is necessarily a social process, collaboration involves opportunities to resolve conflicts, etc.), few efforts have attempted to understand why collaborative learning sometimes fails to exceed the benefit of learning individually. We propose that specifying concrete operational definitions for dialogue patterns may explain when collaborative learning is not always beneficial. Concrete definitions may also pave the way for practitioners (e.g. teachers & instructors) to know how to enable and foster better collaborative learning.

The ICAP Theory

The collaborative dialogue pattern that is optimal for learning can be defined by applying the ICAP theory of cognitive engagement (Chi, 2009). ICAP classifies how students engage with instructional materials into four modes of activities: Students can *pay attention* to instruction and receive instructional information but do nothing else with it (e.g., just listen to a lecture, or watch a video, or read a text). By not manipulating or producing anything else with the instructional materials, this can be labeled the *Passive* mode of engagement. Alternatively, students can *manipulate* the instructional materials in some ways, such as underlining some of the text sentences or copying notes from a power point lecture, without incorporating any additional information. This is labeled the *Active* mode of engagement. Students can also engage in the *Constructive* mode, which is to *generate* information beyond the information provided in the instructional materials. For example, instead of copying the content of a teacher's power point slides, a student can *generate* additional information that was not provided in the power point slides, such as justification for a solution step to a problem, or posing a question about the solution step. Finally, students can engage with learning materials with a peer, and each peer can not only *generate* information beyond what was presented in the learning materials, but each peer can generate information by addressing and extending the partner's contributions, thus engaging in a *co-generative* way in the *Interactive* mode. Basically, the mode in which a student engages can be determined operationally simply by comparing the student's contributions (e.g. outputs or products) with the content materials provided in the instruction. So for the four modes, students' contributions are either: none *(attentive/Passive),* similar in content *(manipulative/Active),* in addition to content *(generative/Constructive),* or extend beyond content and partner's contributions *(co-generative/Interactive).*

ICAP posits that the mode in which students engage with instructional materials determines how much they learn or how deeply they learn. The *Interactive/co-generative* mode is the best, followed next by the *Constructive/generative* mode*,* then the *Active/manipulative* mode, and finally the *Passive/attentive* mode which is the least effective for learning. Thus, the order is I>C>A>P. This hypothesis about the amount or depth of learning as a function of engagement mode arises from the cognitive processes underlying each mode of activity. For example, being *generative/Constructive* means that students are making inferences, whereas being *manipulative/Active* means that students are merely activating prior knowledge and storing new information, but not generating many inferences. The predictions of the hypothesis are supported by hundreds of studies in the literature (Chi & Wylie, 2014).

Applying ICAP to define collaborative dialogues

The definitions of the four I, C, A, P modes can be applied to collaborative dialogues to determine the mode in which each partner of a collaborative dyad contributes. For example, the speaker is simply *paying attention/Passive* if her contribution is "Uh huh" or "ok". However, if the speaker responds to her partner's contribution with a paraphrase, a repetition, or an agreement type of response, then the speaker is contributing in a *manipulative/Active* way because the speaker is not providing any additional information. On the other hand, if

the speaker contributes an idea that differs from what was said before but does not extend the partner's contribution, then the speaker is responding in a *generative/Constructive* way. Finally, if the speaker responds by generating ideas that extend and build on the partner's contribution, then the speaker is being *co-generative/Interactive.* Thus, there are a variety of dialogue patterns, based on how each speaker contributes, such as both partners can be *Active,* or one partner is *Constructive* and the other partner is *Active* or *Passive,* or partners can both be *Constructive* in parallel, building on their own thinking but not building on the partner's thinking, or they can both be truly *Interactive*/*co-generative* in that they each build upon and extend their partner's thinking. There are potentially at minimum nine dialogue patterns, assuming partners cannot both be *Passive-Passive.* Our claim is that only one dialogue pattern, the *co-generative* one, can ensure that the benefit of collaborative learning exceeds learning individually.

Using data collected in Menekse, Stump, Krause, and Chi (2013), we coded multi-turn episodes of dialogues in answering each question from 24 pairs of college engineering students. Co-generative dialogue patterns received a score of 3; dialogue patterns in which only one partner was generative and the other partner was manipulative received a score of 2; and if the participants were both manipulative, or manipulative-attentive, or generative-attentive, then the dialogue pattern received a score of 1. The result of our coding showed that the six pairs with the highest interaction scores learned significantly better than the six pairs with the lowest interaction scores, based on an ANCOVA comparing post-test scores while controlling for pre-test scores, $F(1, 11) = 18.30$, $p < .01$. A similar analysis was carried out for data collected in another study (Muldner, Lam, & Chi, 2014), in which 40 undergraduates worked in pairs to complete a diffusion worksheet while watching instructional videos. The dialogues were coded in the same way. We again found that the six higher scored pairs had significantly greater learning gains than the six lower scored pairs, comparing adjusted post-test scores, $F(1, 11) = 5.31$, $p = .05$. Figure 1 plots the results from both studies, showing the same pattern of significantly higher learning gains when students collaborate in a co-generative way.

Conclusion

Applying ICAP's definition of modes of engagement to define interactive dialogue patterns allows us to operationally specify which dialogue pattern is optimal for collaborative learning. Our definition and coding results suggest that collaborative learning can exceed individual learning when dyads interact in a mutually-and-reciprocally co-generative way.

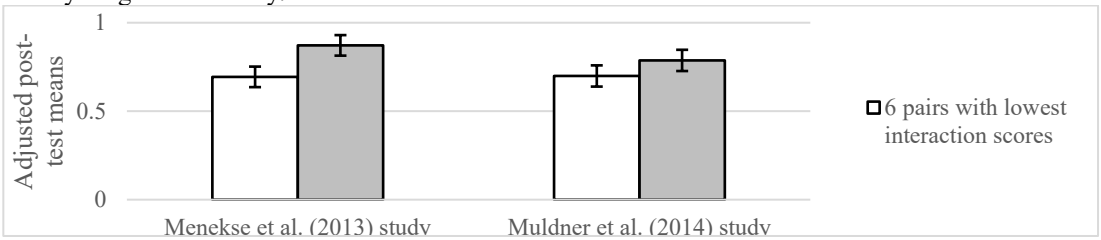

Figure 1. Adjusted post-test means of data coded from two separate studies. Error bars represent +/- 2 SE.

References

Barron, B. (2003). When smart groups fail. *The Journal of the Learning Sciences, 12*(3), 307-359.

Chi, M.T.H. (2009). Active-constructive-interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science, 1*, 73-105.

Chi, M.T.H., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. *Educational Psychologist, 49*, 219-243.

Dillenbourg, P., Baker, M., Blaye, A., & O'Malley, C. (1996). The evolution of research on collaborative learning. In E. Spada & P. Reiman (Eds.), *Learning in humans and machine: Towards an interdisciplinary learning science* (pp. 189-211). Oxford, UK: Elsevier.

Menekse, M., Stump, G., Krause, S. & Chi, M.T.H. (2013). Differentiated overt learning activities for effective instruction in engineering classrooms. *Journal of Engineering Education, 102*, 346-374.

Muldner, K., Lam, R., & Chi, M.T.H. (2013). Comparing learning from observing and from human tutoring. *Journal of Educational Psychology, 106*, 69-85.

Perret-Clermont, A. N., Peret, J. F., & Bell, N. (1991). The social construction of meaning and cognitive activity in elementary school children. In L. B. Resnick, J. M. Leving, & S. D. Teasley (Eds.), *Perspectives on socially-shared cognition* (pp. 41-62). Washington, DC: American Psychological Association.

Acknowledgements

The author is grateful for funding provided by the Institute of Education Sciences (Grant No. R305A150432).