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Examining Prompted Discourse Patterns in an Informal, Online, Global Collaborative Learning Environment

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Abstract: This paper examines the discourse patterns of adolescent participants and adult facilitators from two countries while collaborating on STEM-oriented media projects over videoconference. Epistemic network analysis (ENA) is used to examine the influence of prompting on three levels of analysis including the presence of prompting, the prompter (adult/facilitator versus peer), and the prompt type (elaboration, procedural, reflection). In the context of project collaboration, elaboration emerges as a dominant and natural prompt approach to promoting discourse. Results show that prompting fosters content-related connections in discourse, primarily modeled intentionally by adults/facilitators and mirrored by peers. Adult prompting unexpectedly elicited more pronounced social disposition, and complemented peer prompting that was affiliated with sharing information and media production of projects. These results help to reinforce the value of an informal, mixed generational learning environment where adults and peers are able to share equally in advancing content-related discourse.

Introduction

Redefining the way we communicate, advancing technological tools encourage meaningful connections between culturally diverse individuals. No longer limited by geographical barriers, online tools expand students' abilities to collaborate globally and with more even footing. Creating an inclusive environment for students as they navigate the online space allows learners to develop skills in creative inquiry, active engagement, and social competence (Kreijns et al., 2013). One way to foster an inclusive environment is by implementing prompting into the learning environment.

Prompting is designed to elicit creative thought and critical engagement by providing learners with hints, feedback, and guiding inquiry (Hammond & Manfra, 2009; Harney et al., 2015). The study examines prompting among three categories: the presence of prompting, the prompter, and the prompt type. A close examination of prompts could elicit insight into strategies that could nurture productive discourse in online group settings as education institutions begin to immerse themselves in virtual communication tools.

Prompting

Presence of Prompting

Prompting is both formal and informal educational settings can guide learning and promote critical analysis. In informal settings, the presence of prompting can be identified by the spoken utterances of both facilitators and student participants. With the encouragement of shifts away from only information acquisition, prompting can activtly foster creative thinking with diverse levels of engagement (Hammond & Manfra, 2009). The presence of prompts evokes active engagement in concept formation. Such learner-centered instruction acknowledges the knowledge, skill sets, beliefs, and attitudes each learner brings to the educational setting (Bransford, 2000). Incorporating prompts into instruction has been shown to elicit the construction of constructive arguments and the mobilization of evidence in a non-judgmental environment (Hammond & Manfra, 2009). Prompting questions are designed to have no right or wrong answer; instead, they emphasize learners to reflect and elaborate on the specific content. Additionally, previous research indicates an improvement in prosocial behaviors, cognitive development, and evidence-based writing (Layous et al., 2012; Vogt et al., 2021; Yarrow & Topping, 2001).

Prompter

Facilitators and peers can use prompting to initiate guiding questions and reflective responses to further active discourse among learners. Adult facilitators in informal settings such as those reported here can improve students' problem-solving performance by incorporating externalized scaffolding to stimulate high-level observation and reflection processes (Ge & Land, 2004). A facilitator assists in student participation by informally including learners in the conversation through unscripted prompting. While facilitators intentionally use prompts to promote

discourse, they are not provided with any scripted prompts to use. The implementation of unscripted prompting aims to encourage participants to share their ideas without fear of consequence in learning a new topic. Facilitators are usually close in age to the participants, mostly students in college who were formerly participants themselves. This was designed to limit the impression of adult expertise and open opportunity for mutual learning for adolescent learners (Hammond & Manfra, 2009).

Though facilitators are usually the source of prompting in meet-ups, peers also implement prompting to assist in providing reflection, context, and elaboration. Through the exhibition of these prompting strategies by facilitators, students will model and implement these prompting approaches with their peers to conduct productive discourse (Rosenshine, Meister, & Chapman, 1996). Additionally, learners are given the skills to execute general guidance in troubleshooting and moving the conversation forward during meet-ups. A substantial amount of research on peer-prompting focuses on the prosocial benefits found in peer-to-peer engagement. Peer-prompting can increase social competence, discussion engagement, and peer inclusion (Velez et al., 2021; Arendale & Hane, 2014; Ackerman et al., 2021). Although there is substantial research evaluating the individual effects of facilitator and peer-prompting, limited research analyzes the simultaneous process of facilitator (adults) and peer-prompting often present in synchronous learning environments. This study provides a unique environment where facilitator/adults and peer-prompting coexist, allowing the two prompter roles to be compared.

Prompt type

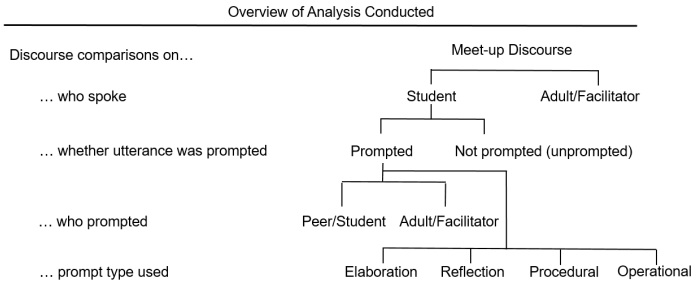
The overall aim of prompts is to stimulate learners on a meta-cognitive or cognitive level, fostering related learning processes in elaboration and reflection (Vogt et al., 2021; Morris et al., 2010). Derived from previous research, prompts are categorized into three types: elaboration, procedural, and reflection (Ge & Land, 2004; Rosenshine, Meister & Chapman, 1996). Elaboration prompts aim to elicit articulate thoughts and explanations (Ge & Land, 2004). By promoting explanatory responses and high-level thinking, learners effectively build upon their newfound knowledge and take the initiative in verbalizing cognition (Rosenshine, Meister & Chapman, 1996). Elaboration prompts aim to activate learning engagement by making semantic connections through explanatory and problem-solving components (Vogt et al., 2021). Reflection prompts aim for participants to voice introspection on a metacognitive level by focusing on problem-solving and personal reflection (Davis & Marcia, 2000). Increased self-evaluation and self-awareness correlate with students presented with reflection questions (Ge & Land, 2004). Completing specific tasks by implementing cognitive strategies is essential in a collaborative setting. Facilitators or moderators can also support the integration of procedural prompts. Either in the form of a question or suggestion, procedural prompts aim to provide constructive guidance in helping collaborative projects move forward (Rosenshine, Meister & Chapman, 1996).

Purpose of study

This project involves adolescent learners who participate in afterschool clubs to collaborate online with learners in other countries on developing digital media projects with STEM (science, technology, engineering, math) focused content. Clubs are located in several countries, including Brazil, Finland, Kenya, Mexico, and the United States. Club participants interact asynchronously by email or using Slack, a cloud-based team messaging platform, and synchronously through video conference calls known as global online "meet-ups." In meet-ups, student participants from at least two clubs join with a facilitator and adult observers support the conversation. This study probes the influence of prompting in promoting student engagement in this informal, online collaborative learning environment. Additionally, this work seeks to expand on previous studies by comparing both peer and facilitator (adult) roles in prompting. The layers of analysis are in Figure 1: an examination of meet-up discourse according to the utterance's speaker, the presence of a prompted utterance, the prompter, and the prompt type utilized.

Figure 1

Diagram showing levels of analysis addressed in the study.



Methods

This study examines discourse data from two online meet-ups held in 2018 and 2019 with secondary school participants from Kenya and the United States. Each turn of talk, or utterance, represented a single line of data. Two raters independently coded all lines for eight constructs, determined as the most relevant from a grounded analysis of the data: Collaborative Disposition, Content Focus, Curiosity, Feedback, Information Sharing, Media Production, Participatory Teaching and Social Disposition (refer to Table 1). Each utterance was analyzed for whether it was prompted by another line. For example, the response given by a participant to a specific, directed request for their input was classified as a prompted utterance. All other lines, including self-initiated elaborations and clarifications, were categorized as unprompted utterances. In addition, each prompted utterance was further assessed to determine whether it had been prompted by a peer (another student) or an adult participant (facilitator). The type of prompt associated with each prompted utterance was also classified into one of four categories: Procedural Prompt, Elaboration Prompt, Reflection Prompt, or Operational Prompt. Procedural, Elaboration, and Reflection categories were derived from literature, and Operational was added to address circumstances unique to the project's virtual environment such as technical status inquiries and general participant information (e.g. introductions). The final coding for each line of data was determined through a process of social moderation by the two raters (Herrenkohl & Cornelius, 2013).

Table 1
Codebook of Constructs Included in the Analysis

Code	Description	Example
Discourse Codes		
Collaborative Disposition	Promoting cooperation between two or more individuals to accomplish a project-related task, including help-seeking or help-giving behavior	*"So I was wondering if any of you guys could collaborate, just like record a museum or like tell me which museums are best for cultural landscapes in your area and it'll be greatly appreciated."*
Content Focus	Dialogue focused on the meet-up's STEM-related educational content	*"So when you talked about the coding, we used Lego Mindstorm app on the iPad to code the robots and use some sensors. For example, the sensor temperature and humidity sensor and the temperature-humidity sensor"*
Curiosity	Seeking clarification or further information for better understanding of STEM-related content or project	*"I would like to ask is, how cost effective is UV radiation for purifying water and how can you apply UV radiation on that scale?"*
Feedback	Communicating one's opinions/ideas or sharing suggestions on projects	*"What you can improve, you can add other things, for example, in that for making music. We can add some features which can include different types of music."*
Information Sharing	Sharing of personal experiences or contextual information relevant to the discussion (not explicit STEM facts)	*"Every student from our school knows how to program because like everybody is supposed to go through that lesson [in form 2]."*
Media Production	Dialogue related to the production of media artifacts	*" I do video production…so, I make a lot of videos and B roll is very important, just so we're not constantly going back to that same interview."*
Participatory Teaching	Helping others to learn STEM subject matter by providing factual information/content in explanation	*"We have several ways in which you can use to purify water. We can boil, we can use chlorine and other chemicals… You can also use the UV rays..."*
Social Disposition	Demonstrating pro-social tendencies, especially in expressing appreciation, acknowledgement or validation	*"The project was nice… I think you really taught it very well…it's a good project and yeah it can really and it can easily get on market because its well thought."*
Prompt Type Codes		
Elaboration Prompt	Aims to elicit feedback, articulate thoughts, and provide clarification	*"You feel like you are saying you learned…something about Arduino, you're also trying to learn about Arduinos, so what have you learned from the video?"*
Operational Prompt	Relates to technical status and general participant information	*"Can you hear me?"/"Would you like to introduce yourself?"*
Procedural Prompt	Provides examples or project suggestions in order to guide the completion of specific tasks	*"I just think it would be fun for someone from NYSCI to produce something and then maybe at the end we could cut them together."*
Reflection Prompt	Encourages introspection and self-evaluation on a metacognitive level	*"How has it helped your projects?"*

The coded data was examined using epistemic network analysis (ENA), a technique in quantitative ethnography utilizing statistical methods and visualization to identify meaningful patterns in discourse (Shaffer, 2017). ENA models the connections among salient constructs, or codes, in the data by quantifying the relative frequency of their co-occurrences in a recent temporal context (Siebert-Evenstone et al., 2017). A moving window is used to produce a network model for each line of the data by identifying the co-occurrence of codes between a given line and preceding lines in the conversation. The connections for each line of data are then accumulated at the level of the unit of analysis, resulting in network graphs where the nodes represent the codes in the data and the edges correspond to the strength of connection between each pair of codes. For this study, a participant was defined as the unit of analysis, and each meet-up determined to be a conversation to which the connections were limited. Based on a grounded analysis of the data, a moving window of 5 lines (each line plus 4 previous lines) was applied.

ENA was used to examine the discourse patterns of student utterances along three dimensions. The first dimension compared the discourse patterns of prompted versus unprompted student utterances, while the second considered the effect of the prompter—the individual providing the prompt—on student discourse patterns. Comparisons were conducted on the networks of utterances prompted by peers and those prompted by adult participants. Third, the differences in discourse patterns of student utterances prompted by varying types of prompts were explored.

Results

Redefining the way we communicate, advancing technological tools encourage meaningful connections between culturally diverse individuals. No longer limited by the geographical barriers associated with synchronous in-person exchange, online tools expand students' abilities to collaborate globally and with more even footing. Creating an inclusive environment for students as they navigate the online space allows learners to develop skill sets in creative inquiry, active engagement, and social competence (Kreijns et al., 2013). One way to foster an inclusive environment is by implementing prompting into the learning environment.

Prompting is designed to elicit creative thought and critical engagement by guiding learners with hints, feedback, and guiding inquiry (Hammond & Manfra, 2009; Harney et al., 2015). The study examines prompting among three categories: the presence of prompting, the prompter, and the prompt type. A close examination of prompts could elicit insight into strategies that could nurture productive discourse in online group settings as education institutions begin to immerse themselves in virtual communication tools.

Descriptive findings: Who spoke

This study analyzed a total of 699 utterances from meet-ups that occurred in November 2018 and May 2019. Table 2 presents a descriptive summary of the data. A total of 15 students from Kenya and the U.S. participated in these meet-ups. Of the 425 lines spoken by students, about 34% of utterances were prompted, while unprompted utterances made up around 66%. This approximately 1:2 ratio of prompted to unprompted utterances were observed in both meet-ups. A closer examination of the prompted utterances spoken by students found that about 24% were prompted by peers while around 76% were prompted by adult participants. Some differences were observed in the proportion of peer versus adult prompted utterances across the two meet-ups, which may be due to the higher number of student participants in the May 2019 meet-up. As for the type of prompts that elicited responses from students, Elaboration Prompts were found to be the most prevalent, resulting in about two-thirds of all prompted utterances. Operational Prompts, which deal mainly with the aspects of meet-ups, constituted about 24%. Procedural and Reflection Prompts were observed in lower proportions, consisting about 6.3% and 2.8% of prompted utterances, respectively.

Table 2
Descriptive Summary of the Data Analyzed in this Study

	Meet-ups				Total	
	Nov 2018		May 2019			
All Participants	**9**		**12**		**21**	
Students	6	*(66.7%)*	9	*(75.0%)*	15	*(71.4%)*
- U.S.	4		5		9	
- Kenya	2		4		6	
Adults	3	*(33.3%)*	3	*(25.0%)*	6	*(28.6%)*
- Facilitator	1		1		2	

- Observer	2		2		4	
All Utterances	**355**		**344**		**699**	
Students	188	*(53.0%)*	237	*(68.9%)*	425	*(60.8%)*
Adults	167	*(47.0%)*	107	*(31.1%)*	274	*(39.2%)*
Student Utterances						
Unprompted	122	*(64.9%)*	160	*(67.5%)*	282	*(66.4%)*
Prompted	66	*(35.1%)*	77	*(32.5%)*	143	*(33.6%)*
Prompted Student Utterances						
by Prompter						
Peer	10	*(15.2%)*	24	*(31.2%)*	34	*(23.8%)*
Adult	56	*(84.8%)*	53	*(68.8%)*	109	*(76.2%)*
by Prompt Type						
Procedural	2	*(3.0%)*	7	*(9.1%)*	9	*(6.3%)*
Elaboration	50	*(75.8%)*	46	*(59.7%)*	96	*(67.1%)*
Reflection	2	*(3.0%)*	2	*(2.6%)*	4	*(2.8%)*
Operational	12	*(18.2%)*	22	*(28.6%)*	34	*(23.8%)*

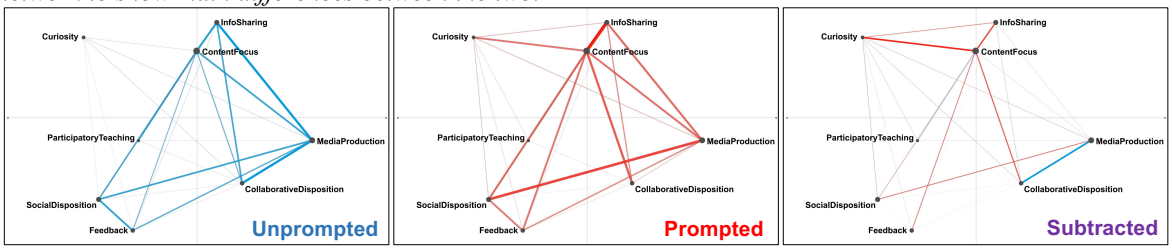
Discourse patterns of student utterances

Was it prompted? Unprompted vs. prompted utterances of students (presence of prompting)

The first analysis compared the discourse patterns of prompted and unprompted student utterances. Figure 2 displays the ENA network models for the prompted and unprompted utterances spoken by student participants during the two meet-ups. The individual networks—shown in (a) and (b)—exhibit similarities in the strongest connections between several codes. In particular, it can be seen through heavier saturation of the edges and nodes that Content Focus plays a central part in both networks, with prominent associations to Information Sharing, Social Disposition, and Media Production, among others. The main differences between the two networks are more readily visible in the subtracted network shown in (c). It can be seen that the connection between Media Production and Collaborative Disposition was prominent in the unprompted utterances. On the other hand, the linkage between Content Focus and Curiosity was stronger in the prompted utterances, along with thicker connections between Content Focus, Collaborative Disposition and Information Sharing.

Figure 2

ENA networks for (a) unprompted and (b) prompted utterances of student participants, also (c) subtracted network to show main differences between the two.



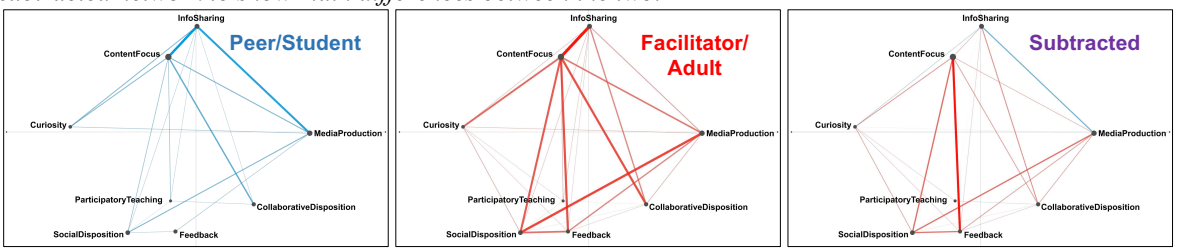
(a) (b) (c)

Who Prompted? Peer vs. adult prompted utterances of students (prompter)

The next analysis focused on examining the discourse patterns of student utterances which were spoken in response to prompts from peers or adults. The ENA networks appear in Figure 3. The connection between Content Focus and Information Sharing is prominent in both networks, indicating its significance in the discourse of prompted utterances regardless of whether they were elicited by adults or peers. From the individual networks, it can be seen that utterances prompted by adult participants demonstrate greater connections among the constructs of Content Focus, Social Disposition and Feedback. In addition, a strong association is observable in the adult prompted utterances between Social Disposition and Media Production. However, peer prompted utterances were more focused on Information Sharing and Media Production.

Figure 3

ENA networks for student utterances prompted by (a) student peers and (b) facilitator/adults and (c) subtracted network to show main differences between the two.



(a) (b) (c)

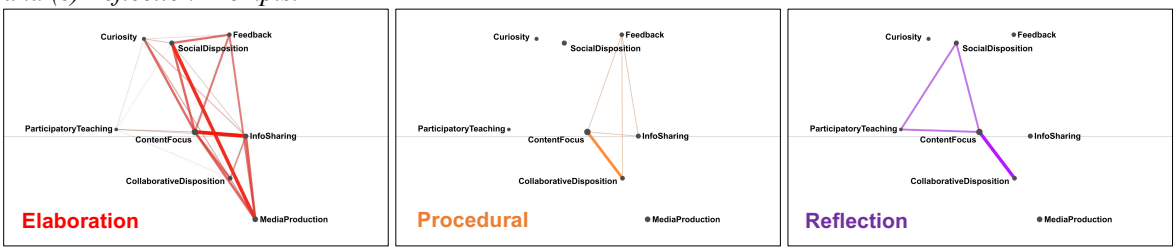
How was it prompted? Student utterances by type of prompt

Next, ENA networks were produced to represent the discourse patterns of student utterances according to the type of prompt that had elicited them (Figure 4). As noted earlier, Elaboration Prompts were the most frequently observed. For this reason, the network for the utterances spoken in response to Elaboration Prompts (a) indicate strong connections between multiple codes, including Social Disposition, Media Production, Information Sharing and Content Focus. The network for student utterances associated with Procedural Prompts (b) shows a thick linkage between Content Focus and Collaborative Disposition. The most prominent connection in the network for utterances related to Reflection Prompts (c) is between Collaborative Disposition and Content Focus; however, significant bonds can also be observed among Social Disposition, Participatory Teaching and Content Focus.

While about one-fourth of all prompted utterances were in response to Operational Prompts, no connections were found among its discourse codes. This meant that no network edges were generated for the Operational Prompts model. Lastly, statistically significant differences were found in the location of the group means of utterances elicited by the various prompt types. Mann-Whitney tests showed that utterances resulting from Elaboration Prompts (Mdn = 0.43, N = 15) were statistically significantly different along the x-axis from those responding to Reflection Prompts (Mdn = -0.56, N = 4, $U = 5.00$, $p = 0.01$, $r = 0.83$) and Procedural Prompts (Mdn = -0.56, N = 7, $U = 12.00$, $p < 0.01$, $r = 0.77$). Similarly, a Mann-Whitney test found a significant difference along the y-axis between utterances related to Elaboration Prompts (Mdn = 0.26, N = 15) and Procedural Prompts (Mdn = -0.36, N = 7, $U = 12.00$, $p < 0.01$, $r = 0.77$).

Figure 4

ENA networks for student utterances spoken in response to (a) Elaboration Prompts, (b) Procedural Prompts and (c) Reflection Prompts.



(a) (b) (c)

Discussion

The above results illustrate the impact of prompting on discourse patterns exhibited by participants in an informal, global, virtual collaborative learning environment. In examining prompted and unprompted utterances from students, prompted responses have more prominent connections to content and other constructs, notably with Curiosity, Information Sharing, Collaborative Disposition and Feedback. This shows how much prompting promotes discourse related to content. Unprompted utterances uniquely drew a noticeable connection independent of content, between Collaborative Disposition and Media Production, speaking to the natural desire for students to discuss making media artifacts together. For example, after one Kenyan student shares their project idea, a U.S. student suggests insights on video production and offers to help.

U.S. PARTICIPANT	So usually in a video, the preproduction is the most important. And if you need any help with the script, like we're here for you. So there's slack and there's [our] email. So if you ever need any help on that we got you.

In examining prompted utterances between those prompted by peers versus adults, adult prompting was more responsible for stronger connections related to content, encouraging students to affirm projects presented and provide feedback. Adult prompting also helped create a connection between Social Disposition and Media Production, where students also affirmed the media aspects of the presented projects. In contrast, peer prompting helped students to draw connections with Information Sharing between Media Production and Content Focus, reflecting a more informal approach to prompting, which complements the more intentional content-focused prompting by adults. In this excerpt, a Kenyan student asks a more general question about the U.S. student's project update, and the U.S. student elaborates on their experience in making their video.

KENYAN PARTICIPANT	Can you please tell me—are you trying to come up with a new energy [source]?... Basically, if you can just briefly tell me what is going on [in your project video].
U.S. PARTICIPANT	…we sort of like did like that that stereotypical Americanized debate show. Where like two people on the sides and one the host in the middle. And they just talk it out and like have a big argument and stop. That's all we were trying to go for like in a dark setting and stuff…We wanted to keep the audience, like, entertained while also being informed, informed of the risks of fossil fuels. And like the benefits of biofuels, we also tried to get both arguments as well.

Looking at utterance patterns by prompt type, Elaboration Prompts provided the most diverse network model, an anticipated outcome as the most used prompt type in the global meet-up setting. Use of elaboration prompting saw students making various connections, notably fostering utterances around informal sharing about content and affirming the media production of the project presented. While Procedural and Reflection Prompts were less frequently used, they helped to connect content related collaboration.

These results highlight how unscripted prompting from both student peers and facilitators/adults helps to generate rich, diverse responses connected to content and curiosity that might not otherwise take place. Overall, strong content connections from prompted utterances complemented the unprompted student utterances, which focused on collaborative and media aspects (such as expressing the desire to work together on the media for a project). While not scripted, intentional prompting from adults is primarily responsible for fostering connections to content, though peers are able to mirror this behavior while also focusing on more informal sharing of experiences, as seen with focusing on info sharing around media creation. This informal focus complements the more intentional adult prompting emphasis on content, and highlights the importance of creating safe social spaces for peers to feel encouraged and comfortable to prompt others and not rely solely on (adult) facilitator prompting. Creating a mixed intergenerational environment where the student peers and adults/facilitators co-exist without expected hierarchy from the latter helps to promote such complementary prompting. Positive interactions and engagement have already been seen when a teacher takes the position of being a coordinator of learning rather than a dispenser of learning (Audrain et al., 2022).

Among the prompt types, Elaboration Prompts are the most natural prompt approach in a project sharing and collaboration setting while also being key to diversifying conversation. Such prompts do not have to be scripted, but important for adult facilitators to be encouraged to utilize and model, which in turn can be further adopted naturally by peers in discourse.

While this study focused on looking at different levels of prompting within global meet-ups, the use of ENA provides additional possibilities to consider for further examination. This study did not fully address the cross-cultural nature of this setting. An examination of prompting influence by country could provide insights on whether prompts impact the discourse patterns of participants from particular countries in different ways. Similarly, such differences could be examined along other metadata, such as gender of the participant or prompter. Further examination of Elaboration Prompts by who and when (using a time segment analysis) could reveal more ways to understand how to promote discourse. The methodological approach of quantitative ethnography allows for data to be examined in different ways that can further uncover insights on the role of prompting in fostering diverse discourse in global, collaborative virtual learning environments.

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