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The Role of Geographical Investigations in Developing Students' Cognitive Thinking

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Abstract

In Singapore, there has been a shift in education towards more inquiry-based learning to equip students with skills for the future. Geographical Investigations (GI) have been introduced as a form of geographical inquiry where students participate actively in knowledge construction through fieldwork. Fieldwork deepens students' understanding of content and aids in students' affective, social, and cognitive development. However, there is limited local research on the value of Geography fieldwork in influencing students' cognitive thinking. This paper, therefore, examines the role of GI in developing Secondary students' cognitive thinking in Geography. Using a case-study approach, Secondary 2 students in one secondary school were interviewed before and after their GI on the topic of Transport. Data was analysed using an adapted model of Bloom's Taxonomy. All students showed an improvement in higher-order cognitive skills after GI, specifically in the development of higher-order cognitive thinking skills and deeper thinking at particular cognitive levels.

Introduction

Fieldwork is an essential part of Geography. Defined as supervised learning that encourages first-hand experiences outside the classroom (Lonergan & Anderson, 1988), fieldwork can be categorized into various types depending on the degree of teacher and student involvement: This ranges from traditional teacher-led field trips to more student-centred inquiry-based field projects and self-discovery (Kent, Gilbertson & Hunt, 1997). Among these, student-centred activities and inquiry-driven fieldwork have been recognised as most effective in facilitating deep learning where students play a more active role in making sense of knowledge (Kent et al., 1997; Oost, De Vries & Van der Schee, 2011). Recently, there has been an increased emphasis on inquiry-based learning for education in Singapore. The Ministry of Education (MOE) has highlighted geographical inquiry as the recommended pedagogical approach for Geography education (Curriculum Planning and Development Division [CPDD], 2014). In line with this change, Geographical Investigations (GI) was introduced to develop students' 21st Century Competencies, cultivating them to become confident, self-directed learners through inquiry-driven fieldwork (CPDD, 2014).

Fieldwork provides students with an avenue to better understand subject content by bridging the gaps between theoretical ideas learnt in class with real-life experiences (Chew, 2008; Das, 2014). It aids in students' affective (Boyle et al., 2007), personal and social development which concomitantly supports cognitive development (Foskett, 1999; Oost et al., 2011). Nevertheless, most studies adopt a generic stance to analysing fieldwork, neglecting how the nature of fieldwork influences students' learning and

development. Empirical studies on how fieldwork contributes to cognitive development are still limited with regard to Geography, and even more so for school Geography in Singapore.

Considering the shift towards more inquiry-based learning and how fieldwork is a defining feature of Geography, there is a need to contemplate how active, inquiry-driven fieldwork develops students' thinking. Thus, this study examines the role of GI in developing secondary students' cognitive abilities. More specifically, it focuses on the effects of a Transport GI on Secondary 2 students' thinking. It aims to compare students' cognitive abilities before and after undergoing a Transport GI.

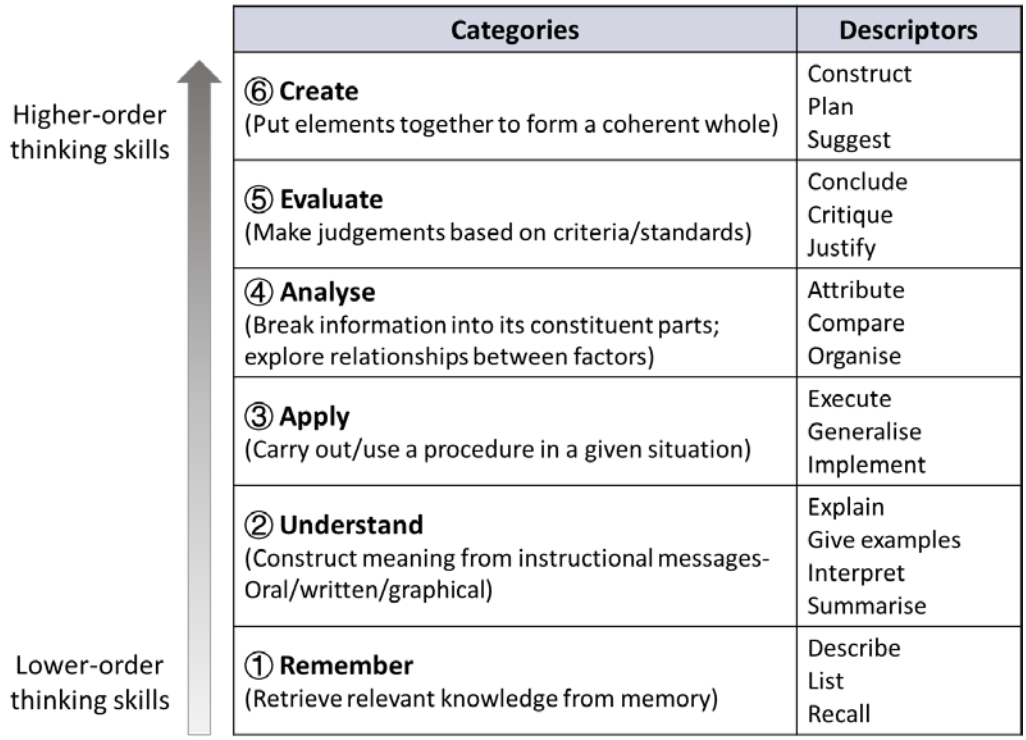
Value of Geography Fieldwork in Cognitive Development

In educational psychology, various learning theories have been proposed to inform educators on students' development and knowledge construction: Piaget's (1954) cognitive development theory outlines the thought process students undergo to attain higher levels of cognition. This involves the formulation of schemas which accumulate and modify with age depending on one's experiences. Apart from learners playing an active role in knowledge construction, Bandura (1986) and Vygotsky (1962) asserted the importance of external factors (specifically, culture, education and environment) in cognitive development: Activities which involve greater student participation, the presence of a supportive environment and more-skilled individuals tend to promote cognitive development. While these theories were largely formulated based on classroom settings, the concepts can still be applied to inform our understanding of learning in the field.

Fundamentally, Geography fieldwork is a form of experiential learning. When fieldwork is active rather than passive, more meaningful learning occurs and cognitive development is enhanced (Foskett, 1999). Mackenzie and White's (1982) comparison of passive observational fieldwork and fieldwork involving active participation revealed that students involved in the latter could better retain knowledge and relate memorable episodes in fieldwork with Geography knowledge learnt. This improvement in cognition was reinforced by students' affective development during fieldwork. Positive affective responses such as heightened interest, self-confidence and motivation were found to facilitate deep learning and higher-order cognition (Boyle et al., 2007; Entwistle & Smith, 2002).

The value of fieldwork in supporting cognitive development was further echoed in Kern and Carpenter's (1986) study with college students in the United States: They found that students who participated in a field-oriented class performed better in subject-oriented tasks that required higher-order thinking skills, compared to those engaged in classroom-based learning. Nevertheless, differences in cognitive abilities were assessed based on the results of a 75-question written test (of which, 25 were open-ended questions). This was quite lengthy which may have affected students' quality of answers and hence, the accuracy of results. Moreover, the study was conducted with an Earth Science class and field-oriented activities conducted would differ from those in Geography (especially in relation to Geography fieldwork in Singapore). Noting how there is limited research on the effects of Geography fieldwork (specifically, GI) on cognition, this study hopes to offer more insights on the role of GI on students' cognitive thinking.

Figure 1: An adapted model of Bloom's Taxonomy



Categories	Descriptors
⑥ **Create** (Put elements together to form a coherent whole)	Construct Plan Suggest
⑤ **Evaluate** (Make judgements based on criteria/standards)	Conclude Critique Justify
④ **Analyse** (Break information into its constituent parts; explore relationships between factors)	Attribute Compare Organise
③ **Apply** (Carry out/use a procedure in a given situation)	Execute Generalise Implement
② **Understand** (Construct meaning from instructional messages-Oral/written/graphical)	Explain Give examples Interpret Summarise
① **Remember** (Retrieve relevant knowledge from memory)	Describe List Recall

Charting Cognitive Thinking in Geography Fieldwork

For this study, an analytical framework was crafted to chart students' cognitive abilities in GI (see Figure 1)

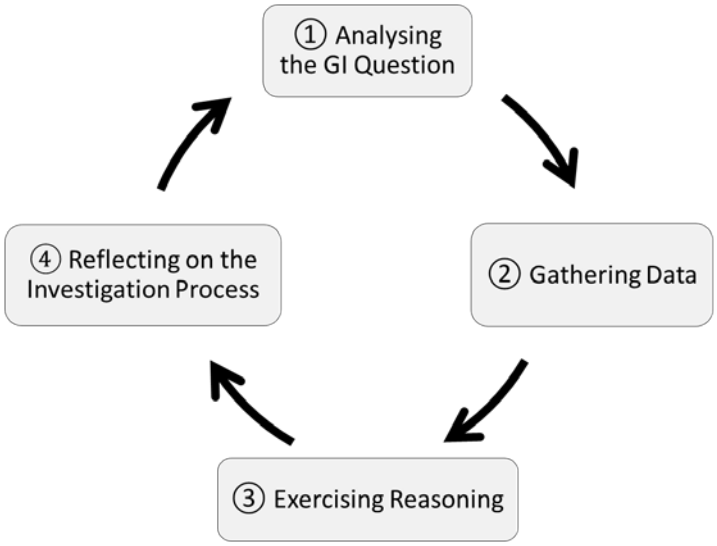
The framework was primarily adapted from Benjamin Bloom's original Taxonomy of Educational Objectives in the cognitive domain (Bloom, Engelhart, Furst, Hill & Krathwohl, 1956), subsequent modifications of Bloom's Taxonomy based on 21st Century education (Anderson et al., 2001; Krathwohl, 2002) and geographical enquiry (Oliver, n.d.), which all highlight the hierarchical ordering of cognitive abilities from simple to complex. As shown in Figure 1, categories 1 ('Remember') and 2 ('Understand') represent lower-order thinking skills, whereas categories 3 to 6 ('Apply', 'Analyse', 'Evaluate', 'Create') are higher-order thinking skills. While the descriptors provided for each category are not exhaustive, they provide an overview of what each cognitive level entails and are the ones more relevant to inquiry-based fieldwork/GI.

Geographical Investigations in Singapore's Geography Curriculum

Recently introduced as a compulsory component in both the Secondary and Pre-university Geography curriculum (starting from 2013 for Upper Secondary, followed by the Lower Secondary and Pre-University H2 syllabi in 2014 and 2016 respectively), GI is a form of geographical inquiry where students participate actively in constructing their understanding of the world (Roberts, 2003). Nevertheless, lower secondary students follow a "guided inquiry approach" for GI as they are "new

to the study of Geography" (CPDD, 2014, p.11). Figure 2 outlines the four stages students undergo in GI based on Robert's geographical inquiry model:

Figure 2: Stages of GI



In GI, students investigate a geographical issue relating to specific topics learnt in class. Each issue has a GI question and students are tasked to gather, select and present relevant data from the field. Based on their data, students will form their own geographical interpretations regarding the issue and answer the GI question.

As Geography is a compulsory subject for Secondary 1 and 2 levels, all Secondary 1 and 2 students have the chance to conduct GI which is believed to help students achieve the learning outcomes of Geography, develop 21st Century Competencies and the Desired Outcomes of Education (DOE) in Singapore's education system: Through GI, it is hoped that students "learn the process of geographical inquiry and use it to make sense of new knowledge" (CPDD, 2014, p.6). Also, GI was designed to give students opportunities to "organise and present geographic information in a coherent way" (CPDD, 2014, p.7). To meet these learning outcomes, students need to tap on both lower-order and higher-order thinking skills. For example, students have to recall what they learnt regarding geographical data representation to choose the best method to present their findings (corresponds to the 'Remember' category in Figure 1). When exercising reasoning and reflecting on data (stages 3 and 4 in Figure 2), students practice their higher-order thinking skills of application, analysis, evaluation and creation (aligns with categories 3 to 6 in Figure 1).

Achieving these learning outcomes in Geography has been deemed to hone students' "critical and inventive thinking", and "information and communication skills" – key 21st Century Competencies framing Singapore's education (CPDD, 2014, p.31). This was envisioned to contribute to the attainment of DOE for

Singapore's education system: Through GI, it is hoped that students will become "confident, self-directed learner[s]" by engaging in independent learning, critical thinking and reflection; working in groups during GI also aims to cultivate students to become "active contributors" (CPDD, 2014, p.1). Nonetheless, empirical evidence on whether GI accomplishes the above aims of Geography and the broader goals of Singapore education advocated by CPDD remains limited. Moreover, the dearth of literature on the role of GI in students' cognitive development stresses the need for further analysis on the influence of GI on students' cognitive thinking, as investigated in this study.

Methodology

This study was based on a Secondary 2 Express class in a Singapore secondary school. The class was average in terms of academic performance in Geography compared to the entire school cohort. Four students (Molly, Keith, Weilin and Zack – all pseudonyms) and their Geography teacher participated in this research. The choice of students was based on the selection of a GI group by the Geography teacher. Also, the focus of this study (Transport) was based on the school's scheme of work for Secondary 2.

As Resnick and Resnick (1992) pointed out, test results may not be the best indicator of higher-order cognitive abilities which involve more abstract reasoning. Thus, emphasis was placed on gleaning insights from students' individual interpretations and experiences, rather than statistical testing and comparison of academic results done in prior studies on the benefits of fieldwork (Kern & Carpenter, 1986; Boyle et al., 2007; Oost et al., 2011). This study primarily tapped on findings gathered from student interviews before and after fieldwork to better understand students' cognitive development (if any) through GI. Findings from teacher interviews and participant observations of Transport GI lessons also were used to gain a more comprehensive understanding of students' GI experiences.

For student interviews, students were presented with the same source (crafted by the researcher) before and after fieldwork (see Figure 3); they were then asked questions about the source to determine if there were differences in responses after fieldwork (see Figure 4):

Figure 3: Source used for student interviews

Jurong West, Singapore-
Considering the feedback provided by many residents, Taman Jurong Community Centre (CC) intends to introduce a peak hour shuttle bus service for residents living in Taman Jurong.

Prior to this decision, a group of volunteers from Taman Jurong CC visited nearby housing estates (Blocks 351, 353 and 361) to interview residents on their opinions regarding the peak hour shuttle bus service. A total of 30 residents were interviewed on a Thursday afternoon (9th March) and a summary of the questionnaire survey results are as follows:

- 24 out of 30 (80%) of the residents chose 'Strongly Agree' or 'Agree' as their option when asked how far they were agreeable to having a peak hour shuttle bus service.
- 27 out of 30 (90%) of residents responded 'Yes' to whether they would use the peak hour shuttle bus service if it was introduced.
- When asked how much more they were willing to pay for each trip using the peak hour shuttle bus service, 25 out of 30 (~85%) of residents preferred for the peak hour shuttle bus service to only cost 0¢ to 10¢ more per trip. Whereas 10% of residents were willing to pay 10¢ to 20¢ more per trip, compared to the normal public bus service.
- Key concerns raised by residents interviewed:
  - Location of stops made by the peak hour shuttle bus service
  - Frequency of peak hour shuttle bus service

These results will be sent to the Welfare Committee of the Jurong Group Representation Constituency to request for funding to implement the peak hour shuttle bus service for Taman Jurong residents.

Figure 4: Pre- and post-GI student interview questions relating to the source

(i) What do the questionnaire results tell you?

(ii) What do the questionnaire results not tell you?

(iii) Do you believe this data is credible? Why/why not?

(iv) What do you think are some assumptions made in this questionnaire?

(v) Would you want to take up the suggestion and offer funding to Taman Jurong CC?

(vi) What else do you hope to know in order to make a better decision?

(vii) Since you have already done your own questionnaire for the Transport GI, are there any questions you would like to add to this questionnaire to improve the results?*

*Note that (vii) was only asked during the post-GI student interviews.

The source was intentionally crafted to mirror students' Transport GI experiences by focusing on the same topic (Transport) and describing the results of a questionnaire. For their Transport GI, students were tasked to craft and administer a questionnaire to help them gather data to write a report that answers the GI question – "What features of our public transport help to ensure a safe and comfortable journey?" (CPDD, 2014, p.12). By presenting students with an unfamiliar source related to Transport before and after fieldwork, students had to apply their prior knowledge and experiences to construct meanings about the source. This requires the use of cognitive thinking skills; hence, comparing students' pre-and post-fieldwork responses to the source indicates the presence/absence of cognitive development. Students' responses to the source were coded for analysis based on the cognitive thinking skills shown in Fig. 1. However, the process of coding was largely iterative due to the multiple cognitive thinking skills embedded in students' responses.

While the term 'GI' is used to encompass all stages in Fig. 2 with fieldwork being a component of GI, for this paper, students were purposefully interviewed immediately after stage 2 (Gathering data) for their post-GI interviews. This was to verify that development in cognitive thinking (if any) stemmed from students' personal experiences in the field, rather than from their teacher who conducted post-GI lessons a few weeks later. For this GI, students' Transport questionnaire was constructed under teacher guidance. Nevertheless, groups conducted their fieldwork in their own time without teacher supervision.

Students' Cognitive Abilities before GI

Before GI, all students exhibited lower-order thinking skills in terms of understanding geographical data provided (corresponds to cognitive category 2 in Fig. 1). More specifically, students could summarise, interpret and explain key findings from the source (subcategories of cognitive category 2 – 'Understand'). When summarising key findings from the source, all students managed to infer that residents were agreeable to having the peak hour shuttle bus service and would use it if it were implemented:

> **Zack:** 'Most of the residents agree and like the idea of having a peak hour shuttle bus service; most of them will use the service.'

> **Weilin:** 'This tells me that residents travel during peak hours because about 80% of them are agreeable to have a peak hour shuttle bus service. Since [residents] agree/strongly agree, it means that they need this shuttle bus service and that they usually take public transport. The survey results said that 90% of them responded 'Yes' to whether they would use the service- not only did the public agree to have a peak hour shuttle bus service, but they are also willing to take the service.'

While Weilin's response was more descriptive than the rest, she and Molly were better at forming their own interpretations about the source. This was gleaned from their opinions about the cost of the shuttle bus service, with Weilin claiming that the residents were "very picky" and Molly asserting that residents were "only willing to pay a mere sum" for the shuttle bus service. Also, all students

instinctively tried to explain the data findings presented in the source despite not being prompted to do so:

> **Keith:** 'I will fund the service because it benefits more people: From personal experience, during peak hours, there are many vehicles on the road and most of the time, there will be traffic congestion…so this shuttle bus service will probably help to transport people faster from place to place.'

> **Molly:** 'If the bus comes frequently then it will be able to fetch a higher number of residents in a shorter amount of time. And the location is because normally when you have bus-stops, they are fixed and some of the residents who live far away need to walk quite a distance.'

Keith and Zack tapped on their prior knowledge of traffic during peak hours to rationalise how the shuttle bus service would be beneficial for residents. However, their elaboration on the benefits of the shuttle bus service was not explicitly linked to the source's findings. Conversely, Molly's and Weilin's explanations were more relevant and logically linked to the source. For example, Molly elaborated on how the key concerns stated in the source (location of bus stops and frequency of bus service) were related to the efficiency of the peak hour shuttle bus service and the convenience it affords.

Furthermore, all students demonstrated some form of higher-order thinking when evaluating the source (corresponds to cognitive category 5 in Fig. 1) and suggesting ways to improve the reliability of data (a sub-category of cognitive category 6 – 'Create'). They offered their own conclusions on the reliability of the source. All critiqued that the number of residents interviewed was too few by justifying that the source's questionnaire was for a larger-scale study ('Conclude', 'Justify' and 'Critique' are sub-categories of cognitive category 5 in Fig. 1). This led them to suggest for more residents to be interviewed:

> **Weilin:** 'I think 30 residents is too little. They only interviewed residents from Blocks 351, 353 and 356. What about others living in the area? They should also gather [data] from other blocks.'

Only Molly and Weilin could suggest (with justification) more ways to improve the reliability and validity of survey results: Molly highlighted how she wanted to know more about the age distribution of residents surveyed, suggesting possible age groups (elderly, teenagers, working adults) that were interviewed. She also proposed for more of the target audience to be surveyed. To her, the target audience refers to teenagers and working adults as these are the people who would use the shuttle bus service. Whereas for Weilin, she critiqued the day and time which the survey was conducted, proposing to change the frequency and period of data collection.

Based on the data findings, existing differences were observed in students' lower-order and higher-order cognitive skills before GI: While all students understood the geographical data from their ability to summarise the source (coincides with cognitive category 2 in Fig. 1), Molly and Weilin were more proficient in interpreting and explaining findings ('Summarise', 'Interpret' and 'Explain' are sub-categories of cognitive category 2 – 'Understand'). In relation to higher-order thinking skills, all students showed some ability to evaluate (corresponds to cognitive category 5 in Fig. 1) by drawing

conclusions regarding the reliability of the source and offering justifications for their critique of the source ('Conclude', 'Justify' and 'Critique' are sub-categories of cognitive category 5 – 'Evaluate'). They also were able to suggest improvements to the source (a sub-category of cognitive category 6 – 'Create'). However, Molly and Weilin provided a stronger critique of the data and proposed more ways to improve findings, as opposed to Keith and Zack whose responses were more limited. Hence, it can be inferred that Molly and Weilin were better able to understand, evaluate and provide suggestions to improve the reliability and validity of data compared to Keith and Zack.

Students' Cognitive Abilities after GI

After GI, all students continued to demonstrate lower-order cognitive thinking skills in cognitive category 2 ('Understand'). They showed significant improvement in higher-order cognitive thinking, albeit to different extents. This improvement came in two forms: All students showed a development in higher-order thinking skills which was not evident prior to fieldwork. Also, all students exhibited deeper thinking at specific higher-order cognitive levels.

Firstly, all students demonstrated the ability to 'compare' and 'attribute' – cognitive skills in cognitive category 4 ('Analyse') outlined in Fig. 1 which were unapparent before GI. Students could compare findings of the source with their personal experiences during GI:

> **Keith:** 'Last time, I said that 30 people is too little to decide for the rest of the people living in Taman Jurong…but from the [GI] experience, I feel that asking 30 people is really difficult and time-consuming. Maybe the committee could send more people to conduct the survey over a longer period so that there will be more accurate results.'

After GI, students spontaneously related their experiences in the field to their analysis of key findings in the source. Keith and Weilin acknowledged the difficulties with data collection for the sample size stated in the source: Based on their GI experience, the group also surveyed 30 people and all asserted that they faced many rejections by the public which made the fieldwork less enjoyable. Cognisant of the difficulties in data collection, Keith proposed for the number of surveyors to be increased. The importance of surveying more people was still maintained by students as echoed by Weilin, who compared the purposes of data collection for the Transport GI with the source: The former was only used "to do a report", whereas the latter was a "larger-scale [project] which uses funds".

Apart from comparing their Transport GI experience with the source's findings, Molly and Weilin provided deeper analysis of data after GI by attributing key findings presented to each other, instead of simply viewing findings as discrete:

> **Molly:** 'I think that time is missing, because [the source] only said 'Thursday afternoon (9th March)', so they only interviewed people in the afternoon. Most adults will be working on a Thursday afternoon, so the people interviewed are mostly senior citizens or children coming home from school.'

> **Weilin:** 'For those who strongly agree/agree, get the frequency that they would like the shuttle bus service to be. If the 30 people you ask do not take public transport that

> much, then they would not need the service, so even if you implement the service, there would not be much point.'

The connection Molly made between the time of conducting the questionnaire and ages of respondents seems to reflect her experiences of administering the Transport GI questionnaire: She mentioned "[our group] had to record down the time because it was on the [class questionnaire] template, so the teacher knows we are doing a fair test". This suggests that the act of noting down the time which she conducted the survey (albeit made compulsory by the Geography teacher) indirectly led to Molly developing a deeper understanding of how the time of survey could influence the age profile of survey respondents and validity of results. Additionally, Weilin's improved ability to analyse data appears to stem from her experience of crafting the Transport GI questionnaire: Her suggestion of obtaining information on the preferred frequency of the shuttle bus service mirrors her GI experience of crafting more specific questions to understand commuters' idea of safety and comfort when using Mass Rapid Transit (MRT) journeys. The group had included a question which asked commuters about their MRT usage frequency in their GI questionnaire; this was not present in the standardised class questionnaire. Thus, it can be inferred that the group's decisions on what questions to include in their GI questionnaire played a role in shaping their perception of the linkages among key findings of the source.

Secondly, all students showed deeper thinking in evaluation and creation after GI (corresponds to cognitive category 5 and 6 respectively in Fig. 1). In terms of evaluation, Molly and Weilin were able to offer further critique of the source's findings with justification; this was linked to their conclusions on the reliability and validity of data ('Critique', 'Justify' and 'Conclude' are sub-categories of cognitive category 5 – 'Evaluate'):

> **Molly:** I feel that these 2 questions ['How far are residents agreeable' and 'Whether residents would use the shuttle bus service'] are quite similar and redundant. Actually, if most people agree to the service, they will use it.

Molly's critique of the usefulness of survey questions may have stemmed from her experience of crafting questions for the Transport GI questionnaire. Based on the questionnaire template provided by the teacher, students were required to state the purpose/relevance of each crafted question in answering the overarching GI question.

Furthermore, all students showed considerable improvement in their ability to propose ways to improve the reliability and validity of the source's findings. This falls under the 'Create' category in Fig. 1 which has been recognised to be the most complex cognitive thinking skill. A greater variety of ideas were put forth by students to improve the source's questionnaire. These suggestions not only extend beyond what was presented in the source, but also indicate student's awareness of having a planned approach when administering questionnaires ('Suggest' and 'Plan' are subcategories under cognitive category 6 – 'Create'):

> **Zack:** 'Ask them reasons about why residents disagree [to having the service] so that [the committee] can improve on it and more people will accept the idea.'

> **Keith:** 'Ask [the residents] how they feel about current transportation- is it sufficient? How [can we]

> improve the current transportation system? If they say it cannot be improved/there is no way to improve it, then maybe this shuttle bus service is useful and we can promote it to the residents.'

Zack and Molly expressed the need to ask residents why they disagreed with having the shuttle bus service. This possibly arose from the questions crafted for their Transport GI questionnaire which required respondents to provide reasons for their choice of numerical rating for the safety/comfortability of their train journey. Keith's thoughts on gathering residents' opinions about the existing transport system seem to be influenced by the questions crafted for the Transport GI questionnaire: They include asking commuters to rate Singapore's public transport and suggest features they find necessary for public transport but have yet to be implemented.

Additionally, the need for more specific survey questions was raised ('Construct' is another sub-category under cognitive category 6 – 'Create'):

> **Weilin:** 'They mentioned that some key concerns raised by the residents are the location of stops and the frequency. I think if they set the location and set the frequency and ask the public again, you can get more specific feedback.'
>
> **Molly:** 'Ask [residents] about what features they expect the peak hour shuttle bus service to have. For example, do they want the bus to be able to accommodate 30 people? Or 10? Ask whether they want any additional features to make their journey more enjoyable (like it is safer and more comfortable).'

Weilin's proposition to fix the locations and frequencies of the shuttle bus service has followed from her experience of crafting more specific questions for the Transport GI questionnaire (respondents were asked to rate their opinions of the safety/comfortability of the train journey based on a specific set of features). As for Molly, she wanted to ask residents about their expectations relating to the features of the shuttle bus service. She also hoped to find out if residents wanted any features to make their journey safer/more comfortable. While the Transport GI question was already known to students prior to fieldwork, Molly did not offer recommendations to the source's questionnaire with reference to the terms used in the Transport GI question ('features', 'safe' and 'comfortable'). This supports Mackenzie and White's (1982) assertion that active participation in fieldwork enhances students' ability to relate their field experiences with existing knowledge: In this case, Molly ascribed greater meaning to the terms mentioned in the Transport GI question after fieldwork.

Based on the data findings, it was observed that all students demonstrated enhanced cognitive thinking with regard to analysis and synthesis after GI (corresponds to cognitive category 5 – 'Analyse' and category 6 – 'Create' respectively). Students could offer more suggestions to improve the reliability and validity of data, despite them admitting that they had not learnt much content through the GI as public transport was something they were familiar with. This emphasises the value of GI in deepening students' higher-order cognitive thinking by creating opportunities for students to gather data in real-life contexts and be involved in crafting data collection instruments (in this case, questionnaires), further sensitising them to geographical data. Even so, Molly and Weilin exhibited

greater deepening of higher-order cognitive skills compared to Zack and Keith. This may be due to the actual level of involvement of students in conducting the questionnaire surveys for their Transport GI out in the field. As noted by Weilin, she and Molly "did more talking" whereas Keith and Zack "did not have the courage to ask people to do the survey". Thus, it could be inferred that students who play a more active role in conducting fieldwork may experience more significant development in cognitive thinking (Mackenzie & White, 1982).

Conclusion

All in all, this study has affirmed the importance of fieldwork in contributing to students' cognitive development. More importantly, it has provided a deeper understanding of Geography fieldwork and its effects on cognition by investigating the role of GI (an inquiry-driven fieldwork) on students' cognitive thinking. Through the construction of an analytical framework to compare students' cognitive abilities before and after GI, a more in-depth understanding of the complexities of students' cognitive development was attained. Furthermore, this study contributes to the nascent academic literature on how Geography fieldwork influences students' cognitive thinking, especially in relation to GI in Singapore: In this study, all students experienced a marked improvement in higher-order cognitive thinking skills after their Transport GI. More specifically, they developed higher-order cognitive thinking skills in analysis, and showed deeper thinking in higher-order cognitive levels of evaluation and creation. These cognitive skills are essential in helping students make sense of new knowledge- one of the main learning outcomes of Geography, thereby contributing to the honing of 21st Century Competencies specifically critical and inventive thinking. These experiences help shape students to become confident, self-directed learners and active contributors of the future, ultimately fulfilling the DOE of Singapore's education system.

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