

**Project Title:** Literacy challenges and students' strategic language learning efforts during the primary-secondary transition

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# Final Report

by

Principal Investigator

(a) Title

Literacy challenges and students' strategic language learning efforts during the primary-secondary transition

(b) Abstract

Under the fine tuning of Medium of Instruction (MOI) policy in Hong Kong's secondary school, many primary school leavers are expected to learn subject knowledge with and through English after admission to secondary schools. This change of MOI poses significant language demands on Form 1 students. Given the increased language challenges, these students may not necessarily have developed effective learning strategies to cope with them. Therefore, this project examined the literacy challenges that secondary Form 1 students have and self-regulated learning strategies they use during the transition year. Two secondary schools and four primary schools were involved in this project while Integrated Sciences and Math were the EMI subjects in our investigation. We collected a variety of data including lesson observations, interviews, and material artefacts such as students' textbooks, homework, notebooks and test papers. We also conducted interviews with teachers and parents and surveyed on a large number of students. Systematic analysis was performed on the data we believe yield most significant insights. So far, we found that the underachievers involved in this project experienced challenges in learning subject content in English. The language challenges include technical and non-technical terms, dense noun phrases, difficult conjunctions/propositions/pronouns, implicit logical relationship,

and unclear questions. Differences were also identified between the underachievers and the high achievers in terms of the type of resources and the processes they use. Suggestions were provided to the teachers about ways to facilitate students to overcome the language challenges and to develop their self-regulated learning ability.

(c) Keywords

English-Medium Instruction; academic studies; language demands; bilingual education; self-regulated learning; sociocultural theory

(d) Introduction

This report documents how we draw empirical evidence to identify the language challenges bilingual students have when learning EMI academic subjects in Hong Kong so that we can enhance our understanding of the challenges and self-regulated learning in bilingual learning contexts, this study draws upon. It also documents effort that we undertook to examine the way Hong Kong students appropriate resources during EMI academic learning through sociocultural perspectives. Academic learning presents a significant challenge for students when they transit from one learning environment to another, especially when they have to shift the medium of instruction from mother tongue to a second or foreign language in many bilingual education contexts (e.g., Pessoa, Miller, & Kaufer, 2014; Hu & Gao, in press). Though very little empirical evidence has been provided to support it, sociolinguists believe that informational density, abstraction, technicality, and authoritativeness that form the specific features of scientific language are one of the most notable challenges (Fang, 2005; Maxwell-Reid & Lau,

2016). In response to such linguistic challenges, these students may need to develop the required capacity and skills and become autonomous learners who can regulate and enhance learning of language and academic content beyond the classroom. This draws attention to the promotion of bilingual students' self-regulated learning defined in terms of metacognitive processes including paying attention, planning, obtaining and using resources, organising, implementing plans, orchestrating strategy use, monitoring and evaluating (Gao, 2007; Oxford, 2011; Teng & Zhang, 2016). Since it is believed that self-regulated learners are able to learn more and better (Pintrich, 2000; Zimmerman, 2000), self-regulated learning has attracted much research attention for decades. In the last few decades, researchers have examined self-regulated learning processes such as planning (e.g., Kellogg, 1987), organising (e.g., Bråten & Strømsø, 2003), monitoring (e.g., Fadlelmula, 2010) and evaluating (e.g., Fitzgerald, 1987).

In light of recent broadening of sociocultural perspectives on language learning (e.g., Lantolf, 2006; Gao, 2008, 2010), researchers have contended that it is important to explore the mental process situated within particular sociocultural communities. For this reason, a number of studies have explored the notions of co-regulation or socially shared regulation in learning and have focused on groups' coordination of learning during a shared activity (Panadero & Järvelä, 2015). Studies have also examined individual learners' self-regulated learning as researchers view learning as a process involving appropriation of various material artefacts and discursive resources, as mediated by contextual conditions and social agents (e.g., Lantolf, 2006; Vygotsky, 1978). While many relevant studies have been conducted to explore self-regulated strategic language learning (e.g., Lei, 2008), very little effort seems to have been made in bilingual

learning contexts where both language and subject content are the goals of learning. In such contexts, learners may encounter different challenges of using resources to mediate the self-regulated learning.

(e) Review of literature for the project

1) Language challenges for EMI academic learning

Efforts have been made to identify the challenges students have when learning academic subjects with a second or foreign language as the medium of instruction (Kibler, 2014; Campbell & Li, 2007). Most of the studies highlight the problems of mastering language skills or knowledge from a macro perspective, such as having difficulties in writing in different genres (Campbell & Li, 2007), as well as lacking knowledge of vocabulary, background of the reading topic, and reading comprehension skills (Pessoa et al., 2014). Few studies have probed linguistic features of the language that makes the learning difficult.

Functional linguists have used systemic functional linguistics as a language-driven tool to identify language demands for scientific reading and writing. According to systemic functional linguistics, informational density, abstraction, technicality, and authoritativeness form the specific features of scientific language (Fang, 2005; Maxwell-Reid & Lau, 2016). Readers may find it hard to understand or use the language due to the abstract and technical vocabulary, difficult prepositions, conjunctions and pronouns, ellipsis, subordinate clauses where subjects and auxiliary verbs and/conjunctions are removed, with-prepositional phrases which transfer the meaning from one grammatical category to another, lengthy nouns, and passive voice, etc. (Pessoa et al., 2014; Fang, 2006). However, the assumed challenges are normally identified

through the analysis of the written texts according to researchers' own interpretation. Whether they are actual challenges to learners' in a particular level of education or in what way they are difficult to the leaners has been seldom discussed. Attempts to explore learners' experience and perception of scientific literacy are needed for a better understanding of this issue.

## 2) Self-regulated learning

Given the belief that self-regulated learning is closely associated with effective learning, researchers have investigated it in various disciplines, such as science (e.g., Moos & Azevedo, 2008) and language (e.g., Spörer & Schünemann, 2014). Relevant studies have developed instruments to measure self-regulated learning strategies (e.g., Teng & Zhang, 2016), identified relationships between self-regulated learning strategy use and variables like learning beliefs and learning outcomes (e.g., Law, Chan, & Sachs, 2008) and have explored changes in self-regulated learning processes across time, in different learning environments and for different learning purposes (Coiro & Dobler, 2007; Linderholm & van den Broek, 2002).

Researchers have also identified differences and similarities among learners in terms of self-regulated learning strategy use (e.g., Goldma et al., 2012) and have examined teachers' perceptions and instructional practices with regard to self-regulated learning (e.g., Lau, 2013), besides having developed effective pedagogy to promote self-regulated learning (e.g., Teng & Zhang, 2016; Schraw, Crippen, & Hartley, 2006). Zimmerman and Schunk (2011) summarised four historic groups of self-regulated learning studies: metacognitive and cognitive enhancement which highlight teacher support to enhance strategy use; social and motivational processes that focus on the motivational outcomes influenced by social communities;

behavioural and cognitive-behavioural processes of self-regulation; and Vygotsky socio-cultural perspective that highlights the mediation of contextual resources in mental development. However, research investigating self-regulated learning from Vygotsky socio-cultural perspective did not emerge until recent years, when researchers realised the importance of considering learners' discourse community to develop a full understanding of mental processes (e.g., Kang & Pyun, 2013; Lantolf & Thorne, 2006; Prior, 2006).

(f) Theoretical and/or conceptual framework of the project

The project used socio-cultural theory as the theoretical framework, which highlights the mediation of contextual resources in mental development. From a socio-cultural perspective, self-regulated strategic learning is defined as 'a learner's socially mediated plan or action to meet a goal' (Oxford & Schramm, 2007, p. 48). In this goal-meeting process, Vygotsky's idea of mediation is the key and artefacts including tools (e.g. a saw) and signs (e.g. language) are highlighted as important resources for human beings to mediate relationships with others and the world (Lantolf, 2006; Vygotsky, 1978). Drawing on this notion, Engeström (1999, 1987) developed an activity theory, in which the mediating resources are expanded to artefact, community (a social group that undertakes the same actions with the same goals), rules (e.g. time and academic requirements) and division of labor (e.g. roles played and power relationships in the community). Together with the artefacts, these mediators interact with each other when acting upon the subject's activity, from which the outcomes of the activity emerge (Engeström, 2001; Yu & Lee, 2016).

As it is believed that we might be able to enhance underachievers' success record by

teaching them what high achievers do and expanding their strategy repertoire (Rubin, 1975; Griffiths, 2015), this study uses the activity theory as the framework to explore bilingual students' appropriation of resources for self-regulated learning of academic subject content, comparing the resource-mediated strategies used by high achievers and underachievers on one hand and the processes of the resource use on the other. Three research questions were addressed in the project: 1) what literacy challenges do Hong Kong students have when learning EMI academic subjects in the first year of secondary school? 2) what resource-mediated strategies do these students use for self-regulated learning of EMI academic subject content? 3) How do they strategically use resources in self-regulated writing for academic studies in the medium of English?

(g) Methodology

The project adopted mixed methods directed at documentation of learners' literacy challenges, strategic learning and development (Cohen & Macaro, 2007; Gao, 2004; Hsiao & Oxford, 2002).

(h) Data collection and analysis

In the inquiry, textbooks, pedagogical activities and assessment methods [not sure] used for Secondary 1 IS teaching were collected for identification of the literacy challenges students face. Twelve students (profiles of the students are presented in Table 1) were chosen to be focal students according to their academic achievements, who were followed up to document their strategic efforts to improve their literacy skills with interviews, observations and stimulated recall interviews (please refer to Appendix 1 for sample student interview transcripts). The

number of student participants was initially set to be 16. Due to the good quality of data we collected from the 12 student participants, we felt confident that 12 participants were able to provide enough quality data to help us gain insights into the students' self-regulated learning. Their teachers and parents were also interviewed and observed about their efforts to support these students' learning of English language and subject classes (please refer to Appendix 1 for sample teacher interview transcript and lesson transcript). Unfortunately, the interviews we conducted with parents are of poor quality and have not been used for analysis. Lesson observations and interviews were also conducted with primary school teachers to examine the gaps of primary-secondary transition period in terms of literacy demands. Based on the qualitative results, we also developed a survey instrument to find out the self-regulated strategy use of a larger number of students (but the survey data are still being processed).

The analysis of data is still ongoing considering the amount of data we have collected in the project. So far in the analysis, the student-related data were read both deductively and inductively and coded into literacy challenges, categories of resources and processes of resource use. The data were coded into basic-level concepts first and then grouped into different categories. Final categories of literacy challenges included technical and non-technical terms, dense noun phrases, difficult conjunctions/propositions/pronouns, implicit logical relationships, and unclear questions; Resources included artefact, rule, community and role; Self-regulated strategic processes included noticing, selecting, reorganising, evaluating, reviewing and memorising, imitating as well as adapting.

**Table 1.** Profile of participants ( $n = 12$ ).

Groups	Name (pseudonyms)	Gender
High achievers	Katty	Female
	Joey	Female
	Daniel	Male
	Allison	Female
	April	Female
	Amy	Female
Underachievers	Cindy	Female
	Frankie	Male
	Thomas	Male
	Tracy	Female
	Helen	Female
	Jessica	Female

### (i) Results and Discussion

We have published four journal articles and one book chapter based on the analysis of data we have conducted so far (see appendix 2). In this project report, we briefly present main findings emerging from the qualitative analysis of student data. We highlight the challenges that these students have and strategic responses we found they adopted in the transition process. The underachievers involved in this project were found to have great problems with learning content in English. Their literacy challenges included technical and non-technical terms, dense noun phrases, difficult conjunctions/propositions/pronouns, implicit logical relationship, and unclear questions. The data also show differences between underachievers and high achievers in terms of the types of resource-mediated strategies they used and the processes they used.

#### 1) Literacy challenges

Analysis of students' EMI science textbooks, their assignments, and their interview responses, together with the comparison between secondary and primary textbooks, revealed that many linguistic features that have been identified by functional linguistics were found difficult by the underachievers involved in this project (Fang, 2005; Halliday & Martin, 1993).

Those challenges are elaborated and explained in the following sections.

*Technical terms.* Technical terms we identified in students' learning materials of

Integrated Sciences can be categorised into 4 main groups: general concepts, field concepts, apparatus and its use, and methodology. Some of the vocabulary items, despite students' limited exposure to them in English lessons due to their specificity, are used extensively in discourses of Integrated Sciences, which leads to students finding it difficult to understand the word meaning and so the sentence or text meaning in a given material. In general, students said in interviews that they check dictionary or ask teachers and classmates much more often as the words are not taught in English lessons. The high density of these difficult and technical lexemes, as mentioned in students' interviews, has been a significant obstacle for them to master the Integrated Sciences subject itself. Having said that, not all technical terms students have problems dealing with, especially for the terms that are the main theme of a chapter or that keep being reinforced throughout, such as 'cells' and 'electricity'. From this case, we argue that the frequency at which a word is encountered by students is positively correlated with the likelihood of them knowing the meaning of that particular word.

*Non-technical terms.* Some students were found to have difficulties in understanding non-technical vocabulary in a given text in Integrated Sciences subject. One example we have seen in the interviews was that students were able to explain the meaning of vocabulary which is regarded as technical vocabulary and yet were unable to tell meanings of simple words such as 'correct'. Students probably have been exposed to non-technical and simple lexemes in their English lessons. However, the example here suggests that the high frequency of exposure to a word in one context *might not* be able to enhance the likelihood of realising the meaning of the

same word in an unfamiliar context. That is, students might not be able to transfer lexical knowledge from one context to another. That explains why there are cases in which students fail to understand words with simple meaning and are supposed to have taught in the English subject.

*Dense noun phrases.* Students generally have difficulties in decoding complex nominalised phrases in sentences, which then hinders understanding of the meaning of a given text. Apart from the use of passive voice, nominalisation, which is also to enhance the level of objectivity, is another salient language feature found in scientific texts, including textbooks. The noun phrases, very often, are realised in relative clauses and/or participle phrases as illustrated in the sentences '*The foetus grows inside a bag of watery liquid that fills the mother's uterus.*' and '*The embryo develops into a foetus with all major organs formed.*'. Students can easily be confused as they read the relative clause that is intended to supply detailed description of '*a bag*'. The internal structure and logical relationships within the sentences can be extracted by skilful and experienced readers of English. Yet, to Form 1 students who may or may not have started to master relative clauses in English lessons, understanding the relationships between phrases in this sentence can be a challenge for they, in the first place, are still developing the sense and skill to parse English sentences into meaningful chunks to facilitate comprehension.

*Conjunctions preposition and pronouns.* Some students were found to have problems understanding the functions and meanings of conjunctions and prepositions in scientific texts as well as their usage when it comes to sentence production level. This can be attributed to the fact that some conjunctions and prepositions are inherently polysemy in nature, which means there

are multiple meanings attached to a single form, and that students may not necessarily have enough reading experience to understand the different meanings these functional words carry in different contexts. For example, ‘as’ can be used as a conjunction or preposition; even if it serves as conjunction, it can mean ‘when’, ‘because’ or ‘though’. Higher achievers may be able to infer the meaning as they encounter the same conjunction or preposition that serves different functions than what it typically does; yet lower achievers have the tendency to assign the usual sense to the targeted conjunction or preposition in every context, hindering their understanding towards the given text. For example, in the sentence ‘*The embryo develops into a foetus*’, ‘into’ typically carries the meaning taping onto the spatial aspect; however, in the current context, it implies a change of state. To some students, the incongruity between the word meaning and what they think the sentence may mean can possibly pose obstacles to know about the actual meaning.

Cases in which students failed to understand meaning of conjunctions, prepositions and inferring meaning of pronouns were also noticed. For example, a student did not understand the meaning of ‘*the above*’ in the questions, causing the student to give answer without referencing to the information given previously. This may be due to unfamiliarity with the words as they have not encountered them in English lessons or they can not apply the learnt knowledge in another context beyond English classroom.

*Implicit logical relationship.* It is noticed from students’ interviews that some of them read the questions quickly and the words in the questions selectively. They reported that very often, they read the very last sentence in a question. This is understandable because students have to

finish the given tasks against time pressure in quizzes and exams; therefore, skimming the questions and reading only the last sentence *could be* a useful strategy. However, it is worth noticing that skimming when reading questions is not without risk. Upon our detailed analysis, it is found that there is often implicit logical relationship embedded within and across sentences. Students will probably overlook those implicit clues that help form a clear picture of the question if they are not reading carefully but skimming, which will then affect the accuracy of the answer.

*Unclear questions.* One of the major differences between secondary study and primary study is one of assignment criterion. In primary school, as student interviewees explained, specific details are not required to be given, whereas, this is not the case in secondary schools where precision and specificity are more emphasised on. Students who transited from primary school to secondary school may not be well aware of these expectations of their assignments; therefore, students tend to give general answers when the questions allow ambiguity.

## 2) Types of resource-mediated strategies

Findings show that our participants used all the four categories of resource-mediated strategies (i.e. artefact-mediated strategies, rule-mediated strategies, community-mediated strategies and role-mediated strategies) (Engeström, 2001; Yu & Lee, 2016). The high achievers and the underachievers were also found to have displayed different patterns of strategy use for appropriating resources. The ways the two groups of participants used each strategy and the reasons thereof are elaborated in the following sections.

### *Artefact-mediated strategies*

The participants, especially the high achievers, were found to have strategically used artefacts, including textbooks, notes, dictionary, symbols, L1 and L2 as resources to facilitate self-regulated learning. Such strategic use of artefacts can be further categorised into tool-mediated strategies (i.e. participants' utilisation of physical learning resources) and sign-mediated strategies (i.e. participants' strategic reliance on symbols, L1 and L2 as learning resources) (Lei, 2008).

The tools used by the students included textbooks, notebooks, dictionaries and internet for self-regulated learning of IS. The data suggest that high achievers often referred to textbooks and notes when they had difficulties related to either language or content. They recycled sentence patterns in the textbooks and notes when completing written assignments. They also infer difficult words' meanings with the help of textbooks and notes.

In contrast, underachievers also used textbooks and notes but less often. As found in the interviews, they had difficulties in using the textbooks or notes due to lack of ability to locate useful information and low English proficiency. They referred to the textbook or notes only when they could locate the relevant information easily. They were also less willing to use notes for learning because they did not know whether particular notes would be useful.

Apart from textbooks and notes, the high achievers use dictionary or internet frequently in the self-regulated learning process (Lei, 2008). In the focus group interview, Amy and Allison reported that they had used dictionary more often than other resources because dictionary is convenient to use. Furthermore, they mentioned that they did not look up every single word in the dictionary and consulted dictionary only for keywords that affect

understanding. This shows how goals mediate the strategic efforts that participants put in self-regulated learning (e.g., Liu, 2015).

In comparison with the high achievers, the underachievers do not regard dictionary as a preferred learning resource because they do not feel that they can better understand sentences by looking up words in it. Considering they had to learn the subject content in L2, they probably had too many unknown words that they needed to look up in the dictionary. In addition, they were unable to use dictionary effectively since they found it difficult to choose the right one from various meanings of a word presented in the dictionary.

Negative experiences of using tools, including dictionaries, discouraged these participants from using them. Such negative experiences might have been caused by the fact that the underachievers did not even know how to use a dictionary because they did not know ‘how to use the Chinese words to look up for the corresponding English words in the dictionary’. (Frankie, stimulated recall). This draws attention to the participants’ use of L1 in learning subject content in L2 (i.e. English) (e.g., Lei, 2008).

Apart from tools, participant students used signs to mediate the self-regulated learning process. The sign-mediated strategies highlight students’ strategic reliance on symbols, L1 and L2 as learning resources. In the inquiry, the high achievers were found to have often used L1 to mediate self-regulated learning (Lei, 2016; Yu & Lee, 2016). They used L1 to understand assignment questions and IS content. In contrast, the underachievers often did not use L1 strategically to mediate self-regulated learning of IS. Although they had to struggle more with L2, they were reluctant to rely on L1 to better understand IS content because they were not sure

whether L1 could be a useful resource for learning.

Previous research has revealed that learners regulate memorisation with symbols (e.g., Faddelmula, 2010). The high achievers in this study were found to have used symbols such as brackets, asterisk and various colours, to regulate learning of subject content and knowledge. The underachievers used symbols less often and displayed different patterns of symbol usage in comparison with the high achievers.

#### *Rule-mediated strategies*

Like the learning of other subjects in other contexts, the participants' self-regulated learning of IS was found to be mediated by appropriation of rules, such as evaluation criteria (Yu & Lee, 2016) and time constraints (Lei, 2008). This section presents how these rules mediate self-regulated learning.

The high achievers' self-regulated learning was found profoundly mediated by evaluation criteria. They acquired and used resources that were useful for them to achieve better performance when writing assignments and taking examinations. They usually focused on learning and memorising content and languages that were to be evaluated. The high achievers stressed in the interviews that they had to use key terms in IS accurately to ensure their grades do not suffer any deductions. They always followed the evaluation requirements closely when writing assignments or undertaking examinations. They also wrote exact number of possible answers as required in the questions even when they knew more correct answers, again reflecting the mediation of evaluation criteria.

In contrast, the underachievers used fewer evaluation criteria to mediate appropriation of

resources for self-regulated learning. Like the high achievers, the underachievers too sometimes wrote assignments according to the evaluation criteria. For example, Helen reported in the interview that grammar could be ignored in the writing, because writing down the main points was sufficient for her to get scores. The underachievers were also less aware of the criteria used to assess their learning in IS. They tended to apply the criteria set for learning in primary schools to learning in secondary schools. For example, when required to write classification reports, naming things under categories, Thomas, Cindy and Frankie only named the categories, like they used to do in primary schools. They were not aware that the task had different requirements in secondary school.

Echoing the findings reported in extant research which found high achievers' self-regulated learning mediated by time (Lei, 2008), evidence in this study also shows the students' use of time- mediated strategies. For example, due to the time constraints, the high achievers became selective when taking notes. They only took notes on things that were new, yet to be understood, or important to them. The study also found that the underachievers' self-regulated learning was mediated by time. Due to low English proficiency, underachievers usually need more time to take notes. Nonetheless, the limited time available during the lessons requires a fast speed of note taking, which leads to these participants' failure to take important notes. The limited lesson time apparently also prevents students from asking their classmates or teachers questions. For this reason, underachievers like Jessica consider seeking complementary support after the class.

Due to the limited time, the underachievers were not able to review and memorise

everything taught even though some of them tried hard. For example, Cindy confessed that she was seldom able to memorise notes taken in IS lessons. She explained that she was overwhelmed by the large number of new contents and words. In addition, the limited time did not allow her to appreciate the answers provided by her classmates, either. When completing written assignments, she just wrote down what her classmates told her without understanding it because of the pressing deadline for submission.

The underachievers experienced similar time-related challenges in examinations. According to Thomas, when he has problems in understanding a question or writing the answer to the question, he skips it and moves on to the next. He explained ‘otherwise I won’t have enough time to answer the last question’ (Thomas, interview). While acknowledging the importance of some strategies (e.g. reviewing, memorising, re-reading the difficult texts, etc.), the underachievers give up using them because of time constraints. It seems that time constraints do not make the underachievers strategically selective like the high achievers; instead they ‘dodge’ difficult questions in the self-regulated learning process.

#### *Community-mediated strategies*

Appropriation of resources for self-regulated learning of IS by the participants in the inquiry was found to have been mediated by the broad society and immediate school communities. Various social agents such as teachers, peers and members of family facilitated the participants’ self-regulated learning.

Teachers and classmates are the key members of a community inside a school (Lei, 2008; Yu & Lee, 2016). The high achievers reported having asked their teachers or classmates for help

sometimes when they had difficulties in writing assignments, when the use of artefact-mediated strategies failed to help them solve the problems or when the problems could be solved faster by asking teachers or classmates than by using artefact-mediated strategies. As mentioned earlier, they found using dictionary more convenient. Like the high achievers, the underachievers too regarded classmates as an important resource.

Although they were in the very beginning of Year 1 study, they had classmates who were from the same primary schools and had made some new friends in the training camp before the starting of the Secondary 1 school year. As Tracy recalled in the interview, ‘for the sake of convenience’, they could ask ‘classmates for help when [they] had homework problems’. Frankie said he normally asks classmates when he encounters difficult words. Even when he is not with his classmates after school, he does not use other strategies but asks his classmates when he meets them. Likewise, Jessica indicated in the group interview that she preferred asking classmates to other methods because it was more convenient.

Society-mediated strategy refers to the participants’ appropriation of social resources outside school (Lei, 2008), such as family members and friends, for self-regulated learning of IS. In the inquiry, some of the participants were found to have used social resources outside school while others did not. The interview data reveal that the high achievers decided whether to use social resources according to availability and usefulness of the resources.

It seems that easy access was one of the most important reasons for these participants to use particular social resources. It must be noted that not all underachievers used social resources frequently. Jessica reported having asked her elder sister for help but she found that her

classmates were more helpful in enabling her to overcome learning challenges. Thomas never mentioned using social resources to solve problems in the learning process. It is also important to note that the underachievers did not always make their decisions on whether to use social resources based on the usefulness of the resources.

#### *Role-mediated strategies*

The role students play in the process of learning is also an important resource that mediates utilisation of available learning resources (Lei, 2008). In EMI contexts like Hong Kong, the learning of EMI subjects is expected to achieve dual goals – language and subject contents (Lo, 2015), and thus language students understandably play dual roles in EMI subject learning – language learners and subject content learners. In this study, both high achievers and underachievers tended to view themselves as both subject content learners and language learners. Students like Daniel, Katty and Frankie thought the process of learning science subject knowledge is also a process of learning English, due to the use of English as the medium of instruction. At the same time, they perceive themselves as subject content learners more than English language learners when learning science in the medium of English. Such role awareness motivates them to learn and use English language, useful for science learning specially when reading science texts and writing science assignments. As mentioned earlier, the high achievers looked up words in the dictionary only if that affected understanding of science texts or the scores in IS examinations (see example of Amy, Allison and Katty in the section ‘Dictionary/internet-mediated strategies’ and April in the section ‘Evaluation criteria-mediated strategies’). They also tended to memorise key science subject content and language covered in

IS examinations (see example of Katty in the section ‘Evaluation criteria-mediated strategies’).

They were concerned about the accuracy of language use only when it affected IS subject examination results (see example of Helen in the section ‘Evaluation criteria-mediated strategies’). This shows the interaction between the IS learner role the students play and the rule-mediated strategies they use.

### 3) Processes of using resources

Results emerging from the analysis show that high achievers and underachievers use meta-strategies differently when using resources in the process of self-regulated writing (Lei, 2016). Instead of elaborating the relationships among these meta-strategies and strategic processes, the following sections focus on identification of the differences between high achievers and underachievers. However, it should be noted that the sequence in which the meta-strategies and strategic processes are presented does not indicate the sequence in which the meta-strategies and strategic processes happened. In reality, they did not happen in a linear sequence but were interlinked with each other. For example, evaluating the understanding of a resource could occur either/both before or after selecting the resource. When it occurs before selection, the resources are selected on the basis of the evaluation results, that is, resources that do not make sense to the learners are not selected for writing. It could also occur after selecting. In this case, learners select the important or useful resources when they notice them first, and then check if the selected resources make sense. Further selection might be conducted if the evaluation results are negative. Such reiteration also applies to the rest of the meta-strategies during the self-regulated writing.

### *Noticing*

Previous studies have showed that skilled learners notice a wide range of good writers' language usage and use that as a good resource to support their writing, but less skilled learners do not (Lei, 2016). Data collected in this study also indicate that high achievers can determine the importance of a particular resource for noticing and retention. For instance, the high achievers could tell the importance of particular information for retention when they became aware of the changes in the teachers' presentation. In contrast, the underachievers failed to notice the important resources (Lei, 2016). They had problem identifying important information to take notes on even when teachers signalled them to do so implicitly by changing voice tones and repetition. In the observed lessons, Frankie took notes only when the teacher explicitly asked the students to do so. He confessed in the stimulated recall interview that he did not know what notes to take if the teacher did not tell them. He would even miss the keywords used in the textbook that he could use for his own writing.

The high achievers not only noticed good language used in the provided resources but also bad ones. They noticed the wrong spellings in learning resources provided by teachers and they knew they could not use them uncritically for their own writing. The underachievers did not notice the language mistakes in the same learning resources. The underachievers like Cindy often copied the wrongly spelled terms in the notes, suggesting that she had not noticed the wrong spelling of the terms. In addition, underachievers did not notice the different requirements the teachers set for science assignments in comparison with those in primary schools. They tended to write in the way they used to write when taking general studies in the first language in primary

schools. In the school, Secondary 1 students are often required to write classification reports, naming things under different categories, while in primary schools, students are only required to name the categories. The underachievers were not aware of this difference in task requirements. According to the interview data, Cindy did not notice the changes in task requirements. Even after she was told by the teacher that she needed to write differently for secondary school study, she did not know the new requirements though these were explicitly conveyed through the language used in the task instruction due to her low English proficiency.

### *Selecting*

As mentioned in the section of resource-mediated strategy types, the participants were provided with quite a number of resources (e.g., notes, textbooks and dictionary) to support learning of subject content and completing written assignments. For instance, they could use notes taken during lessons as an important resource when answering scientific questions in writing. Yet our observations and interviews confirmed that not all students were able to copy all notes, whether given orally or written on the board by the teachers. Therefore, selecting information input from the teachers for note-taking and retention is a highly important strategy for the participants to acquire appropriate resources for completing written science assignments. The data revealed that high achievers had a set of criteria to guide the selection of relevant inputs and always managed to select the useful resources for retention. For example, they took notes that did not appear in previous lessons or other learning materials and on the things that were new, yet to be understood, or important to them.

In contrast, underachievers tended to either take whatever was provided or give up

recording all the new resources provided. It seems they were overwhelmed by the mass of notes and felt intimidated when deciding what to record (Mason, 2002). They could not identify what was important or what they already had received and for this reason, they tried to document whatever was provided to them. Lack of knowledge of which information is important or how to use the resources effectively also leads underachievers to give up using them. For example, Frankie did not take notes on any steps of the experiments provided by the teacher, which was the core knowledge in the lesson. He explained later that he didn't think they were important.

The data also suggest that the underachievers knew they could skip what had been included in the learning materials when taking notes. However, they lacked knowledge about what resources were included in the existing learning materials and that led them to note down whatever was provided. For example, Thomas said he had to scan the existing learning materials before he knew whether a particular note had been provided before. He therefore scanned related pages of the textbook that the teacher was teaching and then wrote down teacher's notes if they could not be found on those pages.

When they did not know how to use the provided resources, the underachievers gave up on using them. For instance, Frankie did not use the dictionary when he encountered difficult words during writing because he 'did not know how to use Chinese words to look up the English words in the dictionary' (stimulated recall).

### *Reorganising*

Reorganisation of learning materials plays an essential role during meaningful learning (Novak, 1977). In this study, high achievers were found to have strategically reorganised the

resources. They linked different but related resources by noting down referencing information or putting them together in the same note. However, underachievers did not take such actions to reorganise the information they had received for reuse when writing.

The high achievers in the study did not always put everything together through reorganisation. Instead of linking all the relevant information, they were found to have singled out some resources which they thought were extremely important for regular reviews. For example, Katty prepared a smaller notebook for herself where she put down notes important to her. She always brought the notebook with her so that she could review the notes anywhere anytime. The high achievers also changed the presentation of the notes to make them more systematic. The underachievers usually kept the resources the way they were when they were acquired. They often copied the notes provided by the teacher almost word-by-word. In contrast, Daniel, the high achiever, reorganised the notes into a hierarchical diagram and added examples that he found in the textbook to illustrate each category. Other high achievers such as Katty did the same thing. In the stimulated recall, all the three high achievers said they always organised learning resources by linking them together.

In addition, we also found that the high achievers used colours and symbols (e.g., ‘\*’, ‘□’, ‘{’, ‘↓’ ) to highlight, differentiate, categorise and systematise the resources. However, the underachievers used much less of colours or symbols in notetaking and reorganisation. Even when they used colours and symbols, they might not have done so to facilitate learning and future use of the acquired resources. For example, Thomas mentioned that the notes in a single colour were too boring and added that some colours make the notes more interesting.

### *Evaluating understanding*

As not all students actively evaluate whether the instruction makes sense to them (Baker & Brown, 1984), the high achievers and the underachievers were found to have undertaken different strategic actions in terms of evaluating their understanding of the learning resources before they committed them to memory for future use. As reflected in the following interview response, Katty always tried to find the meaning of relevant information and evaluated her understanding before retaining it as part of her resource repertoire.

Apparently, Katty did not use the information if she did not understand it properly. She persisted in finding out what the information meant from her peers and significant others such as her mother until she understood it. Apart from such strategic efforts, high achievers such as Katty and Daniel used their first language to evaluate their understanding. Katty translated assignments' writing requirements into Chinese when she did not understand them. She sometimes found the writing comparatively easier than the assignments' writing instructions since she had already memorised both the language and the contents for the written assignments. Her difficulties were normally caused by the difficult writing instructions. Daniel always memorised the notes in English since he is expected to write the assignments in English. Prior to memorisation, he usually thinks about the notes' meaning in Chinese to make sure that he has understood the notes.

The study identified that underachievers tend to use the resources even before understanding them properly. For instance, when asked to list the animals whose body temperature is not easily affected by the environment in a written assignment, Cindy wrote down 'Yes, I do. Fish, eling scales', which did not make any sense. According to her interview response,

she did not try to understand the assignment's written instructions and answers provided by her peers properly. Nevertheless, she used them to answer the question.

### *Reviewing and Memorising*

Reviewing and memorising are important strategic processes for effective self-regulated learning (Bouffard, Boisvert, Vezeau, & Larouche, 1995). In this study, the high achievers were found to have reviewed and memorised acquired information for retention and future use from time to time. They reviewed and memorised subject knowledge such as steps of experiments, features of animals, components of equipment, and definition of the phenomenon as well as English grammar, words and pronunciation. As a result, they did not have to constantly consult notes and textbooks when completing written assignments since they had already memorised the relevant information. They deployed different strategies to memorise the subject knowledge and the language. The underachievers did not review or memorise much of the difficult parts of language or subject knowledge. They often consulted notes or textbooks for help if they had difficulties in writing answers or they simply wrote down their 'impressions'. It is likely that the underachievers were not particularly motivated to invest learning efforts. Participants like Frankie did not think review and memorisation was necessary since he could finish the assignment without doing these. Based on his interview responses, it seems he really wanted to finish the assignment but did not care whether he had the correct answers when completing written assignments. His indifference to the correctness of his answers to the assignments showed that low motivation might be a reason for not reviewing or memorising. The underachievers are also likely to be overwhelmed by difficult language and subject content. During one of the

observed lessons, when Cindy was asked to write down the features of mammals, she simply went back to the textbook and found the sentences that she was asked by the teacher to memorise. Instead of memorising them, she simply copied the sentences in writing. In the subsequent stimulated recall interview, she confessed that she did not have time to memorise them because '[t]here are too many things new to me...I almost spent every night reviewing and memorising English words'. (Cindy, stimulated recall)

### *Imitating*

Extant research confirms that skilled writers persistently imitate good writers' writing while less skilled writers hesitate to do so even when they notice the language used by good writers (Lei, 2016). In this study, both high achievers and underachievers were found to have imitated the writing in the textbook and other learning materials as they believe that scientific writing needs to be accurate and the writings in the aforementioned learning materials are considered accurate. Further analysis revealed that the two groups of participants imitated under different circumstances. All high achievers did it when they were not sure about the written assignments.

The underachievers, including Cindy and Thomas, imitated the language in the examples as Joey did. However, unlike Joey, they could not synthesise the example sentences in different places; they only imitated those that could be easily noticed and located. Cindy imitated the writing in the notes because their importance had been greatly emphasised by the teacher. Frankie also imitated the writing in the learning materials, but he did not do so most of the time as reflected in the written assignments. Instead, he tended to write down only those that he

remembered, according to his interview responses. This may again be due to lack of learning motivation, reflected in his interview responses, such as ‘I only care about finishing the assignment’, ‘I will just leave it like this [no matter whether it is correct]’.

### *Adapting*

As noted by Tomlinson (2012), good teachers always adapt learning materials. This applies to good learners also. When completing written assignments, high achievers did not use the acquired resources right away and usually adapted them for use. For instance, they summarised subject knowledge instead of directly copying it when taking notes. They also adapted the language, especially when they detected errors. As mentioned earlier, Katty always revised the writing if she saw wrong spelling in the notes and adapted her writing according to specific requirements. In addition, they also adapted scientific facts to specific contexts provided in the questions. For instance, an exercise in the workbook required learners to state two errors in the diagram of a typical plant cell drawn by Nancy, where words like ‘vacuole’ and ‘nucleus’ were tagged to indicate parts of the cell. A similar diagram with words and phrases was shown in the textbook. Both high achievers and underachievers knew that the textbook could be used to answer the question but they used it in different ways. The assignments showed that Katty and Joey knew that they could not copy the words directly but instead they adapted these words and phrases.

By contrast, Thomas simply copied ‘cell wall’ and ‘cell membrane’ while he was supposed to write ‘There was no cell wall and she did not label cell membrane.’ In the interview, he explained that he did not know that he was supposed to write a complete sentence. Thomas was

not aware that the errors could not have been pointed out adequately without complete sentences. Evidence from the assignments and interviews suggests that the underachievers often did not adapt the resources for writing because they failed to decide whether it was necessary for them to adapt.

(j) Conclusions and Recommendations

To better understand the learning of content of subjects with English as the medium of instruction, the study investigated the literacy challenges students have and the strategic self-regulated learning involved. The study found that underachievers had great problems with learning content in English. Their literacy challenges included technical and non-technical terms, dense noun phrases, difficult conjunctions/propositions/pronouns, implicit logical relationship, and unclear questions. To help students to overcome the literacy challenge, we have developed two school-based reports with regard to the learning of Integrated Sciences and Math (see Appendix 3). These reports have details on what exactly constitute difficulties for these students in the learning process and what subject and English language teachers could do. In a nutshell, we suggest teachers increase systematic exposure of rarely-covered words to their students, using concept maps, graphic organiser, flow chart, word web, etc.; help students to practice packing and unpacking information; point out the different meanings of conjunctions and prepositions in different contexts; raise students' awareness of words, clauses and sentences relationships; and provide explicit instructions as a common practice. We have included a keyword list for each subject in Appendix 4. The lists may help English and subject teachers

identify key vocabulary to support the students' learning of subject content (in math and integrated sciences).

In addition, we would like to draw teachers' attention to the pattern of resources use of skilled learners and their less capable counterparts, revealing that the higher achievers preferred using artefact resources as their primary resources while the underachievers used much less of these resources but preferred community resources. Such differences could be attributed to the students' perceived usefulness of the resources, availability of the resources and their ability of using the resources. The differences between the high achievers and underachievers regarding use of mediating resources as well as the reasons beneath have important implications for pedagogical practices. It is believed that we might be able to enhance underachievers' performance by teaching them what high achievers do and expanding their strategy repertoire (Rubin, 1975; Gao, 2010; Griffiths, 2015). However, we argue that simply asking underachievers to use the resource-mediated strategies used by high achievers may not help, because underachievers may fail to use the strategies because of multiple reasons, as indicated in this study.

Therefore, we suggest teachers find out the reasons first and provide pedagogical support accordingly. For example, the learners did not use some useful resources simply because those resources were not available to them. We therefore suggest teachers provide as many resources as possible to the learners, especially the underachievers. For instance, considering the underachievers' low L2 proficiency, teachers should reduce the number of notes provided orally;

they can instead write down the important notes and give more time to learners for copying the notes. Teachers should also spend more time with underachievers as an accessible community resource that learners can seek help from when they have difficulties in the learning process. As learners may not understand the importance of some resources or have ability to use some of the provided resources, teachers need to give clear instructions on why the resources are important and how they can be used.

In terms of self-regulated learning processes, the study found that high achievers had adopted different strategic processes compared with underachievers because they had different perceptions and knowledge of self-regulated writing processes, L2 proficiency and learning motivation. In light of such findings, we conclude that teachers should continuously provide underachievers explicit instructions and scaffolding to facilitate self-regulated writing for academic learning. Given that learners' L2 proficiency cannot be improved in a short period of time, we suggest that schools consider adjusting their policies of instruction medium. We also suggest teachers be aware of individual differences in terms of learning motivation and focus on enhancing motivation. Further research is needed to explore how teachers can motivate students to self-regulate writing.

(k) Bibliography (*use APA Editorial Style throughout the report*)

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## (l) Appendices

Appendix 1: Sample lesson, student interview and teacher interview transcripts

Appendix 2: Project-related publications (4 journal articles and 1 book chapter: Hu and Gao, 2017a, Hu and Gao, 2017b, Hu and Gao, 2018a, Hu and Gao 2018b, Hu and Gao, 2018c)

Appendix 3: School-based reports (one for math and the other for integrated sciences)

Appendix 4: Pedagogical resource (Keyword lists for math and integrated sciences)