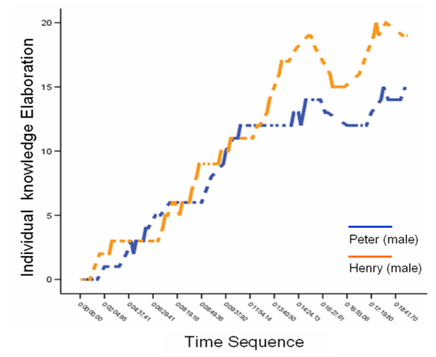
Research Need:

To date, very little research on individual epistemic involvement suffices the need to capture the dynamic progress of the evolvement of individual epistemic engagement in a group setting. It is difficult for us researchers to grasp the overall process of students' epistemic engagement in CSCL by simply tallying the frequency of messages. Against this background, we advanced our previous method using elaboration values and explored a new method, calculating *Epistemic Synchronization Index (ESI)*, to measure the degree of synchronization of students' epistemic involvement during collaborative problem-solving.

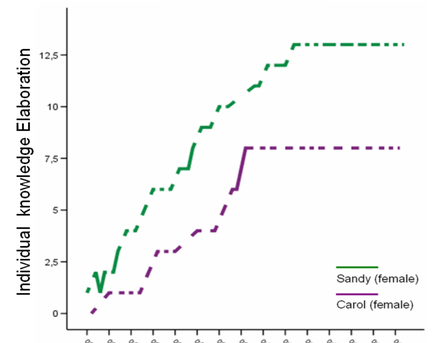
Theoretical Framework:

Based on three cognitive modes from Kumpulainen and Mutanen (1999), we (Ding, 2009; Ding, 2010) developed a coding system to measure students' epistemic engagement, which was termed as "elaboration values" referring *off-task*, *on-task* and *elaboration* activity. Each piece of student online messages was coded into a discrete numerical value as -1, 0, or +1. We've discovered three collaboration patterns of students, cross, parallel, and divergent.

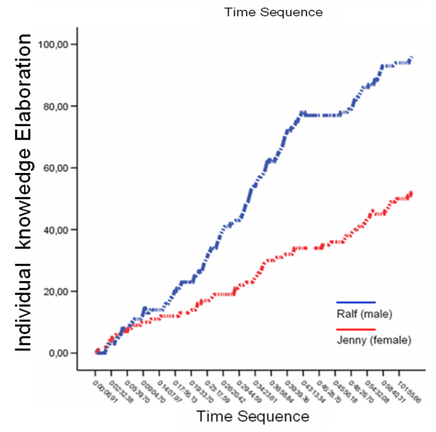
With deeper delving into CSCL data in the past three years, we've recognized the limits of these visualized patterns. For instance, the determination of patterns was not normalized, which indicates that categorizing the process into patterns heavily relied on individual judgment. The distinction among the patterns was ambiguous and the categorization could be subjective. Moreover, we argued that the time sequence of the artifacts needs to be taken into consideration while measuring the effectiveness at the group level.



Cross



Parallel



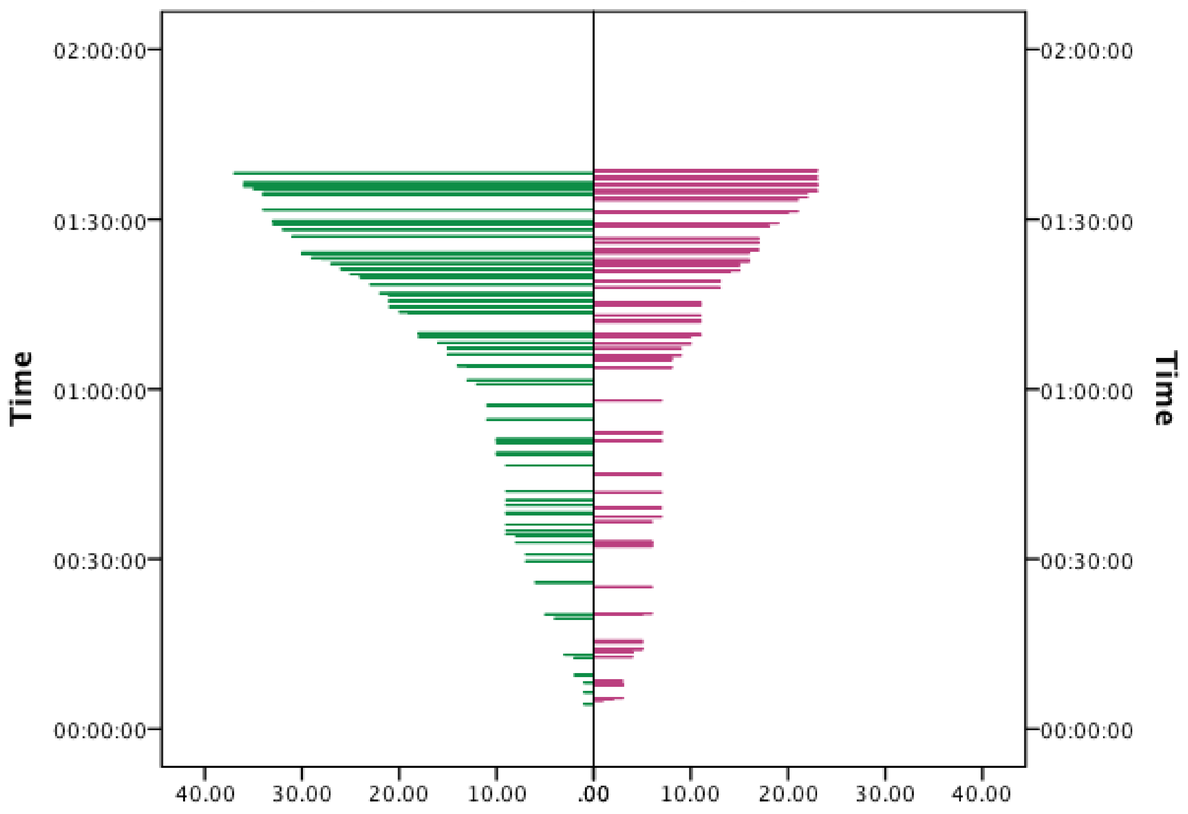
Divergent

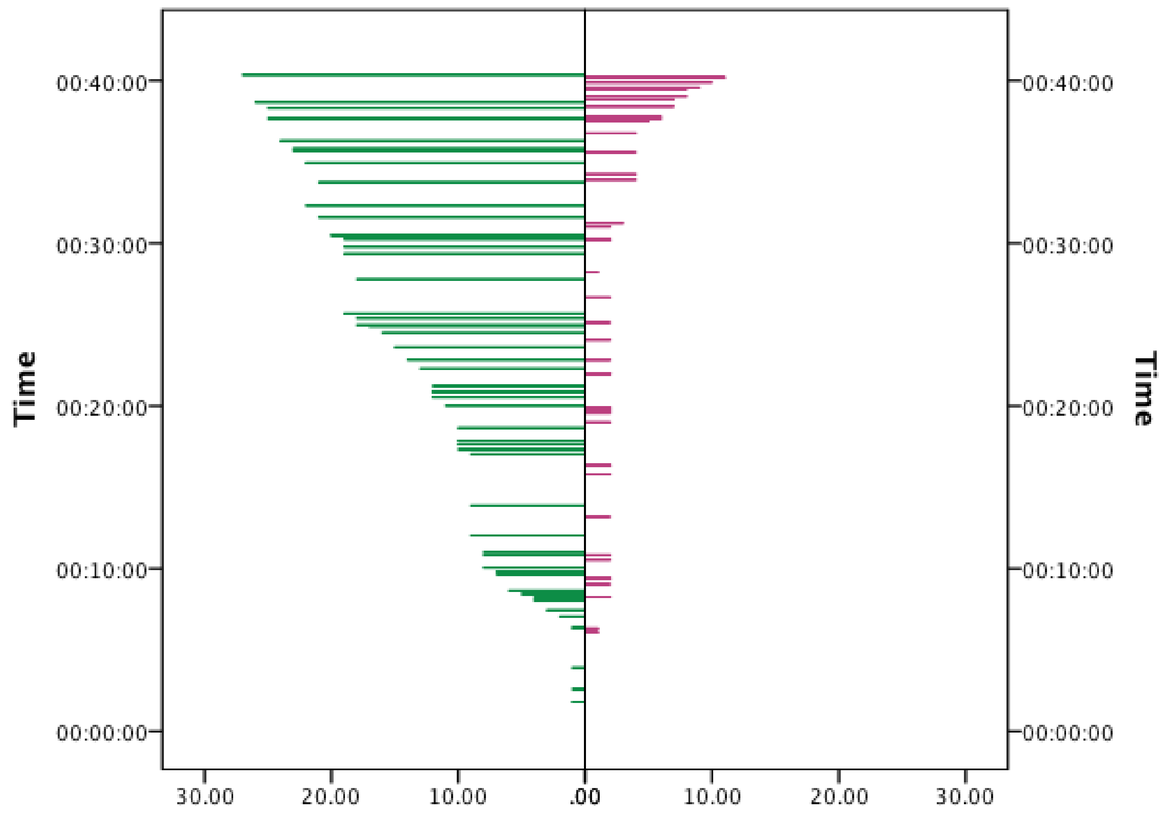
Using Epistemic Synchronization Index (*ESI*) to Distinguish *Gifted* and *Regular* Students' Knowledge Elaboration Process

Dr. Ning DING & Dr. Marca Wolfensberger
Hanze University of Applied Sciences, Groningen, The Netherlands

The full manuscript is to be published in Computers & Education!

Category	Numerical value	Definition	Example
Off-task	-1	Content of the message is not related to the question solving.	*What is your plan for the Christmas vacation?*
On-task	0	- The message only shows an agreement, however, without justification or critical thinking.	- *If we visualize it, each part should be 0.4722.* - *You mean 47.22%?*
		- The message is relevant to the question, however, without any advancement of solution.	- *Ok, we know the z score now. Then, what shall we do?*
Elaboration	+1	- The message shows a step towards the final solution.	- *It is a finite population because n/N is 0.2, smaller than 0.5.*





Data Analysis:

The unit of analysis was defined as each message emerging at a recorded timeslot. Before setting out to scrutinize the content of messages, we distinguished three epistemic levels of knowledge elaboration: off-task, on-task and elaborative messages (Author, 2009, 2010). These three levels originated from the proposition of Kumpulainen and Mutanen (1999).

A series of equations are developed to calcuate the Epistemic Synchronization Index at dyadic and individual level, see Equation 1, 2, 3 and 4.

<Equation 1> $$ESI_0 = \int_{t=0}^{t} A * |CEV_{S1} - CEV_{S2}| * dt$$

<Equation 2> $$A = \frac{1}{\int_{t=0}^{t}(|CEV_{s1}+CEV_{s2}|)*dt}$$

<Equation 3> $$ESI_1 = \int_{t=0}^{t} A * max\{0, CEV_{s1} - CEV_{s2}\} * dt$$

<Equation 4> $$ESI_2 = \int_{t=0}^{t} A * max\{0, CEV_{s2} - CEV_{s1}\} * dt$$

Highlights

- This is a methodological exploration in terms of measuring students' epistemic engagement during CSCL.
- The proposed method combines qualitative content analysis and sequential analysis of online text-based messages.
- Using well-developed equations, researchers are able to use an index number, ranging from 0 to 1, to quantify students' epistemic engagement during CSCL.
- Using this Epistemic Synchronization Index (ESI), it is also possible for researchers as well as teaching practitioners to distinguish members' knowledge evolvement within one group.

Source:

Ding, N. (2009). Visualizing the Sequential Process of Knowledge Elaboration in Computer-Supported Collaborative Problem Solving. *Computers & Education*, *52* (2), 509-519.

Ding, N., Bosker, R.J. & Harskamp, E.G. (2010). Exploring gender and gender pairing in the knowledge elaboration processes of students using computer-supported collaborative learning. *Computers & Education*, *56* (2), 325-336.

Kumpulainen, K., & Mutanen, M. (1999). The situated dynamics of peer group interaction: An introduction to an analytic framework. L*earning & Instruction*, *9* (5), 449–473.