International Society of the Learning Sciences

Detecting Patterns of Constructed Collaborative Novelty in Online Discourse in Knowledge Building Communities

Guangji Yuan, Nanyang Technological University, Singapore, guangji.yuan@nie.edu.sg
Jianwei Zhang, University at Albany-SUNY, U.S.A., jzhang1@albany.edu
Heyjin Park, Korea Institute of Science and Technology Information, South Korea, hpark7@kisti.re.kr

Abstract: Investigating how students collaboratively advance online discussion has much value in understanding the mechanisms of novelty. Extending creative discourse by broadening adjacent novelty with new ideas is an essential benchmark to expand the community's knowledge in a knowledge building community. This study aims to continue the investigation of the mechanisms and novelty momentums behind the discourse in students' knowledge building online discussion, with a new novelty framework to understand students' collaborative discussions. Results show a promising understanding of the discussion patterns from this new perspective.

Introduction

Novelty is a crucial element in advancing the field of knowledge to make breakthroughs. In recent decades, the novelty has been investigated from individual to collaborative levels. A new trend in understanding novelty is the social process developed by transitions between persons sharing a context that technology can support (Bereiter & Scardamalia, 2014; Slotta et al., 2014). The study of novelty expands from both eccentric personalities to a competence that can be learned and developed over a life span (Romero et al., 2012) with the support of technology. The concept of novelty is receiving growing attention in Computer-Supported Collaborative Learning which is often defined as "new and not resembling something formerly known or used" (Merriam-Webster, 1991). While the collaboration format also reveals a significant increase in creativity. For instance, collaboration in design, where collaborative stimulation (prompting, seeding, clarifying, and correcting) occurs while designing entities or questions, stimulating the generative cognitive process. Moreover, it has been shown that collaborative stimulation for seeding and correcting could result in the most significant increase in the novelty of design entities (Sauder et al., 2013). While aggregate and process models provide valuable insights into collaborative creativity, they also have limitations. One limitation of aggregate models is that they tend to focus on the individual characteristics of team members rather than the social and cultural context of collaboration. This may overlook important factors such as power dynamics, group norms, and social identity that can impact creativity in a collaborative setting. On the other hand, process models may oversimplify the complex nature of collaboration by reducing it to a set of discrete interactions. This may overlook the role of context and the non-linear nature of collaboration, where creativity can emerge from unexpected sources and pathways. Our research question asks: what patterns of students' online knowledge building discourse are based on novelty analysis?

Novelty framework:

We created a novelty framework (2021, Yuan et al.,) and analyzed idea novelty based on the content of students' online posts that contained unique and relevant information extending their current understanding. The analysis led to a refined coding scheme that includes six dimensions (main categories). The quality of each type of new contribution was further assessed based on three levels: 0-not new and not substantial, 1: new but not substantial, 2: new and substantial. The levels are determined in a temporal context based on how a specific note compares against the previous notes. Thus, the code of 0 does not mean that note has no rich formation, but it indicates that no new information is provided in that specific note compared to the previous posts under a measurement dimension. Below we explain each dimension.

A) New concept

Definition: In this framework, the new concept is defined in three aspects: 1) adding new topics that have never appeared in the discussion before; 2) adding to or expanding a piece of information on an existing topic/theme; 3) adding different opinions to show alternative thinking. If a note qualifies any of the criteria, we further determine its level of substance; otherwise, we code it as 0.

Substantial or not: We define a note as substantial when it adds detailed information about the topic/theme/concept or it contributes to progress in explaining the topic. We define a note as 0 when it contains only several words or repeated information.

B) New connection

Definition: The new connection is defined as 1) connecting a new conceptual construct to an existing conceptual construct; 2) adding a new connection between two new/existing conceptual constructs that has not been shown before.

Substantial or not: A current note is substantial when it adds an essential connection between two new or existing conceptual constructs with a sufficient explanation. If the connection is only about two concepts briefly, or simply mentions the concept, or if no further explanation is provided, we code it as not substantial.

C) New rise-above

Definition: The definition of new rise-above is: 1) it has a new integration of the previous information at a new/higher/finer level, which means that the note contains synthesized ideas without redundancy; 2) the note adapts to the changes of the progressive set of ideas.

Substantial or not: When the current note shares a higher-level of understanding about the learning concept/topic, or makes a comprehensive integration of the previous information, or summarizes the previous discussion at a higher level with sufficient information, it will be counted as substantial.

D) New question

Definition: The definition of a question is quite clear when the note proposing a new question(s) starts with what, why, how, when, or do, as a sentence starter indicating it is a question.

Substantial or not: A substantial question should: 1) ask a new open-ended question with deeper insights; 2) ask several questions with detailed information. If the question only contains a few words or closed-ended questions, it counts as not substantial.

E) New source

Definition: A note shares non-redundant resources, such as books and websites.

Substantial or not: When a new resource type is shared with links and other explanations, or a summary related to the current topic, it will be counted as 1. If a new resource type is shared with only a link, without any explanation, it will be counted as 0.

F) New context

Definition: This column focuses on whether a new learning environment is mentioned or a different context is connected or compared to the previous concept.

Substantial or not: The new note will be counted as substantial when a new learning environment or context is mentioned/connected/compared with the same discussion topic and with detailed explanations.

Method

Contexts

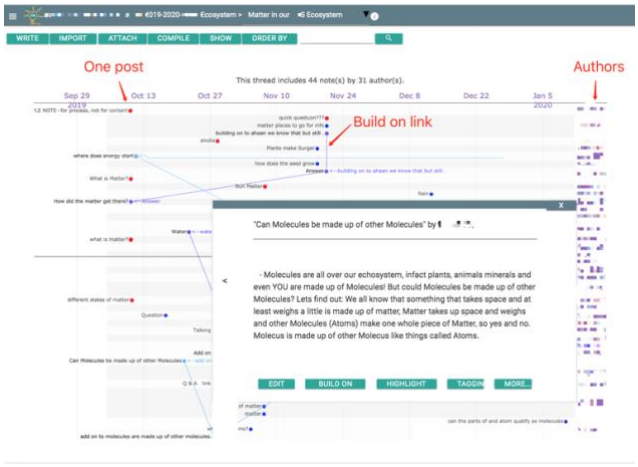
This study was conducted during two consecutive school years (2018-2019 and 2019-2020) at a public elementary school in the Northeastern U.S. Each year, four Grade 5 science classrooms participated—each of two experienced teachers taught in two classrooms. The participants were 163 students, 84 in the first year and 79 in the second year. Students of each year studied ecology from September to December. Their science learning was implemented using a knowledge building pedagogy (Bereiter & Scardamalia, 2014) supported by a collaborative online platform, Idea Thread Mapper (ITM, Zhang & Chen, 2019). Each year, the class began with a set of kick-off activities (e.g., schoolyard observation of living and non-living things) that triggered student interest in the unit topic. Students generated initial questions and shared them in the classroom and online conversations. They had face-to-face metacognitive meetings in classrooms, where they collaboratively built on ideas, explored problems, reflected on collective idea progress, and identified knowledge gaps for further study. They continued the collaborative conversation in ITM (Figure 1). As students expanded questions about overarching inquiry goals (e.g., the interaction of living and non-living things), teachers added wondering areas (overarching question or branch of inquiry) with temporal idea threads in ITM. The online discourse was organized in the idea threads. In each idea thread, students posted a series of notes (discourse entries) addressing a topic of inquiry and built on ideas in the notes connected by links. Students were encouraged to participate in the collaborative discourse in any wondering areas based on their interests. They used multiple resources, such as books, websites, and online videos, and conducted hands-on observations.

Data sources and analysis

The data source was students' notes in ITM over the two school years. In total, we collected 899 notes with an average of 38.62 words per note. A combination of qualitative analysis methods was used to investigate students' online discourse aligned with their face-to-face work over time, which was to develop and test an analytic framework for measuring students' idea novelty, A grounded theory approach (Strauss & Corbin, 1998) was conducted for identifying various creative input types concerning prior and subsequent discourse entries. The authors of this paper read and reread the ITM notes in the context of the classroom inquiry to learn the overall progress of students' ecological understanding and idea creation. The developed coding scheme was employed to conduct content analysis (Chi, 1997) for analyzing the notes and characterize the types and levels of creative contributions involved. To further understand how the community build-on notes relate to the novelty, researchers coded 184 notes from 9 views which contain more than 10 notes, and used Epistemic Network Analysis (Shaffer et al., 2009) to find the relationships among the 6 novelty coding schemes.

Figure 1

An example of Idea Thread in ITM. Each dot represents a post (note), and a line linking two posts shows a build-on response.



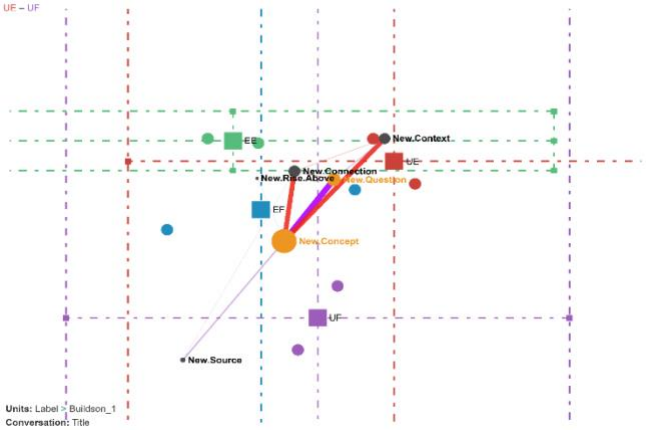
Results

RQ: What patterns of students' online knowledge building discourse are based on novelty analysis?

To understand the pattern of students' online discourse in the six novelty dimensions, researchers conducted an Epistatic Network Analysis based on the novelty coding.

Figure 2

Build-on notes only: plot Unelaborated Fact. The New Question and New Concept show a correlation of 0.85.

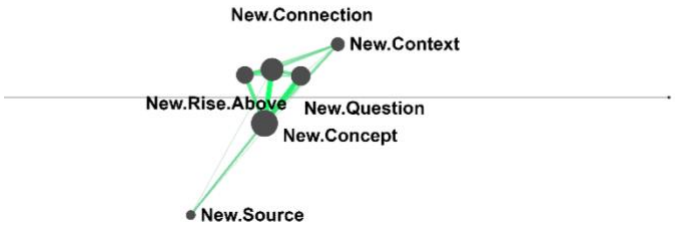


The results of the Epistemic Network Analysis show that among the build-on notes, the cluster of the most frequently contributed note indicates the quality of *Unelaborated Fact*. The connection between New

Question and New Concept shows a correlation of 0.85, which means that students tend to post a simple note with questions and new concepts to extend the conversation at the basic level. However, three coding pairs show a close connection within the cluster of the highest-quality notes (Elaborated Explanation). The New Question and New Concept with a correlation of 0.46, New Concept and New Connection (0.46), and New Concept and New Rise-above (0.36), in dictating the multiple aspects students contribute to extending the conversation at a deeper level.

Figure 3

Build-on notes only: plot notes of Elaborated Explanation, the correlation between the New Question and New Concept is 0.46, New Concept and New Connection (0.46), New Concept and New Rise-above (0.36).



Conclusion

This study implied a new novelty analytic framework in a new dataset, which was applied to understand the temporal patterns and progress of students' idea development in the online discourse of knowledge building communities. The Epistemic Network Analysis reveals patterns of students' novelty contribution during online discussion. Researchers and educators may use this analytic framework to investigate students' collaborative discourse in a way that captures the progressive changes of students' novel contributions. This analytical framework may also serve as a foundation for creating classroom rubrics and generating formative feedback on students' collaborative discussions.

References

Bereiter, C. & Scardamalia, M. (2014). Knowledge building and knowledge creation: One concept, two hills to climb. In S. C. Tan, H. J. So, J. Yeo (Eds.) *Knowledge creation in education* (pp. 35-52). Singapore: Springer.

Chi, M. T. H. (1997). Quantifying Qualitative Analysis of Verbal Data: A Practical Guide. *Journal of the Learning Sciences, 6*, 271-315.

Merriam-Webster's Collegiate Dictionary (10th ed.). (1999). Merriam-Webster Incorporated.

Romero Velasco, M., Hyvonen, P., & Barberà Gregori, E. (2012). Creativity in collaborative learning across the life span. *Creative education, 2012, 3* (4).

Sauder, J., Lian, E., & Jin, Y. (2013, August). The effect of collaborative stimulation on design novelty. In *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference* (Vol. 55928, p. V005T06A009). American Society of Mechanical Engineers.

Shaffer, D. W., Hatfield, D., Svarovsky, G., Nash, P., Nulty, A., Bagley, E., Frank, K., Rupp, A., & Mislevy, R. (2009). Epistemic Network Analysis: A prototype for 21st century assessment of learning. *International Journal of Learning and Media 1*(2): 33-53.

Slotta, J., Suthers, D., & Roschelle, J. (2014). CIRCL Primer: Collective Inquiry and Knowledge Building. In *CIRCL primer series*. Retrieved from http://circlcenter.org/collective-inquiry-knowledge-building/

Strauss, A., & Corbin, J. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (2nd ed.). Thousand Oaks, CA: Sage.

Yuan, G., Zhang, J., Park, H., & Yu, C. (2021). Designing and Testing the Novelty Analytic Framework for Collaborative Online Discourses in Knowledge-Building Communities. Paper presented at *the Annual Meeting of American Educational Research Association* (AERA 2021).

Zhang, J. & Chen, M. (2019). Idea Thread Mapper: Designs for Sustaining Student-Driven Knowledge Building Across Classrooms. In Lund, K., Niccolai, G. P., Lavoué, E., Hmelo-Silver, C., Gweon, G., & Baker, M. (Eds.), In *13th International Conference on Computer Supported Collaborative Learning (CSCL) 2019, Volume 1* (pp. 144-151). Lyon, France: International Society of the Learning Sciences.