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Where Literacy Meets Geography: Using Talk Moves to Engage Students in Geographical Data

Lin Yunqing

National Institute of Education (Singapore)

Abstract

From a perspective of social constructivism, literacy is shaped by social practices (Moje, 1996) and serves the purpose of knowledge construction in a discipline (Moje, 2008). To help students become "geographically literate" (Dolan, 2019) entails equipping them with skills to make sense of and critique geographical data presented in multimodal formats (Roberts, 2014) by creating more space for geographical dialogue in the classroom. This paper first discusses the relationship between talk and students' ability to analyse and account for geographical data. Using the evidence of a questionnaire survey, it examines the impact of Talk Moves in supporting dialogic teaching in 3 Singapore's secondary geography classrooms. Statistics show that Talk Moves helped students improve their analytical skills for geographical data and their ability to articulate answers in a geographical manner. However, more support could be provided to enhance students' classroom participation and their writing based on geographical data.

Introduction

The theoretical foundation of this study is social constructivism which believes that knowledge is produced and constructed in a social setting. This socialcultural perspective emphasises that literacy is shaped by social practices (Moje, 1996) and serves the purpose of knowledge construction in a discipline (Moje, 2008). It builds students' understanding of the acceptable form of "socialisation into how members of a community talk, write, and participate in knowledge construction" (Quinn, Lee, & Valdés, 2012, p. 49). Like other disciplines, the geography epistemic community has its own ways of seeing and understanding the world (Roberts, 2013) which are different from "everyday thinking" (Lambert, 2017, p. 20).

The demands of each discipline determine the literacy skills that students need to address the domain-specific problems of the discipline in question (Brozo, Moorman, Meyer, & Stewart, 2013). From a geo-literacy perspective, the implementation of a literacy approach in geography should then serve the needs of geographical learning by taking into account the characteristics of knowledge formation and interaction in that discipline (Burke & Welsch, 2018). Therefore, the social construction of geographical knowledge requires students to be "geographically literate" in order to effectively comprehend geographical information, engage in reasoning, communicate their ideas and make informed decisions (Dolan, 2019). Geography teachers draw upon a rich range of data representations to bring the geographical concepts to life in their teaching (Lambert & Balderstone, 2010) and guide students in studying physical and socio-cultural phenomena, and interactions

between people and their environments. These data representations include graphs, maps, photos, sketches, table of figures and texts (CPDD, 2013). Therefore, to help students become "geographically literate" entails equipping them with skills to make sense of and critique geographical data presented in multimodal formats (Roberts, 2014). Such data analytical skills are also required in Singapore's Geography curriculum (CPDD, 2013):

1) Extract relevant information from geographical data;
2) Interpret and recognize patterns in geographical relationships data;
3) Analyse, and evaluate and synthesize geographical data to make informed and sound decisions.

A geography classroom should provide ample opportunities for teachers and students to engage in meaningful socialisation around geographical data and communicate with one another using geographical discourse. This paper sets out to investigate the relationship between talk and students' ability to analyse and account for geographical data.

Talking to learn

Though the geography classroom is replete with talk around geographical data, geography teachers might still face difficulty in scaffolding students' active engagement with data (Seow, 2015). This could be because students are not given enough opportunities to engage with the task. Here "engaging students" implies more than just providing a task for them to work on or showing them stimulating learning resources. As much as they are important in triggering students' interest, if the task/resource is not unpacked by encouraging students' talk in the classroom, students will still be playing the role of passive listeners and knowledge receivers instead of as active learners. Alexander (2004) argued that "children, we now know, need to talk, and to experience a rich diet of spoken language, in order to think and to learn…Talk is arguably the true foundation of learning (p. 9)." Students need to talk to learn. However, classroom talk is often asymmetrical (Mercer & Dawes, 2008) with the teacher taking an authoritative role to impose his/her way of thinking and the students following (Morgan & Lambert, 2005).

This led me to think about the quality of classroom talk. A "noisy" class involving multiple questioning and answering exchanges does not necessarily guarantee learning. A closer examination of such classroom talk will show us that it is the teacher who controls the knowledge construction. Teachers' questions are usually less cognitively demanding questions (Kawalkar & Vijapurka, 2013) and a teacher may be satisfied with surface-level answers which contain information often from students' memory and are not built on one another's ideas. In other words, such interaction lacks depth (Zwiers & Crawford, 2011). As a result, unengaged students remain quiet and high-achieving or active students always give good answers, leaving the teacher no choice but to move on to the next question. On the contrary, dialogical teaching assumes that "knowledge is something people do together rather than an individual possession" (Lyle, 2008, p. 225).

A dialogic classroom aims to construct common understanding by offering structured, cumulative talk that prompts, provides guidance, and reduces choices, risks and errors (Alexander, 2004). The goal is to conduct an authentic dialogue that is more extended, equitable and meaningful. It exerts the power of talk to foster productive students' engagement, and scaffold and extend their thinking

(Alexander, 2004), and eventually advance their understanding and lead to deeper learning (Michaels & O'Connor, 2012).

Dialoguing to be geo-literate

Roberts (2013) defined geographical talk as "talking about the subject matter of what was being studied or investigated" (p. 96). In a dialogic classroom, the teacher invites students to be a contributor to the dialogue. When students are engaged in geographical talk around data, the teacher uses dialogue to support students in organising their thoughts, clarifying, identifying evidence to support their opinions, reasoning, summarising (Zwiers & Crawford, 2011; Lambert & Balderstone, 2010) and eventually writing which are core literacy skills in geography that students should acquire. Also, as students are immersed in the geographical dialogue, it enables students to practice geographical specialised language that they have been exposed to, using sources such as the teacher, learning resources (e.g. textbooks and worksheets), and their peers (Zwiers & Crawford, 2011). The use of appropriate geographical language should be encouraged in students' geographical talk and writing in order to effectively and accurately communicate their ideas. With the increased amount of student articulation (Boyd & Markarian, 2011), the teacher has "something" to work on, which means the teacher can assess students' responses and develop a more discriminating disciplinary discourse together with the students. It would be a lot more difficult for students to develop these geo-literacy skills and geographical language skills in a teacher-centered monologic classroom culture due to the lack of practice.

Talk Moves

To build a dialogic geography classroom is, no doubt, a big challenge because it involves changing entrenched habits for both students and teachers (Bignell, 2012). Students need to practice active listening in order to build on one another's responses and the teacher needs to make strenuous effort to improve their questioning skills and structure their talk to meet students' learning needs. Michaels & O'Connor (2012) outlined four goals that teacher can work towards:

1) Help individual students share, expand, and clarify their own thoughts;
2) Help students listen carefully to one another;
3) Help students deepen their reasoning;
4) Help students engage with others' reasoning.

They also provided strategic questioning frames for teachers to support students' participation and reasoning. Grounded in the theories of dialogic teaching, and Michaels and O'Connor (2012) and Zwiers & Crawford (2011)'s work, the English Language Institute of Singapore (ELIS) adapted Talk Moves for local primary and secondary classrooms (see Appendix A). Each Focus Area can be adapted by the geography teacher to facilitate talk around geographical data. For example, Focus Area 3 – Probe for reasoning or evidence – can be used to prompt students to provide evidence from the data to support their argument, and Focus Area 4 – elicit a student's view on another student's idea – requires students to identify the missing parts in another student's reasoning and complete it with more evidence or prior knowledge.

Talk Moves have been incorporated by Singapore teachers in biology (Ho, Wong, & Rappa, 2019), mathematics (Vijayakumar, Wong, Adams, & Lee, 2015), and geography (Vijayakumar et al., 2015) classrooms. These studies suggested

that teachers became more conscious in their use of Talk Moves to facilitate students' knowledge construction. However, very little empirical evidence, especially quantitative evidence, has been provided on the usefulness of Talk Moves in engaging students in geographical data analysis from the student's perspective. This led me to ask if the use of Talk Moves enhanced students' geographical literacy (including analytical skills for geographical data, articulating answers in a geographical manner, writing a geographical account based on data) and students' classroom participation.

Methodology

In this study, I drew on a collaboration with 3 geography teachers with classes in 2 different mainstream secondary schools in Singapore. Students were at lower to upper secondary level of study and ranged from 13 to 15 years of age. Table 1 provides more details of the classes involved. School 1 drew from a wide range of students from both upper-middle to lower socio-economic levels, while School 2 had students largely from middle to lower levels of socio-economic backgrounds. Students from Class 1 generally had average or below average academic ability, whereas Class 2's students showed average academic performance. The study involved 2 research cycles. In each research cycle, the research team helped teachers incorporate Talk Moves into 3 of their lesson plans where geographical data would be used, which totaled 6 lessons for each class. After each cycle, an anonymous questionnaire survey (see Appendix B) was conducted with the students to find out their perceptions of 1) whether their analytical skills for geographical data improved; 2) if they became better at articulating their answers in a geographical manner; 3) if they became better at writing a geographical account based on data; and 4) whether they became better able to contribute to classroom discussions.

Table 1. Profiles of Classes Involved

		School 1	School 2	
	Teacher	Teacher 1	Teacher 2	Teacher 3
	Class & Grade	Class 1 Upper secondary	Class 2 Lower secondary	Class 3 Upper secondary
Cycle 1	No. of participants	25	36	24
	Total no. of participants (*n*)		85	
Cycle 2	No. of participants	22	35	25
	Total no. of participants (*n*)		82	

Note: n = sample size.

The survey consisted of 17 Likert-scale questions. Questions 1 to 6 were designed to measure the dependent variable "analytical skills for geographical data", while Questions 7 to 10 are for measuring "articulating answers in a geographical

manner", Questions 11 to 14 for "students' classroom participation" and Questions 15 to 17 for "writing a geographical account based on data". All the responses were then converted to numerical data for data imputation. "Strongly Agree" was coded as 4; "Agree" as 3; "Disagree" as 2; and "Strongly Disagree" as 1. Data that was missing completely at random (MCAR) was imputed with the column mean of the same class. There were 3 responses where students marked between the boxes of "Agree" and "Disagree" intending to indicate neutral perception towards the corresponding questions. Hence, I used the mean value 2.5 (= (3 + 2) / 2) for the answers in those responses. To address the research questions, I calculated the proportions of all students' ratings of the questions to look at their overall perception.

Findings and discussion

This section discusses the key findings from the surveys. In general, students were positive about the impact of Talk Moves in classroom discussion around geographical data. I will unpack the findings for each dependent variable below.

Analytical skills for geographical data

The quantitative findings suggest that in general, students felt that Talk Moves helped them improve their skills in analysing geographical data. As shown in Questions 1 to 6 in Table 2, after two research cycles, the majority of the students believed that they were better able to understand the requirements of the questions, decode the data representation, identify and account for the patterns and anomalies. Specifically, as represented by Figure 1, 29.27% (n = 82) of students strongly agreed that they became more competent in understanding what the data is showing. It is equally worth highlighting that 28.05% (n = 82) of students saw greater improvement in identifying key words in the data and 24.39% (n = 82) of them perceived that they improved in identifying the anomalies in the data.

As Barnes (1976) stressed, students talk their way into meaning to increase their knowledge and develop their understandings of the topics. The dialogic classroom that promoted whole-class cooperation in making sense of the geographical data through teacher's use of Talk Moves opened up a floor for students to talk about the demands of the tasks and the meanings of data representations. They also shared their observations about the data including patterns and anomalies and accounted for the phenomena presented in data with their geographical knowledge. Talk Moves such as "What do you mean by…?" and "Can you put in your own words what Student X just told us?" probed students to make their own or others' ideas clearer to the whole class and built a common understanding of the data. The use of Talk Moves that elicited a student's view on another student' idea, for example "Do you agree or disagree…?", encouraged students to reflect on others' ideas and help each other make more accurate observations of the data. This is important to understanding and analysing the data because students were given opportunities to explore different ways of meaning making and to modify existing ideas through the support of the teacher and other students (Hogan, Rahim, Chan, Kwek, & Towndrow, 2012). When students' ideas are elicited, valued, and built on by another student's contribution, the teacher's talk will become less "presentational" (Barnes, 1976) and function as a facilitator of classroom discussion and knowledge construction led by the students.

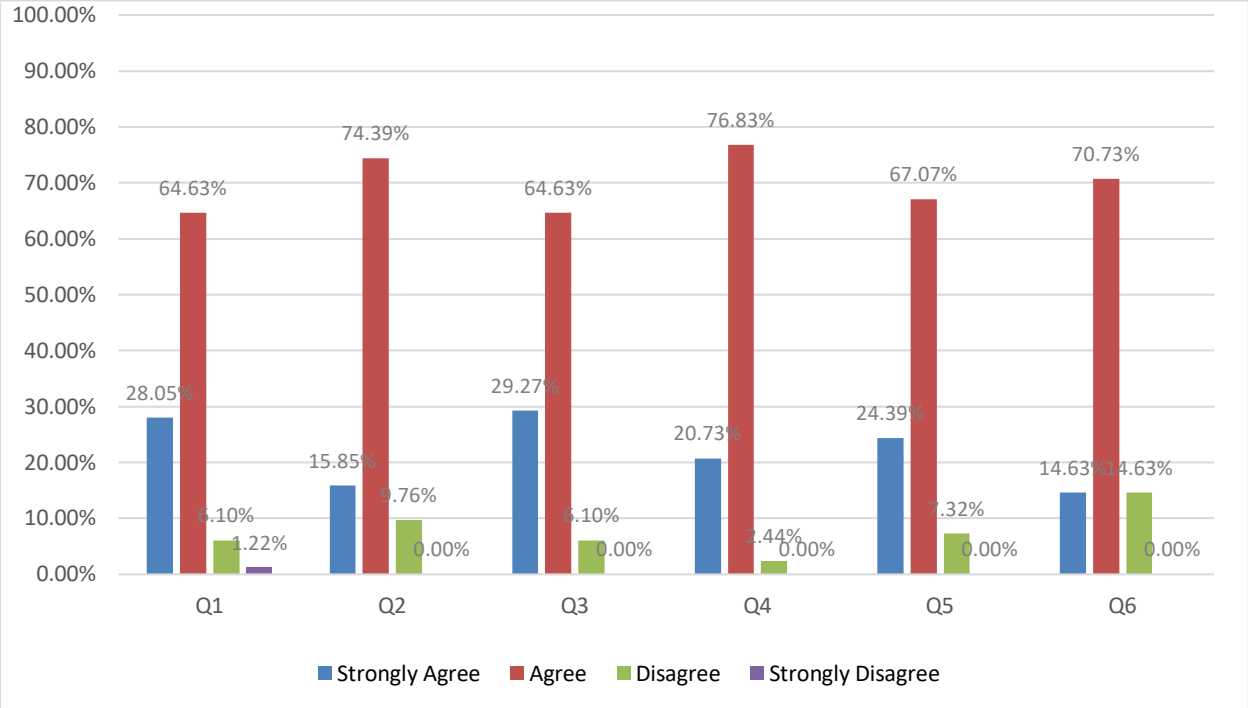
Table 2. Percentages of students who strongly agreed/agreed to Questions 1 to 6 for research cycle 1 and 2.

Survey question	Q1	Q2	Q3	Q4	Q5	Q6
Cycle 1 (n = 85)	89.41%	82.35%	94.12%	89.41%	85.88%	87.06%
Cycle 2 (n = 82)	92.68%	90.24%	93.90%	97.56%	92.68%	85.37%

Question 1: Identify the key words in the question.
Question 2: Explain in my own words what the question is asking me to do.
Question 3: Understand what the data (graph, map, etc.) is showing.
Question 4: Identify the patterns/trends in the data (graph, map, etc.) is showing.
Question 5: Identify the anomalies in the data (graph, map, etc).
Question 6: Provide possible reasons for the patterns and/or anomalies in the data (graph, map, etc).

Note: n = sample size; Q = Question.

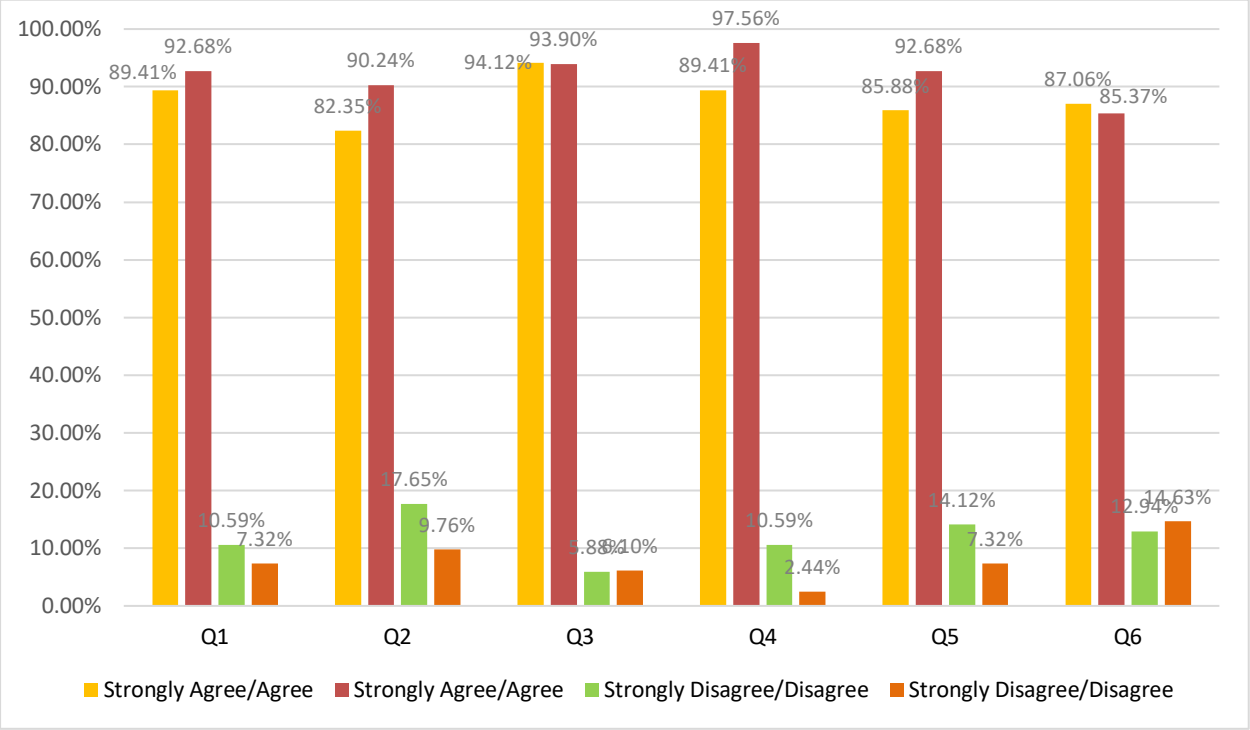
Figure 1. Responses to Questions 1 to 6 on students' analytical skills for geographical data after Cycle 2



Note: Q = Question

To compare Cycle 2 with Cycle 1, I computed the mean of each response for this dependent variable (analytical skills for geographical data) and used a t-test in order to further measure the significance of the overall increase. Unfortunately, there was no statistical significance ($p = 0.106$) due to the large mean and small standard deviation of the sample in Cycle 1. Nevertheless, it is noteworthy that the percentage of students who strongly agreed or agreed that they were better able to "explain in their own words what the question is asking them to do" increased from 82.35% (n = 85) to 90.24% (n = 82) (see Figure 2). The proportion of students who believed that they were better able to "identify the patterns/trends in the data" increased by 8.15% from 89.41% (n = 85) to 97.56% (n = 82) (see Figure 2). These two skills lay a solid foundation for students to reach an accurate interpretation of the data, deduce relationships (CPDD, 2016) and construct a logical explanation.

Figure 2. Comparison of responses to Questions 1 to 6 on students' analytical skills for geographical data between Cycle 1 and Cycle 2



Note: Q = Question.

Articulating answers in a geographical manner

Dialogic teaching provides a testing ground for students to articulate their original answer as a tentative contribution (Mercer & Dawes, 2008) which the teacher or other students can then work on to improve collaboratively in verbal and written formats. As summarised in Table 3, the majority of students indicated that Talk Moves had a positive effect in encouraging them to express their thinking regarding the data. Although there was no drastic increase in the proportions, having been through 2 research cycles, 92.68% (n = 82) of students felt that their ability to describe the data to the class was increased and 93.90% (n = 82) of them were more confident that they could describe the relationships in the data.

In the lessons powered by Talk Moves, the teacher drew on his/her language knowledge for content teaching (Morton, 2018) to initiate the correction of students' use of vocabulary, invite students to use appropriate geographical terms or clarify the meanings of the terms, and encourage them to describe the data and reason using academic language that is precise and concise. Talk Moves such as "So you are saying that…" or "I wonder if you mean…" allowed the teacher to revoice the students' ideas by replacing their vernacular language with the specialised language that is conventionally used by geographers. The teacher would also lead other students to repeat and improve on the responses by asking "Can you repeat what Student X said in a more geographical way?" By employing Talk Moves, the teacher was able to model a disciplinary way to describe and account for geographical data, and allowed students to help one another using the language knowledge they learned or brought into the classroom. As the teacher and students get accustomed to such interactive modes, it will foster a more collaborative learning environment for the class. Most importantly, the teacher nudged the students to use their linguistic resources, which in the long run has the potential of increasing students' awareness in not only what they are answering but also how they should elaborate their ideas to the class (Gibbons, 2001).

Table 3. Percentages of students who strongly agreed/agreed to Questions 7 to 10 for research cycle 1 and 2.

Survey question	Q7	Q8	Q9	Q10
Cycle 1 (n = 85)	82.35%	90.59%	90.59%	85.88%
Cycle 2 (n = 82)	86.59%	92.68%	93.90%	81.71%

Question 7: Use appropriate geographical terms in my answers in class.
Question 8: Describe the data (graph, map, photograph, etc.) used in a class discussion.
Question 9: Describe the relationships in the data (graph, map, photograph, etc.) used in a class discussion.
Question 10: Explain and give reasons for my answers in a class discussion about data (graph, map, photograph, etc.).

Note: n = sample size; Q = Question.

Students' classroom participation

Dialogic teaching requires both teacher and students to take on new identities in the classroom. The teacher needs to use a variety of questioning techniques to elicit students' opinions on other students' responses, while students are expected to be active listeners so as to understand their peers' answers and make meaningful contributions or extensions to the discussion (O'Connor & Michaels, 2019). This is how dialogue can be sustained. However, it takes time to achieve this change of students' role because they are used to taking teacher's talk as the most important source of information and waiting for teacher's evaluation of other students' responses. Some students may have discomfort in pointing out other students' mistakes and challenging them (Robins, 2011), because again, it is usually considered the teacher's job. This could be the reason why I did not see a noticeable

increase in the percentages in this set of questions except Question 12 (see Table 4), though a large number of students still believed they made improvement. Roberts (2013) suggested that teachers discuss with students to set explicit ground rules. These ground rules can include "listen", "show respect", "be considerate", etc., and teachers need to remind the students of the rules if necessary. Over time, a conducive environment will be created for the students to feel safe in commenting on other's mistake or misconceptions (Ho, Wong, Leong, Talib, & Lim, 2017) and offering their ideas without waiting for the teacher's "standard answer".

Table 4. Percentages of students who strongly agreed/agreed to Questions 11 to 14 for research cycle 1 and 2.

Survey question	Q11	Q12	Q13	Q14
Cycle 1 (n = 85)	84.71%	74.12%	80.00%	88.24%
Cycle 2 (n = 82)	87.80%	81.71%	76.83%	87.80%

Question 11: Tell whether my classmate's response to the data (graph, map, photograph, etc.) is similar or different from my own in a class discussion.
Question 12: Tell whether my classmate's response to the data (graph, map, photograph, etc.) is accurate and clear in a class discussion.
Question 13: Add onto my classmate's response with evidence from the data (graph, map, photograph, etc.).
Question 14: Summarise the main points of the discussion.

Note: n = sample size; Q = Question.

Writing a geographical account based on data

Going beyond classroom discussion, I measured the effect of dialogic teaching in translating students' talk to writing. Statistical results in Table 4 suggest that students were generally positive about their improvement in writing an account based on the geographical data, but most of the percentages were lower than 90%. It is not a surprise that the Talk Moves approach did not have a similar level of impact on students' writing as on the other variables (i.e. "analytical skills for geographical data" and "articulating answers in a geographical manner"). Myhill and Jones (2009) argued that the patterns of writing are more subtle and may take longer for students to acquire. Writing is still a salient issue in Singaporean students' geography learning. They struggle with explaining their thoughts effectively (Hassan & Toh, 2018) and coherently (Sukimi, Lim, Tamsir, Tan, & Wong, 2018) through writing. Teachers, as well as educational researchers, need to take students' difficulties in writing into account when exploring the connection between talk and writing. For this variable, I looked into the proportions within a class and identified that in Class 1, 24% more students thought that they could write a well-organised answer in response to questions about data after Cycle 2. This gives future research an interesting direction – how teachers adapt Talk Moves to guide students in structuring their argumentative writing.

Table 5. Percentages of students who strongly agreed/agreed to Questions 15 to 17 for research cycle 1 and 2.

Survey question	Q15	Q16	Q17
Cycle 1 (n = 85)	84.71%	92.94%	76.47%
Cycle 2 (n = 82)	87.80%	89.02%	81.71%

Question 15: Use appropriate geographical terms in my written answers.
Question 16: Support my answer with evidence from the data (graph, map, etc.).
Question 17: Write a well-organised answer in response to questions about data (graph, map, etc.).

Note: n = sample size; Q = Question.

Conclusion

Developing students' geographical literacy means teaching them skills to process and analyse geographical data and explain the phenomena presented by the data. To help them obtain these skills, we need to engage students with the data through a more dialogic teaching approach. The Talk Moves approach was designed to encourage teachers to be more purposeful in using talk, especially questioning, to create a dialogic learning experience for the students. It can be used to elicit more students' responses regarding their observations and understanding of the data for a meaningful discussion and provide opportunities for them to practice disciplinary language.

This study examined the impact of integrating Talk Moves to promote dialogic teaching in Singapore's secondary geography classroom. Of specific interest was whether the integration enhanced students' geography literacy skills including analytical skills for geographical data, articulating their answers in a geographical manner, writing a geographical account based on the data, and their participation in class. Statistical evidence suggest that Talk Moves helped students improve their analytical skills for geographical data and their ability to articulate answers in a geographical manner. Though there is insufficient inferential statistics to further illustrate the findings due to the constraints in data collection, this study has demonstrated the overall positive perception of students regarding the use of Talk Moves and outlined areas related to dialogic teaching that are worth studying in depth in the future.

I also call for more pedagogical support for teachers to enhance students' classroom participation in building a safe classroom for students to be more critical towards each other's answers and to be active learners. More focus can be given to the relationship between students' talk and writing based on geographical data.

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References

Alexander, R. (2004). *Towards dialogic teaching: Rethinking classroom talk.*

Cambridge, UK: Dialogos.

Barnes, D. R. (1976). *From communication to curriculum.* Harmondsworth: Penguin Education.

Bignell, C. (2012). Talk in the primary curriculum: Seeking pupil empowerment in current curriculum approaches. *Literacy*, *46*(1), 48–55.

Boyd, M. P., & Markarian, W. C. (2011). Dialogic teaching: Talk in service of a dialogic stance. *Language and Education*, *25*(6), 515–534.

Brozo, W. G., Moorman, G., Meyer, C., & Stewart, T. (2013). Content area reading and disciplinary literacy: A case for the radical center. *Journal of Adolescent & Adult Literacy*, *56*(5), 353–357.

Burke, P., & Welsch, J. G. (2018). Literacy in a 'broad and balanced' primary school curriculum: The potential of a disciplinary approach in Irish classrooms. *Irish Educational Studies*, *37*(1), 33–49.

Curriculum Planning and Development Division, Ministry of Education. (2013). *Teaching and learning guide for geography*. Singapore: Curriculum Planning and Development Division, Ministry of Education.

Curriculum Planning and Development Division, Ministry of Education. (2016). *Geography syllabus*. Lower Secondary: Express and Normal (Academic) courses. Singapore: Curriculum Planning and Development Division, Ministry of Education.

Dolan, A. M. (2019). Geoliteracy: An approach to enquiry-based learning for Junior Cycle Geography students in Ireland. *Teaching Geography, 44*(1), 24–27.

Gibbons, P. (2001). Learning a new register in a second language. In C. Candlin & N. Mercer (Eds.), *English language teaching in its social context* (pp. 258–270). London: Routledge.

Hassan, Z. B., & Toh, H. H. D. How does formative, written feedback help students improve their geographical writing. *HSSE Online, 7*(1), 53–76.

Ho, C., Wong, A., Leong, C. P., Talib, S. & Lim, A. (2017). Enhancing students' content learning through productive classroom talk in Primary Science. *Subject Literacy Inquiry Digest, 2*, 4–8. Retrieved from https://academyofsingaporeteachers.moe.edu.sg/docs/librariesprovider2/classroom-inquiry---subject-literacy/sl-digest2.pdf

Ho, C., Wong, J. K. Y., & Rappa, N. A. (2019). Supporting students' content learning in Biology through teachers' use of classroom talk drawing on concept sketches. *Journal of Immersion and Content-based Language Education, 7*(2), 233–260.

Hogan, D., Rahim, R. A., Chan, M., Kwek, D., & Towndrow, P. (2012). Understanding classroom talk in secondary three mathematics classes in Singapore. In B. Kaur & T. L. Toh (Eds.), *Reasoning, communication and connections in mathematics: Yearbook 2012, Association of Mathematics Educators* (pp. 169–197). Singapore: World Scientific.

Kawalkar, A., & Vijapurkar, J. (2013). Scaffolding science talk: The role of teachers' questions in the inquiry classroom. *International Journal of Science Education, 35*(12), 2004–2027.

Lambert, D. (2017). Thinking geographically. In M. Jones (Ed.), *The handbook of secondary geography* (pp. 20–29). Sheffield: Geographical Association.

Lambert, D., & Balderstone, D. (2010). *Learning to teach Geography in the secondary school* (2nd ed.). Oxford: Routledge.

Lyle, S. (2008). Dialogic teaching: Discussing theoretical contexts and reviewing evidence from classroom practice. *Language and Education*, *22*(3), 222–240.

Mercer, N., & Dawes, L. (2008). The value of exploratory talk. In N. Mercer & S. Hodgkinson (Eds.), *Exploring talk in school* (pp. 55–71). Sage.

Michaels, S., & O'Connor, C. (2012). *Talk science primer*. Cambridge, MA: TERC.

Moje, E. B. (1996). "I teach students, not subjects": Teacher-student relationships as contexts for secondary literacy. *Reading Research Quarterly*, *31*(2), 172–195.

Moje, E. B. (2008). Foregrounding the disciplines in secondary literacy teaching and learning: A call for change. *Journal of Adolescent & Adult Literacy, 52*(2), 96–107.

Morgan, J., & Lambert, D. (2005). *Geography: Teaching school subjects 11–19*. Oxon: Psychology Press.

Morton, T. (2018). Reconceptualizing and describing teachers' knowledge of language for content and language integrated learning (CLIL). *International Journal of Bilingual Education and Bilingualism, 21*(3), 275–286.

Myhill, D., & Jones, S. (2009). How talk becomes text: Investigating the concept of oral rehearsal in early years' classrooms. *British Journal of Educational Studies*, *57*(3), 265–284.

O'Connor, C., & Michaels, S. (2019). Supporting teachers in taking up productive talk moves: The long road to professional learning at scale. *International Journal of Educational Research*, *97*, 166–175.

Quinn, H., Lee, O., & Valdés, G. (2012). Language demands and opportunities in relation to Next Generation Science Standards for English language learners: What teachers need to know. *Understanding Language Conference* (pp. 32–43). Stanford University.

Roberts, M. (2013). *Geography through enquiry: Approaches to teaching and learning in the secondary school*. Sheffield: Geographical Association.

Roberts, M. (2014). Powerful knowledge and geographical education. *The Curriculum Journal, 25*(2), pp. 187–209.

Robins, G. (2011). The effect of exploratory talk on the development of sentence structure in able writers. *Literacy*, *45*(2), 78–83.

Seow, T. (2015). *Understanding Teachers' Knowledge and Practice of Lower Secondary Geographical Investigations*. NIE Research Funding Programme (ERFP), Project No. OER19/15 TS. Unpublished raw data.

Sukimi, J., Lim, S. Tamsir, S., Tan, S. P., & Wong, Y. J. (2018). Developing a writing framework to guide students' writing in geography. *HSSE Online, 7*(1), 77–82.

Vijayakumar, N., Wong. K. Y., Adams, J., & Lee, G. (2015). Deepening individual students' reasoning and summarising in Geography and Mathematics through teacher questioning and talk. *ELIS Classroom Inquiry, November*. Singapore:

English Language Institute of Singapore. Retrieved from http://www.plmgss.moe.edu.sg/qql/slot/u173/images/PDF/2015-erf-deepening-students-reasoning-summarising.pdf

Zwiers, J., & Crawford, M. (2011). *Academic conversations: Classroom talk that fosters critical thinking and content understandings*. Stenhouse Publishers.

Appendix A

Extract of Talk Moves

Focus Area 1: Voice and clarify a student's ideas	
Talk Move	**Frames for prompting**
Seek clarification	What do you mean by X? Can you be more specific about X?
Revoice for verification	Let me see whether I understand you correctly. Are you telling us...? I wonder whether you mean…
Focus Area 2: Listen closely to another student	
Talk Move	**Frames for prompting**
Ask a student to restate another students' contribution	What do you think student X was saying? Can you repeat what student X just told us?
Focus Area 3: Deepen a student's reasoning	
Talk Move	**Frames for prompting**
Probe for reasoning or evidence	Why do you think that…? What's your evidence for that?
Focus Area 4: Engage with another student's reasoning	
Talk Move	**Frames for prompting**
Elicit a student's view on another student's idea	What do you think about what student X has just said? Do you agree or disagree, and can you explain why?

(Adapted from Michaels & O'Connor, 2012 and Zwiers & Crawford, 2011 by English Language Institute of Singapore)

Appendix B

Questionnaire Survey

Since Jan this year…					
When answering questions with data, I think I am better able to…		Strongly Agree	Agree	Disagree	Strongly Disagree
1	Identify the key words in the question.				
2	Explain in my own words what the question is asking me to do.				
3	Understand what the data (graph, map, etc.) is showing.				
4	Identify the patterns/trends in the data (graph, map, etc.) is showing.				
5	Identify the anomalies in the data (graph, map, etc).				
6	Provide possible reasons for the patterns and/or anomalies in the data (graph, map, etc).				
In classroom discussion, I think I am better able to…		Strongly Agree	Agree	Disagree	Strongly Disagree
7	Use appropriate geographical terms in my answers in class.				
8	Describe the data (graph, map, photograph, etc.) used in a class discussion.				
9	Describe the relationships in the data (graph, map, photograph, etc.) used in a class discussion.				
10	Explain and give reasons for my answers in a class discussion about data (graph, map, photograph, etc.).				

11	Tell whether my classmate's response to the data (graph, map, photograph, etc.) is similar or different from my own in a class discussion.				
12	Tell whether my classmate's response to the data (graph, map, photograph, etc.) is accurate and clear in a class discussion.				
13	Add onto my classmate's response with evidence from the data (graph, map, photograph, etc.).				
14	Summarise the main points of the discussion.				
In writing tasks, I think I am better able to…		Strongly Agree	Agree	Disagree	Strongly Disagree
15	Use appropriate geographical terms in my written answers.				
16	Support my answer with evidence from the data (graph, map, etc.).				
17	Write a well-organised answer in response to questions about data (graph, map, etc.).				