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Students' beliefs about the role of interaction for science learning and language learning in EMI science classes: evidence from high schools in China

Abstract

Interaction has been established as an important mechanism for language learning and science learning. As such, English medium instruction (EMI) science classes are home to a unified interest in the role of interaction for learning English and content knowledge. While a lack of interaction has been commonly found in previous EMI research, this study investigates one possible reason: student beliefs. Data were collected in nine EMI high school programs across China, consisting of 331 questionnaire responses and interviews with 60 students. Results showed that although most students recognized the general benefit of interaction for both science learning and English learning, they were less committed to extensive interaction. Discrepancies between macro- and micro-level beliefs were illuminated, together with language-related challenges, which directed students' immediate actions in class. Suggestions for EMI teachers are provided regarding how to adjust their teaching approach to meet students at their current level.

Keywords: English Medium Instruction, classroom interaction, student beliefs

1. Introduction

For several decades, the role of interaction in language learning has been a popular topic of discussion. Long's (1996) Interaction Hypothesis suggests that through interaction—particularly negotiation of meaning—language learners have opportunities to notice differences between their own formulations of the target language (i.e., their interlanguage) and the target forms; learners can then receive or provide feedback which leads to modifications of input and/or output. Presently, in the field of second language acquisition (SLA), it is commonly accepted "that there is a robust connection between interaction and learning" (Gass & Mackey, 2007, p. 176). Extending the work on negotiation of meaning, Macaro et al. (2016) proposed substantial student turns at talk as a principle of high-quality interaction for second language (L2) learning in language classrooms. This positive stance towards interaction can also be found in the broader areas of education and psychology with Sociocultural Theory (Vygotsky, 1986; Wood et al., 1976) and social constructivism (Bruner, 1990; Palincsar, 1998; Watts et al., 1997), which posit that learning starts from the interpersonal plane and then is internalized in the intrapersonal plane. On the interpersonal plane, cognitive developments originate in interaction with peers, teachers, as well as semiotic tools.

In science education, Sociocultural Theory's central tenet of the social nature of learning has inspired ongoing research on the structures of classroom interaction and how it can better facilitate knowledge construction for students, socializing them into the domain of science. Based on empirical data in first language (L1) subject classrooms, Sinclair and Coulthard (1975) identified the pervasive triadic dialogic structure of Initiation-Response-Feedback (IRF) of classroom discourse. Following this structure, a teacher will initiate a dialogue (usually by asking a question), a student will respond, and then the teacher will provide feedback. These exchanges are highly teacher dominant and offer little space for student participation (Lemke, 1990). To break the constraints of the brief IRF pattern and allow more extensive interaction, Mortimer and Scott (2003) proposed the extended IRFRF chains where students provide further responses after their teacher's feedback. They argued that the extended IRFRF structure is a typical form of classroom discourse with a more dialogic nature, which allows teachers to explore students' ideas in more detail and gives students the chance to talk their way into the scientific perspective. Underpinned by these frameworks, scholars in science education have promoted a dialogue-based teaching approach, where learners are given ample opportunities to articulate their thinking (Littleton & Mercer, 2013). Thus, similar to language learning classrooms, students' substantial linguistic output has also been argued for as a key feature for effective learning in science classrooms (Alexander, 2004; Littleton & Mercer, 2013).

In the context of learning science through an L2, the theoretical underpinnings of interaction in SLA and science education converge, as manifested in English medium instruction (EMI) science classes. Macaro (2018) defined EMI as "the use of the English language to teach academic subjects (other than English itself) in countries or jurisdictions where the first language of the majority of the population is not English" (p. 1). This means that in an EMI science class, the learning of both science and English is of interest, and many scholars believe that interaction is a key mechanism to enable learning to occur. Existing EMI research has indicated low levels of classroom interaction; however, there is a dearth of research on students' beliefs about interaction for learning as one possible explanation. Therefore, this study aims to investigate EMI students' beliefs about the role of interaction for science learning and English learning in the context of the foreign high school programs in China.

2. Literature review

As a rapidly growing global phenomenon, the rise of EMI can be attributed to many factors (see (Macaro, 2018; Macaro et al., 2018). One of the pedagogical factors is the favorable conditions for interaction that EMI classes are purported to offer toward L2 development. Many stakeholders believe that the communication of subject knowledge in English could create more opportunities for students to engage in meaningful and authentic interaction where students receive input that is comprehensible, produce output, and negotiate meaning with teachers (Genesee & Lindholm-Leary, 2013; Nikula et al., 2013). Thus, this perceived advantage of EMI classes points to the need to investigate interaction—and students' beliefs about interaction—in EMI science classes.

Definition of classroom interaction

In the field of science education, Tang's (2021) work defined classroom interaction as a pattern of classroom discourse, which examines the conversational exchange between the teacher and the students, their expected roles, the kind of questions asked, and so on. It represents the activity structure of a lesson and works simultaneously with other patterns of classroom discourse, such as thematic patterns and multimodal translation patterns, to contribute to meaning-making in science learning (Tang, 2021). Classroom interaction can take different forms. And Tang (2021) outlined four distinct types of classroom interaction pattern: IRE (initiate-response-evaluate), IRF (initiate-response-follow-up), teacher talk, and student dialogue. The first two types resemble the brief, single-cycled IRF structure (Lemke, 1990) where student talk is typically limited, and the extended IRFRF structure (Mortimer and Scott, 2003) where there is more room for student elaboration. Teacher talk refers to extended teacher monologues, which is also by definition a type of interaction, although the students do not have verbal participation and are only expected to listen. As this study only focuses on teacher-whole class interaction, these three types of patterns constitute classroom interaction in this study. Along a continuum from low classroom interaction to high classroom interaction, a low level of classroom interaction would feature more use of teacher talk and single-cycled IRFs, and a higher level of interaction would be typically characterized by more use of extended IRFRF structures.

Effective use of classroom interaction

To understand how classroom interaction can be more dialogic, and thus afford more opportunities for deep learning, fine-grained analysis of classroom discourse across many studies has identified teachers' effective use of questions and feedback. For example, Chin (2006), based on science classes in Singapore, developed a framework of different types of teacher feedback that can be used following student answers of different nature and to stimulate more elaborate student responses in extended IRFRF exchanges. Chin (2007) further proposed a framework of constructivist questioning approaches to direct classroom discourse and promote productive thinking in students. Tytler and Aranda (2015) identified how expert science teachers in different countries responded to student answers in a way that the students were supported to explore and articulate their own ideas. Tang (2021) summarized that more teacher-student interaction can be achieved through asking more open-ended questions in extended IRFRF exchanges, and using a chain of follow-up questions. These studies point to the value of extended dialogues and students' elaboration on their own ideas in the construction of knowledge.

The language of science

With the rapid spread of EMI, the issue of language demand in science classes has also been increasingly foregrounded, given the medium of instruction is the students' L2. In science education, science learning is often construed as the learning of the specific ways of talking about science (Lemke, 1990; Tang, 2021), thus highlighting the central role of language. One main difficulty in learning to talk about science is learning the distinctive features of science discourse, including high lexical density, frequent use of nominalization, and grammatical metaphor, among others (Fang, 2005; Halliday, 1993; Martin, 1991). These features present unique challenges for science learners, particularly L2 learners. Thus, recent studies have also focused on how classroom interaction in EMI settings can integrate language learning. For example, researchers have examined how teachers use questioning to help students gain specificity in their use of the language of science (Ho et al., 2019), how teachers switch from the content plane to the language plane to provide language-focused episodes (An et al., 2019), how classroom discourse can effectively introduce and help retain new science terminology (Seah & Silver, 2020), and how scaffolding of science learning can be more language aware (Xu &

Harfitt, 2019). These studies highlight the importance of language development in EMI science classes.

The specialized ways of using language in different subject domains form another reason for this study's focus on science classes. We speculate that the distinctive features of the language of science could pose unique challenges for students to engage in classroom interaction. Compared with humanities subjects, the language of science demonstrates a high level of abstraction and technicality (Seah and Silver, 2020), and often describes logical relationships among abstract concepts, generalized processes, and universal phenomena (Lemke, 1990; Seah et al., 2014). However, in humanities subjects, the use of language is often more narrative and involves more expressions of relationships of time, actions, places, and people (Schleppergrell, Achugar, & Ote'iza, 2004; Lemke, 1990). This makes the use of language more for specific and concrete matters (i.e., less abstract) than the language of science (Lemke, 1990). As the present study also concerns language development through interaction, the distinctive features of the language of science led us to explore science classes.

Student beliefs about classroom interaction

While there has been a great deal of research on classroom interaction, there is still little evidence on student beliefs about this matter in the EMI literature. To our knowledge, there are only two published studies which have considered Chinese EMI students' views about interaction, both at the university level. Qiu and Fang (2019) explored Chinese EMI university students' perceptions of L1 English teachers and L2 English teachers and reported that students favored the increased teacher-student interaction found in their expatriate/L1 English teacher's classes. Moreover, in their investigation of English learning affordances and agency in EMI classes, Jiang and Zhang (2019) found that most students perceived interaction between the teacher and students as helpful for their English learning. However, we have not encountered a study that examined EMI secondary students' beliefs about interaction which draws upon the theoretical frameworks of interaction for both language learning and content learning.

The commonly found lack of teacher-student interaction in many EMI studies marks the timeliness of this topic (An et al., 2021; Dalton-Puffer, 2007; Lin, 2006; Lo & Macaro, 2012; Yip et al., 2007) for which student beliefs could provide possible explanations. For example, Lo and Macaro's (2012) study found students' turn length in EMI secondary school classes in Hong Kong to be only 2.6 seconds on average, which was interpreted as indicative of limited English and content learning. The authors also identified a negative association between the amount of L2 use and the level of teacher-student interaction, which suggests L2 as the medium of instruction led to a lower level of interaction. Similarly, An et al.'s (2021) study found a limited level of teacher-whole class interaction in the same context as the present study--foreign EMI high schools in China. However, few classroom-based studies in this area reported students' beliefs about interaction, which could be an explanatory factor behind their classroom observation findings. Studies on student beliefs have widely demonstrated that student beliefs about teaching and learning influence their learning behavior (Brown, 2009; Sato, 2017; Schulz, 1996; Sylvén, 2013), the effects of instruction (Horwitz, 2007; Mantle-Bromley, 1995), and, subsequently, their learning outcomes (Sato & Storch, 2020). Thus, this study aims to provide evidence on this important factor that could impact students' participation in classroom interaction, and provide suggestions for instruction in EMI programs.

Context of this study

The context of this study is foreign high school programs in China. This is a type of rapidly growing EMI program where a high number of L1 English subject teachers, typically from the US, UK, and Canada, teach local Chinese students an Anglophone curriculum. Examples of the curricula include the American AP (Advanced Placement) curriculum, the UK's IGCSE (General Certificate of Secondary Education) and A-level (Advanced level) curricula, and Canadian provincial high school curricula. The teacher population in this context provides a rather unique EMI scenario where the teachers' own English proficiency is unlikely to restrict their interaction with students. As frequently reported in previous studies, EMI teachers' English proficiency often inhibits them from engaging in spontaneous speech in English or to discuss complicated subject matter in dialogues with students (Cho, 2012; Probyn, 2006; Pun & Thomas, 2020; Sopia et al., 2010; Tan, 2011; Zacharias, 2013). This can shape students' beliefs about interaction as their experiences in the classroom shape beliefs (Brown, 2009). However, in this study, the factor of teachers' English proficiency is eliminated (as teachers were from English dominant contexts and did not speak Mandarin fluently), and this allows the exploration of students' beliefs without its impact.

The current study addresses the following questions:

1. What are students' beliefs about the role of interaction for content and language learning in EMI science classes taught by L1 English speaking teachers in foreign high school programs in China?

2. What challenges do these students perceive as affecting their ability to interact in EMI science classes?

3. Methods

3.1. Research design

As described above, our construct of classroom interaction constitutes teacher monologues and teacher-whole class interaction with different degrees of student participation, where a higher level of student participation is recognized as being more beneficial for students' learning of English and science. This conceptualization of classroom interaction aligns with Tang's (2021) aforementioned definition in which teacher talk (monologues), IRE (single-cycled IRFs), and IRF (extended IRFRFs) are types of teacher-whole class interaction patterns. As one of the first EMI studies to investigate students' beliefs about classroom interaction, this study aims to explore what students see as the role of interaction, and particularly extended interaction, for their English and science learning as well as any challenges they experience participating in interaction.

This study forms part of a larger, mixed-methods project that included lesson observations (see An et al., 2021), questionnaires, and semi-structured post-lesson interviews to allow triangulation of findings from multiple data sources. Mixed-methods designs are desirable when researching a complex psychological construct like student beliefs (Bernat & Gvozdenko, 2005; Sato, 2013). While the questionnaire allowed the exploration of a large sample (Dörnyei, 2003), the interviews provided in-depth data that could be analyzed qualitatively with reference to specific scenarios (Borg, 2003). Given the dynamic nature of learner beliefs, which have been found to change depending on students' experiences with tasks (Yashima et al., 2018), the post-lesson interviews provide more nuanced details about student beliefs through reflections on specific activities observed in lessons. In addition, the open-ended nature of semi-structured interviews provided a space for students to elaborate on their personal beliefs and reveal any issues that were not covered in the questionnaire (Sato & Storch, 2020; Seidman, 2006).

3.2 Population and Sample

The target population includes local Chinese students studying in EMI foreign high school programs in China, which had adopted EMI to teach an Anglophone curriculum. The EMI programs employed expatriate, L1 English science teachers from the US, UK, and Canada. The student body typically comprises local Chinese students who plan to transition to tertiary education overseas.

Nine schools in seven cities from three provinces in north, central, and south China were recruited, involving 331 students. Schools were selected that could represent variations of the characteristics of the target school programs, such as the geographical location and the type of curriculum being taught.

According to the background section in the student questionnaire, the participants were 16-18 years old (M = 16.8), self-reporting as male (n = 142) and female (n = 189). As there is no standardized entrance examination applied in EMI high schools in this context, and each program administered their own entrance examination, students' academic attainment and English proficiency level were obtained by consulting their science teachers. The majority of students were described as being at an intermediate English level (CEFR B1-B2), with relatively weak spoken English, and possessing relatively strong academic ability. None of the students had previous EMI experience prior to attending their current high school program, and all attended Chinese medium instruction state primary schools and middle schools.

In total, 15 in-tact classes participated in lesson observations and post-lesson interviews. These post-lesson interviews with students from all 15 classes formed the interview data for this study. Each of the 15 classes was observed for two consecutive lessons, resulting in 30 lesson observations. After each lesson observation, a post-lesson student interview was conducted with two students from the class. In total, thirty student interviews were conducted, involving altogether 60 students. The students were numbered from 1-60 to maintain anonymity and are reported as such (e.g., Student 27) in the findings section.

In a background questionnaire, all 15 teachers from these focal classes rated English as their most proficient language and reported having at least a bachelor's degree from either the US, UK, or Canada. None of the teachers reported having a level of functional Mandarin that would enable them to use the language in their teaching.

3.3 Study instruments

3.3.1 Questionnaire

Following background questions, there are two main sections in the questionnaire: 1) interaction for science learning in EMI science classes and 2) interaction for English language learning in EMI science classes. Guided by the aim of this study, items were developed to understand students' beliefs about the fundamental value of interaction between teachers and students-- i.e., whether interaction between teachers and students, particularly extended interaction, is important, and whether the students believe that teachers should dominate classroom talk.

As there were no existing questionnaires to explore students' beliefs about the role of interaction for subject knowledge learning and language learning in the EMI contexts, items were generated by examining relevant literature and adapting items in existing, validated questionnaires that are relevant to the topic of interaction. The questionnaire items can be found in Tables 1 and 2 (see Results section).

For Section 1 of the questionnaire, Items 1 and 2 were developed based on the general significance of interaction argued in science education literature (see Alexander, 2004; Chin, 2006; Littleton & Mercer, 2013; Mortimer & Scott, 2003). Items 3 and 4 were developed in response to the common finding of a lack of student output in the existing EMI/CLIL literature (e.g., Dalton-Puffer, 2007; Lo & Macaro, 2012; Yip et al., 2007), as well as the highlighted role of students' substantial explanations of their ideas in the science literature (e.g., Littleton & Mercer, 2013). Items 5 and 6 were adapted from the BARSTL questionnaire (Beliefs About Reformed Science Teaching and Learning, Sampson et al., 2013), which assesses the alignment of science teachers' beliefs about teaching science with an interaction-oriented, constructivist view of teaching (NRC, 1996).

Section 2 of the questionnaire was mostly developed by adapting items from Lo's (2014) and Hoare's (2003) questionnaires, both used in EMI secondary schools in Hong Kong. Lo's questionnaire explored English language teachers' and EMI content teachers' perceptions of their roles, and Hoare's investigated EMI science teachers' language awareness. Item 1 was developed for this study to enquire about the students' general opinion on the necessity of producing output for language development in EMI science classes. Items 2 and 3 were adapted from a section of Hoare's questionnaire on opportunities for students to use language in EMI classes, and Item 4 was adopted from Lo's questionnaire, which enquired about corrections of language errors in EMI classes.

Each multiple-choice item used a 5-point Likert scale, ranging from strongly disagree to strongly agree. An open-ended question was also used to elicit students' views on interaction in EMI science classes in general, helping to answer Research Question 1, and another to enquire about the challenges they may face in participating in interaction, addressing Research Question 2. This afforded intra-method mixing (Johnson & Turner, 2003) and helped to generate data that could be analyzed both quantitatively and qualitatively. The questionnaire was translated into Chinese, checked by one highly proficient bilingual researcher, and back translated into English by another to make sure the meaning in the Chinese version did not deviate from the original meaning in English.

The questionnaire was checked by one language education expert and one science education expert to ensure the validity of the items, which were considered appropriate. The questionnaire was also piloted with 30 students in two science classes in an EMI high school program in China, where students' feedback was solicited on the clarity of the items. Four students were invited to complete the questionnaire in front of the first author, where they were asked to report uncertainty regarding the wording of the items as they completed the questionnaire. Changes were made to the wording of several items to ensure accurate understanding.

As Cronbach alpha is commonly low for scales with fewer than 10 items, inter-item correlation was considered more appropriate to check the reliability of the two sections in this study (see Pallant, 2016). The mean inter-item correlation is .21 for the six items in Section 1, and .25 for the four items in Section 2, both of which fall within the optimal range of .2-.4 for scale reliability of fewer than 10 items (Briggs & Cheek, 1986; Pallant, 2016).

3.3.2 Semi-structured interviews

The post-lesson interviews used general, prepared prompts that required students to reflect on their learning experience in the lesson just observed, particularly the use of interaction with the teacher (RQ1), and any challenges they felt regarding interaction (RQ2). Students were encouraged to elaborate on their ideas, and follow-up questions were asked based on the students' previous responses (Merriam, 1998; see Appendix for the interview protocol). Although the two general prompts are similar to the two open-ended questions in the questionnaire, which asked about the students' beliefs in general (macro level), the post-lesson interviews aimed to understand students' beliefs in relation to actual lessons they had just experienced (micro level).

The interview questions were also trialed in a pilot study in one EMI foreign high school program in China. The most notable change was a decision to interview two students at the same time, due to the finding that focus groups of three to four students were ineffective to elicit detailed responses and thus not able to benefit from the supposed advantages of focus groups (Krueger, 1994).

3.4 Data collection procedures

After obtaining approval from school administrators and science teachers, the first author visited classes and informed students about the study. As the students were above 16 years old, their consent was sought with an opt-out consent form (as per CUREC, n.d.). The student questionnaires were then completed. In total, 331 questionnaires were returned from the nine school programs, with a response rate of 73%. The first author also observed and video recorded two consecutive lessons (at the back of the classroom) taught by each of the 15 L1 English speaking science teachers with the 15 in-tact classes. This provided necessary contextual information. After each observation, two students of average academic attainment and English proficiency—to represent student profiles similar to the class majority—were identified by their teacher for the post-lesson interview. The interviews were conducted by the first author in the students' L1, Mandarin, and audio recorded with their consent. In total, 30 post-lesson interviews were conducted with 60 students. Each interview lasted approximately 30 minutes. All student questionnaires and post-lesson interviews that were conducted for the larger project were analyzed for the current study.

3.5 Data analysis procedures

Descriptive statistics (mean and standard deviation) were obtained to analyze the Likert-scale responses in the questionnaire. In addition, percentages of student answers are also presented in three categories: 1) strongly disagree and disagree; 2) neutral; and 3) agree and strongly agree, to show more clearly the distribution of student answers. Analysis of the open-ended questions was completed using inductive thematic coding to establish common themes (Corbin & Strauss, 2008).

Interview data were analyzed qualitatively, following a mixture of deductive and inductive thematic coding processes. The deductive coding process involved establishing three overarching themes: 1) student beliefs about the role of interaction for science learning; 2) student beliefs about the role of interaction for language learning; and 3) the challenges students faced engaging in interaction. Guided by the construct of classroom interaction discussed above, students' answers regarding teacher monologues and interaction between the teacher and students (particularly extensive interaction with their teacher) were elicited.

Following the established themes, iterative, inductive thematic coding was undertaken to identify common sub-themes (Corbin & Strauss, 2008). The codes were refined and modified throughout the process to ensure all themes were systematically explored.

To ensure the reliability of the coding process, ten percent of the interview data were re-coded by the first author again, more than six months after the first coding. The Cohen's Kappa coefficient for intra-rater coding is 0.80, showing a reasonably high level of coding reliability (Robson, 2002).

4. Results

4.1 Context of the students' beliefs and perceived challenges: observed lesson interaction

To provide the context for students' beliefs and their perceived challenges, the overall interaction pattern observed in the lessons is briefly presented here. Guided by the definition of the construct of classroom interaction explicated above, parameters that could reflect the degree of interaction between the teacher and students and the degree of teacher monologues were used.

Based on the lesson transcripts, teacher talk represented an average of 85.6% of teacher-whole class interaction time, while student talk only comprised 11.6% on average. This illustrates the dominance of teacher talk. In addition, the average teacher turn length was 20.5 seconds with an average student turn length of only 3.5 seconds, demonstrating that when students did speak up, they did not hold the floor long and rarely provided substantial elaborations of their ideas.

As a more refined parameter, IRF structures were also used to understand the degree of teacher and student verbal exchange. On average 31.6 IRF sequences were observed in a lesson with 13.8 being single-cycled IRF sequences. This suggests that less than half of the IRF sequences failed to evolve into extended dialogues (i.e., IRFRF sequences) in which students could further elaborate on their ideas. Overall 39.2% of the teacher-whole class interaction time was teacher monologues where no verbal student output was invited. These findings suggest the prevalence of brief single-cycled IRF exchanges, and the common use of teacher monologues, again showing a limited degree of interaction between teachers and students.

For a detailed analysis of the classroom interaction patterns of the 30 lessons—complete with quantitative accounts of five parameters of classroom interaction and excerpts from teacher and student talk during lessons—see An et al. (2021). While An et al. (2021) provides a descriptive account of the actual classroom interaction that occurred, the current study focuses on students' beliefs about classroom interaction and the challenges they experienced with classroom interaction in the observed lessons.

4.2 Research question 1: beliefs about interaction

Table 1 presents the findings for items related to students' beliefs about the role of interaction for content learning in EMI science classes.

Table 1

Interaction for content learning in EMI science classes

	Strongly disagree/ disagree	Neutral	Strongly agree/ agree	*M* (*SD*)
1. Interaction between teacher and students is important for learning science.	4.2%	23.3%	72.7%	4.0 (0.9)
2. In most situations, teacher's monologue of explanation is more effective and helpful for my science learning than teacher-student interaction.	24.9%	51.7%	21.4%	3.0 (0.9)
3. Teachers' elicitations of substantial verbal answers from students to explain our views are NOT necessary for my learning.	77.7%	14.9%	7.3%	1.9 (0.9)
4. In most classes, students' substantial verbal explanations of their ideas are NOT necessary. Having short verbal answers from students is good enough.	61.6%	27.9%	10.6%	2.3 (0.9)
5. In most situations, teachers should do most of the talking in class.	25.6%	45.4%	29.0%	3.0 (0.9)
6. Teachers should NOT let students' existing understandings, or their difficulties determine the direction and the focus of lessons.	79.1%	15.8%	5.1%	2.0 (0.8)

(1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree)

In general, participants indicated that interaction between teachers and students was important for learning. However, only a quarter maintained this view when relying on teachers' monologues was an option. Students expressed that teachers should elicit substantial verbal output from students, although when the option for responding with short answers was presented a smaller percentage acknowledged that substantial answers are necessary. This weakened view towards interaction was also shown when the possibility of teachers doing most of the talking was explicitly presented. The importance of letting teachers know of their existing understandings was largely recognized, and therefore interaction was seen as contributing to the learning of science. These findings reflect that, although the students recognized the general role of interaction, they were less inclined to engage in extensive interaction with the teacher.

Table 2 presents the findings for items related to the role of interaction for English language learning in EMI science classes.

Table 2

Interaction for English learning in EMI science classes

	Strongly disagree/ disagree	Neutral	Strongly agree/ agree	*M* (*SD*)
1. Spoken English language output is unnecessary for me to improve my English.	74.8%	20.4%	4.7%	1.9 (0.9)
2. In EMI science lessons, I do NOT need regular opportunities to talk about science in English.	57.1%	31.3%	11.6%	2.4 (0.9)
3. Doing work in science that requires long spoken answers in English is helpful for me to improve my English.	10.1%	39.4%	50.5%	3.5 (0.9)
4. I hope my EMI science teachers would correct my oral English in EMI science classes to improve my English.	16.0%	45.5%	54.9%	3.5 (1.0)

(1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree)

Most students believed in the role of output for language learning. However, less recognition was shown for both regular or lengthy output. Furthermore, the hope for error correction from teachers was relatively low. These results show that approximately half of the students were not keen on engaging in extensive and regular interaction for the benefit of English language development in their EMI science classes or receiving corrective feedback on their spoken English.

In the first open-ended question about whether interaction with teachers is important for learning in their EMI science classes and why, 269 students (81.2%) stated that it was important while 46 students (13.8%) explained that it was not. Sixteen students (5%) did not provide an answer. This shows, again, that the majority of participants did approve of the role of interaction between the teacher and students in general, reinforcing the findings from the multiple-choice questions. The reasons in support of interaction between the teacher and students were that it 1) allows teachers to find out students' misunderstandings, so more targeted teaching can be provided; 2) is helpful to develop a more thorough understanding of science knowledge; and 3) assists in remembering correct terminology and its appropriate usage. Those unsupportive of interaction with teachers mentioned that it 1) takes too much time, limiting how much content can be taught in a lesson; 2) is less important than listening; and 3) is less helpful than interacting with peers or finding answers through self-study.

While a general clear recognition of benefits of interaction was shown in the questionnaire, the post-lesson interviews indicated that most students preferred not to engage in interaction with the teacher and instead favored listening in class. This belief was mostly described in relation to the linguistic challenges that interfered with students' participation in classroom interaction (see below). The main non-linguistic theme is that many students did not see asking questions as part of learning, but rather something that slowed down learning/teaching. This view was reflective of students' beliefs about engaging in interaction rather than perceived linguistic challenges. For example, as Student 27 mentioned: "If you ask a question, that takes time away from the learning of new science knowledge, and other students may not want to hear the teacher's answers." Responses such as this one show that, despite the general approval of interaction in the questionnaire, when referring to actual lessons, what many students perceived as effective immediate action was different.

4.3 Research question 2: perceived difficulties in participating in interaction

In the second open-ended question from the questionnaire, the vast majority of participants reported not participating in teacher-student interaction in class, despite a high percentage of students perceiving it to be important. Major reported challenges fell within the scope of 1) limited general English proficiency to comprehend the teacher and to express ideas clearly and quickly and 2) there being too much content to comprehend and digest before engaging in extensive interaction with the teacher. The linguistic challenges were elaborated on in much more detail in the post-lesson interviews, which also explained the students' less favorable views of interaction in actual lessons.

In the post-lesson interviews, the most common interaction scenario that the students reported avoiding is asking teachers questions. Apart from the aforementioned unfavorable view of asking questions as not integral to learning, many students explained that the difficulty of accurately phrasing questions in English and then understanding their teachers' answers rendered the interaction process ineffective. Many students explained that they were deterred by the possibility that their teachers may ask for clarification, which was pressure-inducing. Another common scenario that students mentioned as discouraging was teachers misunderstanding their questions and provide an explanation for something different. Even when the teachers did provide an answer they asked for, the students explained that they often did not fully understand, which added to their confusion and the need to think of further questions; this posed additional challenges to the interaction process. Therefore, what the students preferred was discussing uncertainties among their peers in Mandarin, reading textbooks and notes, and looking up information online in their L1 to answer questions themselves. As Student 3 clearly put it,

> I hope the teacher could use only half of the lessons to teach and then give us the other half to discuss with each other. We want more discussion, so we could ask each other. We don't usually ask the teacher, because then he will talk even more, and this may be even more difficult for us. So, we prefer asking each other in Chinese.

Here, the difficulty the students faced in communicating clearly with their L1 English speaking teachers is shown, and this seemed to have contributed to the students' need for more peer discussion in L1 rather than engaging in interaction with the teacher in L2. Such responses also reinforced the answers in the questionnaire regarding their limited English proficiency as a main difficulty in participating in classroom interaction. The interview data additionally illuminate three specific linguistic aspects that caused obstacles in interaction: technical vocabulary, non-technical vocabulary, and L1 knowledge inaccessible in L2.

4.3.1 Technical vocabulary

In almost all of the interviews, students mentioned that the high quantity of technical vocabulary caused difficulties in their comprehension of teacher input, inhibiting their ability to interact. For example, Student 25 mentioned that "because of the density of these terms, you have to pay attention very closely all the time. If you miss a point, you will be lost". This sense of feeling like they were always trying to "catch up" with the teacher, due to unknown, technical terms, was evident in the interviews. Student 49 mentioned that in the observed lesson, there were many new technical terms, such as *magma* and *tectonic*, which were key vocabulary items in that lesson on continental drift theory and were repeated several times. However, she commented that many of her classmates only became clear about the meaning of the two key terms after class by looking them up in a bilingual dictionary and reviewing notes, too late to engage in meaningful interaction with the teacher. Describing the general experience of how dense content delivery shaped interaction with their teacher, Student 5 explained that students were often busy copying down information from the slides and did not have the time nor cognitive capacity to process the teacher's explanation in L2. She further commented that teachers' explanations were often packed with additional technical terms, leading to her struggle to interact in real time.

The difficulty of technical vocabulary also persisted even when the students could use their linguistic knowledge of suffixes to figure out part of the meaning of a word. As explained by Students 13 and 14 from a biology lesson on macromolecules, they could figure out the approximate meaning of *polymer* and *monomer* based on their knowledge of *mono* (one) and *poly* (many); however they still needed to use their bilingual electronic dictionary to understand the two words fully. To overcome the challenges associated with high lexical density, some students again proposed that more pauses in teachers' talk would be helpful to allow more time for students to look up new technical terms as they hear them. These experiences provided further explanations to the questionnaire finding that having too much content to comprehend before interaction was possible represented a main reason for not interacting with teachers.

4.3.2 Non-technical vocabulary

In addition to the high density of technical vocabulary, perhaps more surprising were the frequently reported challenges with non-technical vocabulary that emerged as another constraint on students' comprehension of teacher input and subsequent interaction. For example, after a lesson on continental drift, Students 51 and 52 specified that they did not understand how magnetic stripping takes place, a key concept introduced in the lesson. It turned out that Student 51 did not know the meaning of *ridge*, a non-technical key word used in the teacher's explanation of magnetic stripping, and Student 52 misunderstood the meaning of it as "two sides", which is inaccurate. This example demonstrates the common challenge of how a non-technical word used in teachers' science explanations, most likely known to L1 English students at a similar education level, can cause comprehension problems for EMI students.

Another example regarding non-technical vocabulary is *submarines* in a teacher's explanation of *periscope* in a physics class on reflection and refraction. Student 29 described having to look up the word *periscope* (潜望镜) in her bilingual electronic dictionary, because the teacher's explanation provided in class—"an optical device used in submarines"—included another word that she did not know, *submarines*. This unknown, non-technical word in the teacher's explanation again shows how non-technical vocabulary may stand in the way of students' comprehension of teachers' input, deterring students from asking for clarification from the teacher. This finding sheds light on student questionnaire responses indicating a lack of English proficiency as the main challenge that interferes with their ability to participate in interaction.

4.3.3 L1 knowledge inaccessible in L2

Apart from the difficulties imposed by L2 technical vocabulary and non-technical vocabulary to engage in interaction, the lack of access to prior knowledge in L1 in time to allow for interaction with teachers was described as another major challenge.

Some students explained how they often sought to locate the L1 equivalent of new terms introduced in their EMI science classes and to access existing knowledge they may already possess in L1. They stated that successful linkages they made often helped them to be more confident about the possibility of interaction. After a lesson on the structure of plants Student 27 explained that:

> Actually, we learnt some of the biology concepts in this lesson already in middle school, and in this lesson, we were learning them again through English. So, when the teacher described them, we were trying to remember what we learnt before.

The student expressed how she was eventually able to connect *xylem* and *phloem* with their Chinese equivalents (导管 and 筛管), and then realized that she had already studied this topic in her previous middle school. Similar situations were depicted by other students, such as Student 53 linking *cotyledon* with its Chinese equivalent (子叶), a term reported to have been learned in middle school. Students 31 and 32 from a physics lesson on reflection and refraction also described how they made a connection between the English term *total reflection* and the Chinese equivalent (全反射). These students all explained that this helped them access prior knowledge they had about the concept, which facilitated better comprehension of teacher input. However, a major issue many students reported was connections being made after interaction turns had already passed. For example, Students 15 and 16 from a biology lesson on types of sugar described how many students in their class were confused about the word *maltose* when their teacher introduced it in the lesson, until, towards the end of the class, one student translated it into their L1 (乳糖) out loud. The students said knowing the L1 equivalent helped, because they had often seen the word 乳糖 on packages of dairy products in their everyday life and thus understood the concept better. Therefore, even in EMI classes with L1 English speaking teachers, there was still a strong need to make connections with L1 knowledge with the benefit of accessing prior knowledge in L1 in time to enable more interaction well recognized by students.

5. Discussion

This study examined EMI students' beliefs about interaction, contextualized in EMI science classes in foreign high school programs in China. The findings show that most students recognized the general role of interaction for both science learning and English learning in EMI science classes, but were less keen on extensive interaction. The students tended to be drawn to listening to teachers' talk when a more teacher-dominated option was presented. A discrepancy was observed between beliefs indicated in the questionnaire and in the interviews, highlighting that what students believed at the general macro level may not always be what directed their immediate actions in real classes. This was confirmed by the interactional pattern observed in the lessons. This discrepancy was also exacerbated by the linguistic challenges the students faced in participating in interaction.

5.1 Recognizing interaction versus participating in interaction

As the questionnaire data show, students clearly recognized the general importance of interaction for both science learning and language learning. In particular, they valued how interaction allowed teachers to know their misconceptions about science ideas, which indicates alignment with the interaction-oriented constructivist view of science teaching in which the change of misconceptions through dialogues to accommodate new experiences is the core of learning (Chin & Osborne, 2010; Watts et al., 1997). Particular attention was also paid to the role of language in their learning of science, where the use of an L2 led to a heightened need to convey misconceptions to their teacher. However, the lack of comments attributing interaction to improved English learning, apart from science terminology, indicates that the students might have focused more on the opportunities that interaction offers for learning science rather than for learning English.

Despite a clear, general recognition of benefits of interaction, several misalignments were noted between students' beliefs and interaction-oriented approaches to education. First, the limited recognition of the role of substantial output indicates students' lack of consideration that it is a key feature of high quality interaction in science education (Littleton & Mercer, 2013; Mortimer & Scott, 2003) and language education (Macaro et al., 2016). A weakened constructivist stance toward interaction (i.e., that interaction leads to knowledge development) was also shown when listening to teacher talk was presented as an option. This was further demonstrated by a clear preference for relying on teacher talk in post-lesson interviews. In addition, students' negative view towards asking questions is another indication of a lack of alignment with constructivist teaching and learning, where active student inquiries are considered crucial (Chin & Osborne, 2010). Considering the benefits of corrective feedback for L2 development, which triggers noticing and leads to L2 uptake (Schmidt, 1995), students' lack of recognition indicates they might not be fully aware of the importance of feedback for English language development in EMI science classes. Research in immersion contexts has shown that corrective feedback is particularly needed for L2 accuracy to develop when L2 is learnt mostly incidentally in subject classes (Llinares & Lyster, 2014), a scenario similar to the EMI context in this study. When compared to how clearly they favored having their misconceptions of science ideas addressed, we surmise again that the students might have a tendency to prioritize learning science over learning English through interaction.

Given the impact of student beliefs about teaching and learning on their engagement in classrooms (Lasagabaster, 2009; Sylvén, 2013), the misalignment of student beliefs above provides possible reasons for the low level of interaction between the teacher and students observed in the lessons, including the low percentage of student talk, short student turns, and the prevalence of single-cycled IRFs. Students' reported tendency of relying on teacher talk also aligns with the high proportion of teacher monologues observed. These findings suggest that student beliefs about interaction may well be a factor behind the limited student participation in interaction often observed in other studies (e.g., Dalton-Puffer, 2007; Lin, 2006; Lo & Macaro, 2012; Yip, Coyle & Tsang, 2007). Guided by these beliefs, students may be less likely to elaborate substantially on their science ideas, undermining a dialogue-based, constructivist learning approach to benefit their science learning (Chin, 2007; Littleton & Mercer, 2013; Mercer & Littleton, 2007). Similarly, they may also be less willing to experiment with more diverse and complicated linguistic structures in their interlanguage by producing lengthy and substantial output (Swain, 1995). Participants' beliefs about asking questions indicates that they are likely to avoid initiating negotiation of meaning, whether about a linguistic structure or a science concept, reducing their chances of obtaining comprehensible input (Long, 1996).

5.2 Linguistic challenges

The students' lessened belief in interaction expressed in the post-lesson interviews can be explained by the linguistic challenges mentioned, interfering with both students' comprehension of teacher input and their production of output. Similar to previous EMI studies (e.g., Hellekjaer, 2010; Joe & Lee, 2013), teachers' pre-modified input was also described as difficult to comprehend in the present study. However, this study found interactionally modified teacher input was reported to cause even more difficulties and typically consisted of additional unknown words (e.g. *submarine* in the explanation of *periscope*). Thus, although SLA literature describes interactionally modified input as effective to achieve comprehensibility (Pica et al., 1987), in this study EMI teachers' modified input was not perceived to be effective for this purpose. This suggests a difficulty of recognizing how interaction promotes L2 development typically demonstrated in SLA, and the heightened importance of input modification strategies in EMI classes. With a shared L1, it was unsurprising that the students were more drawn to discuss misunderstandings with peers and use electronic bilingual dictionaries rather than raising clarification requests.

Additionally, the feature of lexical density in science discourse (Halliday & Martin, 1993) may also have contributed to this difficulty, where the teachers' interactionally modified input may expose students to more technical vocabulary, deterring students from engaging in extended interaction. As the language of science also tends to be more abstract and alien to students' ordinary experience (Lemke, 1990), the science teachers' further modifications may not always be able to relate to students' personal experiences, unlike the humanities subjects (Short, 1994). These features of the language of science may have contributed to students' reluctance to interact with the teacher to obtain comprehensible input.

As a type of output, accurately phrasing questions was found to be another major linguistic challenge for students to engage in interaction. This challenge of accuracy might also have stemmed from the high demand of precision and accuracy in the use of scientific language (Lemke, 1990). This finding echoes Ho et al.'s (2019) work, situated in biology classes in Singapore, which highlights the importance of helping students refine their use of scientific language and gain accuracy in description of science processes. From an interactionist view of SLA, producing language output allows experimentation with language structures, which leads to more noticing of errors in a learner's interlanguage, thus benefiting language development (Swain, 1995). However, the reported challenge of achieving accuracy and specificity in describing science ideas, along with the pressure of further modifying their output, seemed to have deterred the students from experimenting with their interlanguage. This in turn caused them to miss out on possible opportunities to improve their use of scientific language. This issue of accuracy may also have contributed to students' unfavorable view towards engaging in interaction through asking questions, which rarely seemed to fulfil its intended purposes in their view. Again, this raises the question of how students at this level can realistically benefit from interaction in their EMI classes.

Among the linguistic challenges mentioned, the most notable aspect that stood in the way of interaction was L2 vocabulary. While the issue with subject-specific vocabulary is unsurprising, given the high quantity of technical vocabulary being a feature of science texts, presenting challenges to even L1 students (Halliday & Martin, 1993), what was less expected were issues with non-technical vocabulary. Incidents reported in the post-lesson interviews showed non-technical vocabulary embedded in science explanations caused difficulties for EMI students to comprehend science concepts (e.g., *ridge* standing in the way of their comprehension of *magnetic stripping*). Thus, the challenges caused by vocabulary in EMI classes may not only be technical (i.e., subject-specific) vocabulary. General vocabulary that is typically known to L1 students could be problematic, too, possibly due to EMI students' lack of exposure to English in their everyday life. This interview finding also coincides with An et al.'s (2019) study, where classroom observations of language focused episodes in this context also reported on this same issue. This finding again highlights the often neglected matter of general English language proficiency in EMI science studies (Clark, 1997; Prophet & Towse, 1999). Although this study focuses on science only, the lack of the basic linguistic resources, such as general vocabulary, which L1 speakers of English already possess, may hinder students' participation in interaction across subject domains. However, future studies are needed in other EMI classes to determine the extent of this issue.

Considering the various linguistic challenges reported by participants, it is unsurprising that the level of student participation in classroom interaction was low. Thus, although the students recognized the general value of interaction, they seemed deterred from engaging in it due to these language issues, which render interaction less effective and less beneficial for their learning.

5.3 The potential impact of L1 English-speaking teachers

The unique feature of the L1 English teacher population in this study may also have played a role in students' beliefs about interaction, given the teachers' high English proficiency and inability to use students' L1. Although participants' general recognition of interaction aligns with the findings in Qiu and Fang's (2019) and Jiang and Zhang's (2019) studies, our participants were more positive about teacher monologues compared to the students in Jiang and Zhang's (2019) study, who held a clearly negative view towards them. The reason for such a difference could lie in the quality of teacher input. As described by Jiang and Zhang (2019), the L2 English EMI teachers' monologic lecturing was characteristic of "simple sentences and phrasal expressions" and "a lack of appropriate and effective formulation of language in longer or improvised stretches of discourse" (p. 332). In contrast, the L1 English EMI teachers in the current study were unlikely to demonstrate this feature. Together, these findings show that while Chinese EMI students do acknowledge the benefits of interaction in their EMI classes, when the teachers' own English proficiency is high, they may value teacher input more as a helpful resource.

The L1 English teachers' inability to switch to students' L1 may also have impacted students' beliefs. The L1 English teachers in this study could not understand the students' L1 and could not converse in the students' L1 to fulfill functions such as facilitating access to students' prior knowledge and everyday experience, which were reported as helpful among peers. Thus, the students might have been drawn to listening to the teacher first and obtaining as much information as possible before making sense of the content among themselves in L1 since interaction with teachers rarely helped to answer their questions. In fact, Salloum and BouJaoude (2020) observed that the EMI science students in a secondary school in Lebanon often asked and answered questions in L1, although their L2 English teachers often responded in English. The authors also reported that the students preferred to interact with their teacher in L1 for better understanding, echoing with the avoidance of asking questions in L2 found in this study. Thus, we speculate that in an L2 English teacher's EMI science classes, the students may be more drawn to engage in interaction and ask questions, as L1 is a tool at their disposal to facilitate interaction with their teacher. However, this option is not possible with L1 English teachers. Therefore, the teacher population in this study may have led to a stronger tendency of avoiding interaction in classes. Nevertheless, additional empirical evidence is needed to understand students' beliefs about interaction in L2 English teachers' EMI classes.

In sum, this study shows that, although participating students recognized the general benefits of interaction in a broad sense, they avoided embracing an interactive approach for language and science learning in their actual EMI classes. This study also illustrates why it may be helpful to examine EMI students' beliefs about effective pedagogical practices in their classes, which could provide much needed explanations for their classroom behavior and feedback for teachers to adjust their pedagogical approach.

6. Implications for teaching and research

The implications for teaching first lie in the potential benefit of building stronger interaction-oriented student beliefs. Explicit instruction can be provided on the benefits of substantial output for both science learning and language learning, the value of corrective feedback on language errors in EMI classes for L2 development, the understanding of asking questions as an important process for learning, and the importance of developing the L2 to enable content learning. To facilitate interaction, EMI teachers may benefit from being aware that their further explanations may cause more comprehension problems, and that improving input modification strategies (e.g., using simplified vocabulary and paraphrasing) are important to improve student comprehension and subsequent interaction. Before providing lengthy answers, it may be beneficial to check if they have understood their students' questions correctly. Moreover, a list of new vocabulary can be given to students before classes so they can look up unknown words earlier and take advantage of more interaction opportunities in class. Planned pauses can be implemented in class for students to catch up, as well as group discussion, allowing L1 use for enhanced clarification, especially when students still struggle to obtain a clear understanding of subject knowledge in L2. Finally, given the gravity of linguistic challenges reported in this study, more support for language is essential to enable more successful interaction. This adds to An et al.'s (2019) study, examining explicit focus on language in this context, and Thomas and Rose's (2019) discussion of the potential benefit of explicitly teaching language learning strategies.

This study also demonstrated the facilitative role of L1 in EMI classes, showing L1 use in making connections with prior knowledge and everyday experience as particularly useful, even though it was performed solely by the students. Bilingual electronic dictionaries, as reported to be used prevalently by the students interviewed, may be something EMI teachers could integrate into their classes to reduce the difficulty of participating in interaction. We hope these suggestions will lead to students having more positive and successful experiences with interaction. This, in turn, could lead to more favorable beliefs towards interaction and thus more, and improved, interaction in class.

6.1 Rethinking interaction

While these implications work towards building a more interactive EMI classroom, it is also worth asking whether teacher-whole class interaction is indeed a more effective way to learn for the students in similar contexts. In fact, relying on teacher talk could be a coping strategy in a new EMI environment where the students are not yet able to benefit much from interaction. They might perceive listening to their teachers and then working out problems through peer discussion as more effective, at least initially, to develop the appropriate language to talk about science and learn new science concepts. Thus, although classroom interaction may be beneficial in the long term, insisting on more interaction may not always be the most effective teaching strategy at all stages. As research on student beliefs about corrective feedback in SLA has shown (Sato, 2013; Sato & Storch, 2020), learner beliefs about effective instruction vary across different cultural backgrounds and L2 proficiency levels: no single style of instruction works in all contexts. As there is still a lack of research on student beliefs about pedagogical issues in EMI, more work is needed in various contexts to explore what students believe to be effective teaching and learning.

Similarly, when interpreting EMI classroom interaction studies, we may need to ask whether the commonly reported low level of interaction is indeed indicative of less effective learning. As this study shows, the benefits of interaction for language learning and subject learning did not seem to be readily transferrable to EMI classes, and a great deal of learning was described to take place in students' peer discussions and after class. Experimental studies that compare the learning outcomes between more interactive EMI classes and less interactive EMI classes would be helpful to clarify this issue.

7. Limitations and directions for future research

A limitation of this study is that it only adopted a limited number of items in the questionnaire to explore student beliefs, although the post-lesson interviews elicited more in-depth data. A more elaborate questionnaire needs to be developed for a more thorough understanding of student beliefs on interaction in EMI classes. In addition, stimulated recall sessions with recordings of lessons would also make the retrospective reflections more effective (Borg, 2006; Rose et al., 2020). Another limitation is that during the data collection, the students' understanding of what "classroom interaction" means and constitutes was not comprehensively explored first. It was only understood ad hoc from students' answers in the open-ended questions in the questionnaire and the interviews that the students saw classroom interaction as verbal exchanges between the teacher and students, in contrast with teacher monologues. This view aligns with the components of classroom interaction as defined in this study. However, this study would be more robust if the students' understanding of the key concept of classroom interaction was explored explicitly.

As explained above, future research is needed to explore student's beliefs about interaction in L2 English teachers' classes because the L1 English teachers in this study may have had an impact on the findings. It is also worth asking whether the students hold the same beliefs about interaction if they are learning through their L1 without the linguistic challenges they reported facing in EMI classes and how this may contrast with their beliefs in EMI contexts. This current study was not able to compare students' beliefs about interaction in L1 science classes and EMI science classes in comparable settings, but future studies of such comparison can reveal whether the students' beliefs are particular to EMI classes, or hold true irrespective of the medium of instruction. Similar calls for future research were also put forward in An et al.'s (2021) study on the classroom interaction patterns in EMI high schools in China, where a need was also raised to compare classroom interaction practice between EMI classes taught by L1 English teachers and L2 English teachers, and between EMI classes and L1 subject classes.

Another factor that could be attributed to the student beliefs reported in this study is their cultural influence, which we did not explore in this study. While this study explored students' beliefs about interaction from a pedagogical point of view for language learning and science learning, students' beliefs about classroom interaction could also be influenced by their cultured understanding of who should talk and who should control the talk in classrooms. As argued in Tang's (2021) work, classroom discourse always exists in a cultural and social context. It could be possible that the students had been accustomed to the rule of classroom talk they had experienced in their years of Chinese medium instruction schooling prior to their EMI foreign high schools, which may reflect the Confucian views of teaching and learning (Marton & Tsui, 2004; Watkins & Biggs, 1996). This may have led the students to regard listening to teacher talk as sign of respect. This cultural aspect of their understanding of classroom talk could benefit from further investigation.

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Appendix – Interview protocols

1. How do you feel about your learning in this lesson? What do you think of the teacher-student interaction you had in the class?

> Prompts: Do you prefer having more teacher-student interaction or less interaction? Do you think teacher-student interaction is an effective way to help you learn science through English? Why or why not?

2. What are the challenges for you to participate in classroom interaction in this lesson?

> Prompts: How did you address these challenges? What would you like your teacher to do to help you address these challenges?

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