

# The Effectiveness of Thinking Anchors in Enhancing Singapore Students' Responses to Geography Data Response Questions

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## **Abstract**

*This article examines the impact of structured thinking anchors on Singapore students' ability to respond effectively to data response questions (DRQs) in geography. Through a seven-week action research study using the OHLA (Overall, Highest, Lowest, Anomaly) thinking anchor with Secondary 1 Express (G3) and Normal (Academic) (G2) students in 2022, this research demonstrated significant improvements in student performance and confidence levels during school-based assessments. The findings reveal that thinking anchors serve as effective scaffolding tools that reduce conceptual errors and enhance the quality and structure of student responses to skills-based geographical questions simultaneously.*

## **Introduction**

Geography education at the secondary level requires students to develop sophisticated analytical skills, particularly in interpreting and describing data presented in various formats such as graphs, tables and maps. The three main Assessment Objectives (AOs) listed in the 2021 Lower Secondary Geography Teaching and Learning Syllabuses all require students to exercise reasoning in their demonstration and application of geographical knowledge during assessment.

For instance, under AO1: Knowledge, students should be able to “demonstrate knowledge of geographical data types, skills and techniques”; under AO2: Critical Understanding and Constructing Explanations, they should be able to “apply geographical knowledge to perform analysis and produce explanations”; and under AO3: Interpreting and Evaluating Geographical Data, they should be able to “apply geographical knowledge to observe patterns and deduce relationships” as well as “draw conclusions based on evidence” (Ministry of Education, 2021). However, educators frequently observe that students struggle to write good-quality answers for DRQs. Students may be more concerned with regurgitating facts and content knowledge without any reference to geographical concepts (Paulsen & Kolstø, 2022; Sukimi et al., 2018) or have failed to achieve higher-order reasoning such as comparing trends for more complex data sets involving two or more variables (Ong & Arulushamahaswary, 2018). The responses produced by these students often lack critical thinking, fail to address the question requirements, and generally show poor understanding of command words and question focus.

The challenge of helping students to articulate their geographical understanding more effectively has piqued great interest in structured approaches for academic writing. Wray and Lewis (1997) pioneered the

concept of writing frames as scaffolding tools to help students organise their thinking and produce more coherent, extended writing. Their work showed that providing prompts, connectives, and organisational structures helps learners to develop critical literacy skills. More recently, writing frameworks have emerged as pedagogical tools that help students to enhance both the clarity and quality of their responses (Spýcher, 2021). For the purposes of this study, such structured frameworks are termed "thinking anchors" – systematic, acronymic devices that help students remember key analytical steps while maintaining flexibility in application. This terminology reflects their function as cognitive organisers that support disciplined approaches to problem-solving while grounding students' analytical thinking.

The theoretical foundation for using structured writing approaches in education is well-established in academic literature. Wood, Bruner and Ross (1976) first introduced the concept of *scaffolding* to describe the contingent, temporary support that enables learners to accomplish tasks beyond their current independent capability. Their work demonstrated how expert guidance can structure a learner's performance through modelling, reducing complexity, and maintaining direction, until the learner gains sufficient mastery to take over and complete the task independently. This instructional mechanism provides a powerful rationale for implementing structured writing tools that break down disciplinary tasks and make cognitive processes visible.

Vygotsky's (1978) sociocultural theory further strengthens this justification through the concept of the Zone of Proximal Development (ZPD), which delineates the space where learning is optimally supported by skilled assistance.

Scaffolding occurs within this zone as it connects the learner's current and potential capabilities by organising thinking and shaping higher-order reasoning. Subsequent scholarship such as Hammond and Gibbons (2005) has shown how scaffolding can be applied more systematically to support academic learning. Their model identified designed-in features such as task sequencing and mediational texts as well as interactional scaffolding that provide structured yet flexible supports that enhance students' engagement with challenging curriculum content. As these forms of support are gradually withdrawn, students would have internalised the cognitive routines needed for independent writing and thus a transfer of responsibility from the teacher to the student is achieved. Gibbons (2002) emphasises that scaffolding must be carefully designed to support both content learning and language development simultaneously.

### **Scaffolding in Geography Education**

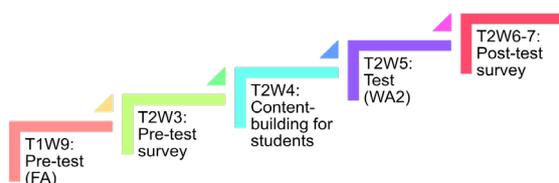
Geography education research has increasingly recognised the importance of explicit scaffolding in developing students' analytical and interpretive skills, particularly in responding to DRQs. Lambert and Morgan (2010) suggest that effective geography teaching requires systematic attention to students' ability to interpret spatial data, recognise patterns, and construct evidence-based explanations, all of which are processes that align closely with the forms of scaffolded support described by Hammond and Gibbons. Heffron and Downs (2012) further identify data interpretation as a core component of geographical thinking, arguing that without the use of explicit instruction in analytical frameworks, students often struggle to move from descriptive to analytical responses. Similarly, Roberts (2013) foregrounds the central role of *thinking geographically*, which requires students to

apply concepts such as place, scale, and interdependence in their written explanations. Roberts posits that structured approaches to geographical thinking can significantly improve students' performance on data interpretation tasks, echoing the larger principles of scaffolding and the gradual release of responsibility. Within this context, the application of thinking anchors in DRQ instruction helps students make disciplinary reasoning visible, organise complex information thoughtfully, and internalise geographical concepts and themes like scale and sustainability. As these supports are withdrawn over time, learners develop greater independence and sophistication in handling DRQs, illustrating the powerful synergy between sociocultural learning theory and geography-specific pedagogy.

### Methodology

This study employed a pre-post intervention design to evaluate the effectiveness of thinking anchors in improving student learning outcomes and confidence levels in answering DRQs. The research was conducted at Canberra Secondary School in 2022 with the entire Secondary 1 Express (now G3) and Normal (Academic) (now G2) student cohort over a seven-week period, commencing in Term 1 Week 9 and ending in Term 2 Weeks 6 to 7.

**Figure 1: Timeline showing the research project taking place over two terms**



The cohort comprised 215 Secondary 1

students across six classes: four Express stream classes (1E1-1E4) with 137 students in total, and two Normal (Academic) classes (1N1-1N2) with 78 students in total. Conducting a census ensures that all variability within the cohort including differences across stream, class, and individual ability is captured, providing better coverage than sample surveys due to greater inclusivity in population extent (Kish, 1979). This approach eliminates sampling error and allows for more precise evaluation of the thinking anchor's effectiveness across all students in the cohort. The census design ensures that the study's findings accurately reflect the outcomes for the entire Secondary 1 population within this school context.

The thinking anchor employed in this study was the OHLA framework, specifically designed for map and graph DRQs. OHLA stands for:

- **Overall:** Identify the overall trend or pattern – from first to last year (graph); even or uneven distribution (map)
- **Highest:** Identify the highest trend or pattern – increase or decrease (graph); highest concentration (map) [Tip: this follows Overall]
- **Lowest:** Identify the lowest trend or pattern – increase or decrease (graph); lowest concentration (map) [Tip: this follows Overall]
- **Anomaly:** Identify any unusual patterns or outliers [Tip: this is the *opposite of Overall*]

This framework provides students with a systematic approach to analysing graphical data while ensuring comprehensive coverage of key analytical elements. Furthermore, the OHLA acronym is memorable and easy to recall, making it

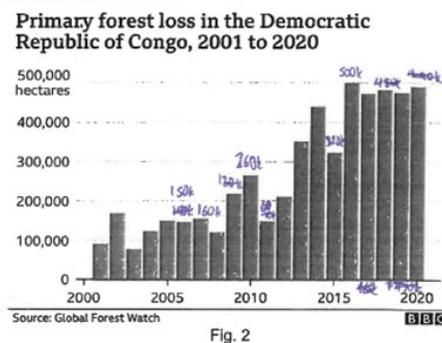
a catchy mnemonic that helps students internalise the structure and apply it consistently when answering DRQs.

For example, Figure 2 illustrates how a student successfully applied the OHLA thinking anchor to analyse primary forest loss trends during Weighted Assessment 2. The response systematically covers: overall increasing trend from 2001 to 2020

(Overall), highest increase from 2015-2016 jumping from 320,000 to 500,000 hectares (Highest), lowest increase from 2006-2007 rising modestly from 150,000 to 160,000 hectares (Lowest), and the anomalous decrease from 2010-2011 declining from 260,000 to 70,000 hectares (Anomaly). This exemplar shows how the framework guides students to provide comprehensive trend analysis with specific numerical evidence from the graph.

**Figure 2: Student response showing the application of the OHLA thinking anchor to analyse forest loss trends with systematic coverage and numerical evidence**

b) Study Fig. 2 below which shows the primary forest loss in the Democratic Republic of Congo between 2001 and 2020.



With reference to Fig. 2, describe the trends of primary forest loss from 2001 to 2020. [2] hectares

Excellent OHLA!

The overall rate of the primary forest loss increased from 2000 to 2020, by 490,000 to 490,000 hectares.

The highest primary forest loss is in 2016, with 500,000 hectares.

The lowest increase primary forest loss is in 2006 to 2007, 150,000 hectares to 160,000 hectares.

From 2010 to 2011, the primary forest loss decrease was the highest, 260,000 hectares to 70,000 hectares.

This study employed a form of methodological triangulation to strengthen the validity of its findings regarding the impact of the OHLA thinking anchor on student learning. Multiple sources of data were collected:

1. **Pre-test Performance:** Formative Assessment 2 (FA2) administered before OHLA instruction, featuring a 3-mark graph description question

2. **Post-test Performance:** Weighted Assessment 2 (WA2) conducted after OHLA instruction, featuring a 2-mark graph description question

3. **Pre-intervention Survey:** Student self-assessment of confidence in answering graph trend description questions via Google Forms

4. **Post-intervention Survey:** Follow-up self-assessment measuring changes in student confidence via Google Forms

By comparing both actual student performance data and perceived confidence levels across pre- and post-intervention time points, the study was able to cross-verify outcomes, providing a more comprehensive and credible understanding of the effectiveness of OHLA (Asogwa, Ede & Hamisu, 2023).

Student responses were evaluated based on two primary criteria, namely the fulfilment of task requirements, including appropriate response length based on points marking and relevance to the question, as well as the provision of correct evidence to support answers. The evaluation process involved systematic assessment of each response against predetermined marking criteria, with task requirement fulfilment measured by direct addressing of question focus and adherence to command word expectations. Evidence provision was evaluated based on students' ability to extract and incorporate specific numerical values, trends, or patterns from the provided data sources into their written responses. Correct evidence was defined as accurate reading and interpretation of data points.

### Results and Analysis

The intervention demonstrated substantial improvements in student

performance across all participating classes. In the pre-test, 108 out of 215 students (50.2%) scored zero marks on the graph description question. Following the introduction of the OHLA thinking anchor, this number decreased significantly to 74 students (34.4%), representing a 15.8 percentage point improvement.

More striking was the improvement in students achieving full marks. In the pre-test, only 18 students (8.4%) achieved maximum marks, while in the post-test, 77 students (35.8%) scored full marks, a remarkable increase of 27.4 percentage points. This represents more than a four-fold improvement in the proportion of students demonstrating mastery of graph description skills, exceeding the effect sizes reported in Graham and Perin's (2007) meta-analysis of writing strategy interventions for adolescents, where strategy instruction yielded an average effect size of 0.82. The distribution of scores across the middle ranges also showed positive changes. Students scoring partial marks (1-2 points) increased from 89 students (41.4%) in the pre-test to 141 students (65.6%) in the post-test, indicating that even students who did not achieve full marks were demonstrating improved understanding and application of graph analysis skills.

**Table 1: Breakdown of Pre-Test (FA2) and Post-Test (WA2) Marks Across All Classes**

Class Name and Size	FA Pre-test (Total mark: 3m)				WA Test (Total mark: 2m)		
	0	1	2	3	0	1	2
1E1 (35)	10	12	10	3	7	13	14
1E2 (36)	8	15	6	7	2	9	27
1E3 (34)	28	3	2	1	22	8	4
1E4 (32)	28	4	0	0	24	4	4
1N1 (38)	23	7	6	2	11	12	14
1N2 (40)	11	17	7	5	8	18	14
<b>Total</b>	108	58	31	18	74	64	77

Analysis by academic stream revealed that both Express and Normal (Academic)

students benefited from the intervention, although there are varying patterns of

improvement. Express stream classes showed more dramatic improvements in achieving full marks, while Normal (Academic) classes showed significant reductions in zero-mark responses. This suggests that the OHLA thinking anchor was particularly effective in providing basic structural support for students who initially struggled with the DRQ task, aligning with Gibbons’ (2002) view that learners develop subject-matter competence when teachers provide deliberate and planned scaffolding.

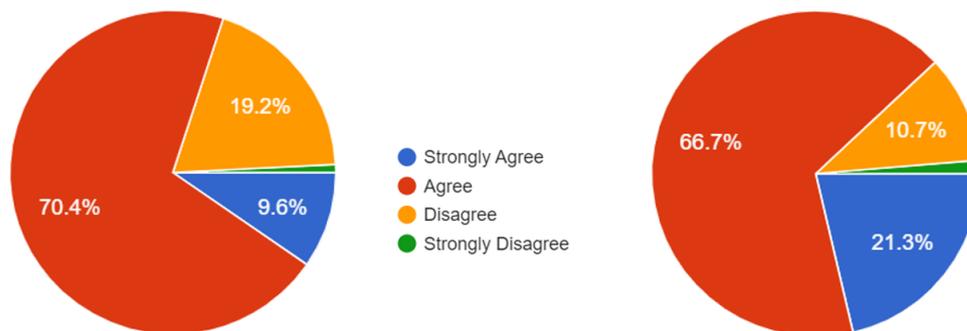
The survey data also provided crucial insights into student confidence and self-perception of their abilities. In the pre-intervention survey, 80% of students

indicated confidence in their ability to answer graph trend description questions correctly. Following the intervention, this figure increased to 88%, representing an 8 percentage point improvement.

More significantly, the proportion of students expressing strong confidence increased substantially and more than doubled from 9.6% to 21.3%. Conversely, the percentage of students expressing disagreement or strong disagreement with their ability to answer such questions decreased from 20% to 12%, indicating that the intervention was efficacious in supporting students who lacked confidence.

**Figure 3: Pie charts showing students’ perceptions of their ability to answer DRQs before (left) and after (right) OHLA intervention**

*“I am confident that I can answer a graph trend description question correctly.”*



### Effectiveness of Thinking Anchors

The findings strongly support the notion that thinking anchors enhance the quality of student responses to DRQs in geography, aligning with Wray’s (1997) foundational writing-frame research, which suggested that scaffolded templates help students produce more coherent and structured non-fiction writing. The OHLA thinking anchor has functioned effectively as a cognitive scaffold, providing students with a systematic approach to graph analysis that reduces extraneous cognitive load while ensuring comprehensive attention to key analytical elements, consistent with the

principles of Sweller’s (1988) cognitive load theory.

The improvement in performance across different ability levels suggests that thinking anchors address fundamental challenges in geographical skills development rather than simply benefiting specific types of learners. This aligns with Gibbons’ (2002) view that well-designed scaffolding provides high challenge and high support, enabling all students to participate more fully in disciplinary learning.

Error analysis conducted as part of the

study revealed important qualitative improvements in student responses. Even weaker students began attempting to use the OHLA thinking anchor when answering DRQs, which improved the overall quality of their responses. Notably, mistakes in post-intervention responses were more frequently attributed to calculation errors and carelessness rather than conceptual misunderstanding or irrelevant answers. This shift in error patterns suggests that the OHLA thinking anchor successfully addressed the core problem of students not knowing how to approach graph analysis in a systematic manner. This is consistent with Vygotsky's (1978) ZPD concept, whereby learners can perform tasks more effectively with targeted scaffolding than they could independently.

The substantial increase in students expressing strong confidence (from 9.6% to 21.3%) indicates that the intervention was especially effective for students who initially felt uncertain about their abilities. The findings also showed that students became more willing to attempt graph description questions following the intervention, thus supporting the idea that strategy instruction can foster motivation, including persistence and self-regulation, alongside cognitive benefits (Pressley & Harris, 2006). Some students who left content-based questions blank during assessments, presumably because they had not studied the material, nevertheless attempted the skills-based DRQ. This suggests that the OHLA thinking anchor provided sufficient scaffolding to make these traditionally challenging questions feel more accessible to students.

The success of the OHLA thinking anchor demonstrates the value of explicit instruction in analytical thinking processes. Rather than assuming students will naturally develop systematic approaches to data analysis, this study suggests that

providing clear, structured frameworks can significantly accelerate skill development, supporting Heffron & Downs' (2012) emphasis on the need for explicit instruction in geographical thinking skills.

### **Limitations and Considerations**

Despite the positive results, this study acknowledges key limitations that must be considered when interpreting findings and planning for future project implementation.

A longstanding concern in the literature is the risk of over-dependence on scaffolds. Applebee (1984) warns that writing frames can lead to formulaic responses that inhibit genuine reasoning and independent analytical thinking. Similarly, Hillocks' (1986) meta-analysis highlights that while structured approaches support early skill development, there is a risk of rigidity if scaffolds are not gradually reduced. Pressley and Harris (2006) further argue that scaffolding must include explicit plans for gradual fading to ensure students ultimately internalise strategies rather than remain dependent on them. These concerns remain relevant for the OHLA thinking anchor – although it supports students in organising their responses, there is a possibility that learners may focus on following the sequence rather than engaging in deeper analytical thinking.

Methodologically, the study also reflects limitations commonly discussed in Campbell and Stanley's (1963) framework, such as the instrumentation threat posed by the unequal mark allocations between the pre-test and post-test, as well as the relatively short seven-week duration, which may limit conclusions about long-term retention and transfer.

Furthermore, although existing research strongly supports structured approaches to writing and thinking, there remains limited

discipline-specific evidence for the use of thinking anchors in geographical skills instruction. Graham and Perin (2007) note that much strategy instruction research has focused on general or language-arts contexts, with fewer studies examining subject-specific writing demands. In geography education, Bednarz and Bednarz (2004) have called for more research into pedagogical strategies that develop geographic reasoning, especially skills such as analysing spatial or graphical data. This study directly contributes to this gap by providing empirical evidence on the effectiveness of thinking anchors in geography, but further research is needed to validate and extend these findings across topics, levels, and longitudinal timeframes.

Ultimately, how can educators implement writing frames and structured approaches without fostering an over-reliance on formulaic responses? Students should be exposed to a variety of contexts that emphasise transferable skills and promote analytical flexibility. Central to this process is the teacher's professional judgment regarding the gradual fading of scaffolds, ensuring that learners progressively internalise strategies and develop independence. Ideally, the use of structured writing support should be embedded within a carefully sequenced, multi-year spiral curriculum designed to build and reinforce schema, rather than confined to a single stage such as Secondary 1.

### **Contemporary Relevance and Success of the OHLA Thinking Anchor in 2025**

The longitudinal impact of the OHLA thinking anchor intervention extends well beyond the initial seven-week study period, demonstrating sustained effectiveness in supporting students' geographical analytical skills. Following the success of

the initial 2022 research, all Geography teachers in Canberra Secondary School adopted the OHLA thinking anchor as a consistent pedagogical approach, implementing it systematically across all Secondary 1 to 4 geography classes over the subsequent three years. The Secondary 1 cohort who participated in the original 2022 research has now progressed to Secondary 4, completing their national examinations in 2025. Recent results from their Preliminary Examinations provide compelling evidence for the sustained effectiveness of structured thinking approaches in geography education when implemented consistently across the curriculum.

Analysis of the 2025 Preliminary Examination results reveals that the OHLA thinking anchor continues to support student success in DRQs at the critical Secondary 4 level. In the Humanities (Geography) GCE Normal (Academic) Level examination, 76.9% of Normal (Academic) students successfully answered DRQs amenable to the OHLA thinking anchor, representing 10 marks of the total assessment. This performance is noteworthy given that these students represent the same cohort that initially struggled with graph description tasks in Secondary 1, with 50% scoring zero marks in the pre-intervention assessment.

Similarly, Express students demonstrated strong performance across different geographical contexts. In the Humanities (Geography) GCE Ordinary Level examination, 65.8% of students successfully passed OHLA-applicable DRQs worth 8 marks, while in the Geography GCE Ordinary Level examination, 80.6% passed comparable questions, also worth 8 marks. These results reflect the cumulative impact of sustained, school-wide implementation of the OHLA framework, suggesting that the thinking

anchor approach has provided students with transferable analytical skills that remain effective across different examination formats and geographical content areas.

The school-wide adoption and consistent implementation of the OHLA thinking anchor over four years demonstrates several important pedagogical principles identified in the literature. Pressley and Harris' (2006) emphasis on strategy instruction promoting long-term retention appears validated by these results, particularly when thinking anchors are reinforced consistently throughout students' secondary education journey rather than being introduced as isolated interventions.

The variation in performance across different streams and subjects also provides insights into the contextual factors that influence thinking anchor effectiveness. The highest performance in Geography, which students study as a full subject rather than an Elective programme, suggests that students may benefit from more extensive exposure to geographical thinking frameworks, supporting Roberts' (2013) recommendations for systematic skill development across the geography curriculum. The consistent reinforcement of OHLA principles across all four years of secondary geography education appears to have maximised these benefits.

The results obtained from the comparative studies between 2022 and 2025 also address concerns that structured writing approaches may lead to formulaic responses, such as those raised by Applebee (1984). Instead of displaying over-reliance on rigid formats, students appear to have internalised the analytical reasoning embedded in OHLA, applying it flexibly across a range of geographical question types. This pattern aligns with Wood, Bruner and Ross' (1976) conception of

scaffolding as temporary support aimed at developing independent competence. The sustained improvements observed over four years therefore indicate that a clear, consistently reinforced analytical framework can strengthen students' capacity to interpret and evaluate geographical data rather than constrain it.

In addition, the 2025 findings highlight the contemporary relevance of thinking anchors for meeting national assessment demands that increasingly prioritise analytical and interpretative skills. The school's long-term commitment to applying OHLA appears to have maximised its alignment with syllabus expectations involving the analysis of patterns, deduction of relationships, and interpretation of geographical evidence (MOE, 2021). These sustained gains across both Express and Normal (Academic) students reflect Gibbons' (2002) view that well-designed scaffolding serves an inclusive function, enabling diverse learners to engage meaningfully in disciplinary thinking. Notably, the particularly strong performance of the Normal (Academic) cohort suggests that systematic and spiral implementation of structured approaches may be more beneficial for students who traditionally face greater challenges with complex analytical tasks, while still maintaining academic rigour.

The success of school-wide, multi-year implementation of the OHLA thinking anchor suggests a few important directions for future research in geography education. Further investigation into how students adapt and refine their use of thinking anchors over extended periods of consistent instruction could yield valuable insights into the development of flexible analytical thinking, while research on how best to sustain their effectiveness across multiple year levels and different teachers would

inform curriculum design and professional learning. Additionally, the variation in performance across examination contexts highlights the need to examine how consistently reinforced thinking anchors transfer across different forms of geographical analysis such as photograph interpretation, map reading, and case study evaluation. Understanding these transfer mechanisms within a sustained, systematic implementation model may contribute to the design of more comprehensive and coherent frameworks for geographical thinking.

### Conclusion

This longitudinal study illustrates how thinking anchors, when embedded within a coherent multi-year instructional programme, can fundamentally strengthen students' geographical reasoning. The sustained performance of students over four years shows that the OHLA thinking anchor has become more than a procedural tool and

supported the internalisation of core analytical habits of mind central to geography education. Rather than relying on prescriptive steps, students have developed a stable conceptual schema for organising, interpreting, and evaluating geographical evidence. This aligns well with Weinstein and Mayer's (1983) assertion that strategy instruction yields its greatest impact when reinforced systematically over time.

The findings further suggest that long-term, school-wide implementation plays a significant role in deepening disciplinary thinking. The repeated and consistent use of the OHLA thinking anchor across different teachers, topics, and assessment formats appears to have normalised analytical rigour as part of classroom culture. This is consistent with calls in geography education literature for sustained

curriculum coherence, particularly Catling's (2014) argument that meaningful geographical learning occurs when students have structured opportunities to revisit, refine, and extend disciplinary concepts over time. In this sense, OHLA has functioned not merely as a tool for improving DRQ responses, but as a heuristic that shapes how students perceive and engage with geographical data.

Importantly, the study highlights the potential for thinking anchors to support greater inclusivity in geography classrooms. The framework's clarity and predictability have benefited lower-readiness students by reducing cognitive load and providing entry points into complex analytical tasks, while still allowing room for higher-ability students to move beyond description toward more interpretive and evaluative reasoning. However, the pattern of results across ability levels also highlights the importance of differentiation. While the OHLA thinking anchor has proven particularly effective for lower-readiness learners by providing essential scaffolding to support meaningful engagement with DRQ tasks, it may not be sufficient for students who are already operating at higher levels of proficiency. For these learners, more sophisticated analytical frameworks may be necessary to extend thinking beyond description and pattern recognition. This aligns with Ong and Arulushamaheswary's (2018) argument that higher-readiness students benefit from instructional approaches grounded in Bloom's Taxonomy, which foreground higher-order cognitive processes such as evaluation, synthesis, and critical reasoning.

Lastly, the study's longitudinal evidence underscores the importance of teacher agency and pedagogical consistency. The lasting educational benefits stemming from the OHLA thinking anchor are inseparable from the collective commitment of teachers

who adopted, refined, and reinforced the approach over multiple years. This raises important implications for school-level professional development, suggesting that thinking anchors and similar frameworks are most effective when integrated into a shared pedagogical vision rather than applied in an ad hoc manner or in isolation.

Future research may explore how thinking anchors interact with more advanced modes of analysis, and how schools can design multi-year curriculum structures that promote the progressive development of disciplinary thinking, ultimately preparing students to engage meaningfully with complex geographical issues beyond the classroom.

### Acknowledgement

I would like to thank the dedicated teachers in the Geography unit of Canberra Secondary School, namely Mr Ng Kok Wah and Ms Nurul Diyana Binte Hashim, as well as former teachers Ms Chia Hua Hoong, Ms Nur Diyana Mohamad Sanip, and Ms Foong Yin Ping, for actively participating in the multi-year implementation of the OHLA thinking anchor and contributing valuable suggestions that refined and strengthened the support provided to students. I am also grateful to the school leadership for their encouragement and support of our Professional Learning Teams (PLT) project, which made the sustained, collaborative implementation of this initiative possible.

### References

Applebee, A. N. (1984). Writing and reasoning. *Review of educational research*, 54(4), 577-596.

Asogwa, V. C., Hamisu, M., & Ede, M. O. (2023). Methodological triangulation in educational research: Pros and cons.

*Propellers Journal of Education*, 2(1), 79–87.

Bednarz, R. S., & Bednarz, S. W. (2004). Geography Education: The Glass Is Half Full and It's Getting Fuller. *The Professional Geographer*, 56(1), 22–27.

<https://doi.org/10.1111/j.0033-0124.2004.05601004.x>

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research*. Houghton Mifflin.

Catling, S. (2014). Giving younger children voice in primary geography: empowering pedagogy – a personal perspective. *International Research in Geographical and Environmental Education*, 23(4), 350–372.

Gibbons, P. (2002). *Scaffolding language, scaffolding learning*. Portsmouth, NH: Heinemann.

Graham, S., & Perin, D. (2007). A meta-analysis of writing instruction for adolescent students. *Journal of educational psychology*, 99(3), 445.

Hammond, J., & Gibbons, P. (2005). Putting scaffolding to work: The contribution of scaffolding in articulating ESL education. *Prospect*, 20(1), 6–30.

Heffron, S. G., & Downs, R. M. (2012). *Geography for Life: National Geography Standards; Geography Education Standards Project (GENIP)*. National Council for Geographic Education.

Hillocks, G. (1986). Research on written composition: New directions for teaching. National Conference on Research in English.

Kish, L. (1979). Samples and

censuses. *International Statistical Review/Revue Internationale de Statistique*, 99-109.

Lambert, D., & Morgan, J. (2010). *Teaching geography 11-18: A conceptual approach*. McGraw-Hill Education (UK).

Lewis, M., Wray, D., & Mitchell, C. (1995). Extending interactions with texts: theory into practice. *Reading*, 29(1), 10-15.

Ministry of Education. (2021). *Lower secondary geography teaching and learning syllabuses: Express course; Normal (Academic) course*. Curriculum Planning and Development Division.

Ong, K. M., & Arulshamahaswary, D. (2018). Guiding Students in Writing Data Response Answers Using Bloom's Taxonomy for Critical Thinking. *HSSE Online*, 7(1), 83–89.

Paulsen, V. H., & Kolstø, S. D. (2022). Students' reasoning when faced with test items of challenging aspects of critical thinking. *Thinking Skills and Creativity*, 43, 100969.

Pressley, M., & Harris, K. R. (2006). Cognitive strategies instruction: From basic research to classroom instruction. In P. A. Alexander & P. H. Winne (Eds.), *Handbook of Educational Psychology* (2nd ed., pp. 265–286). Mahwah, NJ: Lawrence Erlbaum.

Roberts, M. (2013). Geography through enquiry. *Sheffield: Geographical Association*, 125.

Spycher, P. (2021). Scaffolding Writing with the "Teaching and Learning Cycle" for Students in Grades 6-12. *WestEd*.

Sukimi, J., & Lim, S. T. S., Tan, SP, &

Wong, YJ (2018). Developing a writing framework to guide students' writing in geography. *HSSE Online*, 7(1), 77-82.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257–285.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Weinstein, C. E., & Mayer, R. E. (1983, November). The teaching of learning strategies. In *Innovation abstracts* (Vol. 5, No. 32, p. n32).

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of child psychology and psychiatry*, 17(2), 89-100.

Wray, D. (1997). *Writing frames: scaffolding children's non-fiction writing in a range of genres*. University of Reading, Reading and Language Information Centre.

Wray, D., & Lewis, M. (1997). *Extending literacy: Children reading and writing non-fiction*. Psychology Press.